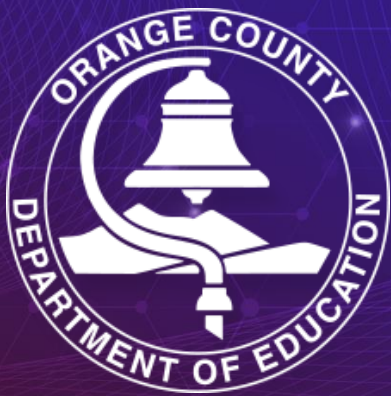


Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports

Summative Evaluation Report

June 2026



inflection



REDWOOD
CONSULTING COLLECTIVE

Disclaimer

This report was prepared as part of the Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports project, funded by a grant from the U.S. Department of Education's Education Innovation and Research (EIR) Program.

The contents of this report were developed under the grant; however, the views, findings, conclusions, and recommendations expressed are those of the authors and do not necessarily represent the views or policies of the U.S. Department of Education, the Orange County Department of Education, Anaheim Union High School District, or any other project partner. No official endorsement by the U.S. Department of Education or any project partner should be inferred.

Any errors or omissions are the responsibility of the authors.

Acknowledgments

This report reflects the work and contributions of many individuals and organizations involved in the Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports project.

We extend our appreciation to the Orange County Department of Education for its leadership throughout the project and for its commitment to expanding equitable access to computational thinking and computer science opportunities. We are especially grateful to the OCDE project team for their ongoing collaboration, responsiveness, and thoughtful support of project implementation.

We also thank Anaheim Union High School District for its partnership and for the time, coordination, and leadership required to support implementation across participating schools. District staff, site administrators, teacher leaders, and school personnel played important roles in helping the project move from design into practice and in supporting the conditions needed for teachers and students to participate.

We are grateful to the administrators, teachers, and students at Anaheim High School, Cypress High School, and Loara High School. Their participation, feedback, and willingness to engage in the work provided the foundation for the implementation and evaluation findings presented in this report. We especially appreciate the educators who contributed their time to professional learning, unit development, classroom implementation, interviews, focus groups, and other evaluation activities.

Finally, we acknowledge the contributions of the project partners and evaluation teams who supported the design, implementation, data collection, analysis, and reporting activities across the grant period. Their collective efforts helped document the *BTCSEI* implementation journey and the lessons learned from this multi-year effort to strengthen computational thinking and computer science pathways for students.

Table of Contents

Table of Contents.....	iii
List of Tables	vi
List of Figures	viii
Executive Summary	x
Implementation Evaluation Findings	x
Considerations for Interpreting Implementation Findings	xi
Implementation Recommendations	xii
Outcomes Evaluation Summary	xiii
Considerations for Interpreting Outcome Findings.....	xiv
Conclusion	xiv
Introduction	1
Statement of Need	1
About the Project.....	1
<i>Project Goals</i>	2
<i>Intervention Components</i>	3
<i>Implementation Design</i>	4
<i>Participating Schools and Students</i>	5
Structure of the Report	6
Implementation Design and Methodology	8
Data Collection.....	8
<i>Project Records Review</i>	9
<i>OCDE Project Staff Interviews</i>	9
<i>AUHSD Project Staff Interviews</i>	9
<i>Administrator and 5Cs Coach Interviews</i>	9
<i>Coherence Review</i>	10
<i>Teacher Perceptions and Practices Survey</i>	10
<i>Teacher Focus Groups</i>	11
<i>Classroom Observations</i>	12
<i>Event Evaluation Forms</i>	12
<i>Student Perception Survey</i>	13
<i>Student Computational Thinking Knowledge Assessment</i>	14
<i>Student Focus Groups</i>	15
<i>Student Records</i>	15

<i>Implementation Fidelity Checklist</i>	16
Data Analyses	16
Project Implementation Results.....	17
Component 0: OCDE and AUHSD Project Staff	17
<i>OCDE and AUHSD Project Staff Interviews</i>	17
Component 1: Coaching for Administrators	21
<i>Coherence Review</i>	23
<i>Administrator Interview Summary</i>	26
Component 2: Professional Learning for Teachers.....	35
<i>Teacher Participation</i>	36
<i>Perceptions of Professional Learning</i>	37
<i>Teacher Perceptions and Practices Survey Results</i>	40
<i>Teacher Focus Groups</i>	57
Component 3: Curricular Materials	69
Component 4: Student Career Exploration and Mentoring.....	76
<i>Student Perceptions Survey Results</i>	76
<i>Student Computational Thinking Knowledge Assessment Results</i>	90
<i>Student Focus Groups</i>	93
Implementation Fidelity	100
Conclusion & Recommendations	102
Key Takeaways from the Implementation Evaluation	102
<i>Key Takeaway 1: Instructional Implementation Was the Strongest Part</i> <i>of the Model</i>	102
<i>Key Takeaway 2: Classroom Implementation Was More Developed Than the</i> <i>Broader Ecosystem of Supports</i>	103
<i>Key Takeaway 3: Implementation Strengthened as the Project Became</i> <i>Better Aligned to District and School Conditions</i>	104
<i>Key Takeaway 4: Students Needed More Explicit Connections Among</i> <i>CT, CS, Careers, and Pathways</i>	105
<i>Key Takeaway 5: Future Sustainability and Replication Depend on Conditions,</i> <i>Not Just Activities</i>	106
Implementation and Methodological Considerations.....	106
Recommendations and Lessons for Future Implementation	108
Conclusion	110
Project Outcomes Results.....	112
Outcomes Design and Methodology	114

Participants	114
Data Sources & Measures.....	116
<i>District Data</i>	116
<i>Inflexion Data</i>	118
Impact Analysis.....	119
Impact on Student Outcomes	119
<i>Standardize Math Test Scores</i>	119
Standardize Science Test Scores.....	121
Differential Impact on Student Outcomes	124
<i>Grade 11 Standardize Math Scores</i>	125
<i>Grade 11 Standardize Science Test Scores</i>	132
Impact on Course-Taking Patterns	139
References	143
Appendices	144
Appendix A: Logic Model	
Appendix B: School Selection and Participating School Characteristics	
Appendix C: OCDE Project Staff Interview Protocol	
Appendix D: AUHSD Project Staff Interview Protocol	
Appendix E: Administrator Interview Protocol	
Appendix F: 5Cs Coach Interview Protocol	
Appendix G: Coherence Review	
Appendix H: Teacher Perceptions and Practices Survey	
Appendix I: Teacher Focus Group Protocol	
Appendix J: Classroom Observation Protocol	
Appendix K: Event Evaluation Form	
Appendix L: Student Perceptions Survey	
Appendix M: Computational Thinking Knowledge Assessment	
Appendix N: Student Focus Group Protocol	
Appendix O: Implementation Fidelity Checklist	
Appendix P. Propensity Score Matching for SBAC and Cast Analyses	
Appendix Q. SBAC & Cast Analyses	

List of Tables

Table 1. Teacher Perceptions and Practices Survey Completion by Implementation Year	11
Table 2. Teacher Focus Group Participation by Implementation Year	11
Table 3. Classroom Observations by Implementation Year and School	12
Table 4. Student Perception Survey Completion by Administration	13
Table 5. Student Computational Thinking Knowledge Assessment Completion by Administration	14
Table 6. Student Focus Group Participation by Implementation Year and School	15
Table 7. Administrator Professional Learning through Portico by Year	23
Table 8. Teacher Professional Learning Hours by Implementation Year	37
Table 9. Overall Perceptions of Project Events by Implementation Year	37
Table 10. Teacher Demographic and Experience Information by Implementation Year	40
Table 11. Teacher Knowledge Related to Computational Thinking by Implementation Year	42
Table 12. Teacher Preparedness for Computational Thinking and Equitable Teaching Practices by Year	44
Table 13. Teacher Self-Efficacy for Teaching Computational Thinking by Implementation Year	47
Table 14. Frequency of Teacher Instructional Practices by Implementation Year	50
Table 15. Teacher Perceptions of Students by Implementation Year	52
Table 16. Perceptions of Computational Thinking Professional Learning Experiences by Year	54
Table 17. Perceptions of Communities of Practice (CoP) by Year	55
Table 18. Percentage of Participating Teachers Encountering Obstacles to Implementation by Year	56
Table 19. Classroom Observation Results by Implementation Year	70
Table 20. Student Demographic and Background Information by Implementation Year	76
Table 21. Student Confidence Related to Computational Thinking by Implementation Year	78
Table 22. Student Computer Science Identity by Implementation Year	80

Table 23. Student Computer Science Identity Subscale Scores by Implementation Year	83
Table 24. Student Career Decision Self-Efficacy by Implementation Year.....	84
Table 25. Student Work and Education Plans by Implementation Year.....	86
Table 26. Longitudinal Student Demographic and Experience Information.....	88
Table 27. Raw Total Correct Scores Overall and by Subscale by Implementation Year	92
Table 28. Longitudinal Raw Total Correct Scores Overall and by Subscale (N = 133).....	93
Table 29. Implementation Fidelity by Component, School, and Implementation Year	100
Table 30. School-level demographics for BTCSEI and business-as-usual schools in Year 1 of the BTCSEI intervention.	114
Table 31. Teacher participation for BTCSEI schools in Years 1 through 3 of the intervention.....	114
Table 32. Number of students reached by participating BTCSEI teachers by school in Years 1 through 3 of the intervention.....	115
Table 33. Student-level demographic and baseline information for the analytic sample (N = 2268).....	116
Table 34. Scale score ranges and achievement level scale score ranges for grade 8 and grade 11 SBAC math test.	117
Table 35. Scale score ranges and achievement level scale score ranges for grade 8 and high school California Science Test.....	117
Table 36. CT confidence scores predicting Grade 11 mathematics SBAC scores by year of intervention.....	131
Table 37. CS identity overall scores predicting Grade 11 mathematics SBAC scores by year of intervention.	131
Table 38. CS identity elements predicting Grade 11 mathematics SBAC scores by year of intervention.....	132
Table 39. CT confidence scores predicting grade 11 CAST scores by year of intervention.....	138
Table 40. CS identity predicting grade 11 CAST scores by year of intervention.	138
Table 41. CS identity elements predicting Grade 11 CAST scores by year of intervention.....	138
Table 42. ICT Pathway & CS courses offered at BTCSEI schools across baseline and intervention years.	139

List of Figures

Figure 1. Implementation Design	5
Figure 2. Inflexion Approach	22
Figure 3. Coherence Review	25
Figure 4. Average Teacher Knowledge of CT by Administration Across Years	43
Figure 5. Average Teacher Preparedness by Administration Across Years.....	46
Figure 6. Average Teacher Self-Efficacy for Teaching Computational Thinking by Administration Across Year	49
Figure 7. Average Student Confidence by Administration Across Years	79
Figure 8. Longitudinal Student Confidence Related to Computational Thinking Scores Across Years	89
Figure 9. Longitudinal Student Computer Science Identity Scores Across Years	90
Figure 10. Student Computational Thinking Assessment Scores by Administration Across Years	91
Figure 11. Longitudinal Computational Thinking Assessment Scores Across Years (N = 133).....	92
Figure 12. Mean SBAC score comparison for students at BTCSEI and non- participating schools.....	120
Figure 13. Mean SBAC score comparison for students based on years of exposure to BTCSEI.....	121
Figure 14. Mean CAST score comparison for students at BTCSEI and non- participating schools.....	122
Figure 15. Mean CAST score comparison for students based on years of exposure to BTCSEI.....	123
Figure 16. Proportion of students from each of three schools for demographic, CT confidence, and CS identity comparisons.....	124
Figure 17. Mean SBAC score comparison for students at BTCSEI schools based on years of exposure to BTCSEI.	126
Figure 18. Mean Grade 11 SBAC score comparison for boys and girls at BTCSEI schools.	127
Figure 19. Change in mean SBAC scores from 8 th grade to 11 th grade for boys and girls at BTCSEI schools.	127
Figure 20. Mean SBAC score comparison for Latinx and non-Latinx students at BTCSEI schools.....	128

Figure 21. Change in mean SBAC scores from 8 th grade to 11 th grade for Latinx and non-Latinx students at BTCSEI schools.	129
Figure 22. Mean SBAC score comparison by gender and ethnicity at BTCSEI schools.	130
Figure 23. Mean CAST score comparison for students at BTCSEI schools based on years of exposure to BTCSEI.	133
Figure 24. Mean CAST score comparison for boys and girls at BTCSEI schools.	134
Figure 25. Change in mean CAST scores from 8 th grade to 11 th grade for boys and girls at BTCSEI schools.	135
Figure 26. Mean CAST score comparison for Latinx and non-Latinx students at BTCSEI schools.	136
Figure 27. Change in mean CAST scores from 8 th grade to 11 th grade for Latinx and non-Latinx students at BTCSEI schools.	136
Figure 28. Mean CAST score comparison by gender and ethnicity.	137
Figure 29. Proportion of students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.	140
Figure 30. Proportion of female students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.	141
Figure 31. Proportion of Latinx students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.	141
Figure 32. Success rates of female or Latinx students in ICT Pathway & CS courses at BTCSEI schools across intervention years.	142

Executive Summary

In January 2021, the Orange County Department of Education (OCDE) received an Education Innovation and Research (EIR) grant from the U.S. Department of Education to support the Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports project. The project was designed to increase enrollment and retention of female students and Latinx students in computer science (CS) courses by improving computational thinking (CT) skills, developing schoolwide and student CS identity, and creating an ecosystem of supports to facilitate equity and inclusion in CS. OCDE partnered with Inflexion as a strategic implementation partner and internal implementation evaluator and with Redwood Consulting Collective (RCC) as the external outcomes evaluator. This summative report presents findings from the BTCSEI implementation and outcomes evaluations. Inflexion's implementation evaluation examined how the project was implemented, what supported or limited implementation, and what may be useful for future sustainability or replication. RCC's outcomes evaluation examined whether the intervention resulted in measurable differences in student outcomes between intervention and comparison schools, whether those outcomes differed based on student characteristics, and what patterns of CS course access and participation emerged across intervention schools.

Implementation Evaluation Findings

Instructional implementation was the strongest part of the model. BTCSEI made the most progress at the teacher and classroom levels. Across the grant period, teachers developed greater knowledge of CT; participated in professional learning and Communities of Practice; created CT-focused units; and implemented CT within math, science, and computer science courses. CT integration was most feasible when it supported work teachers were already doing (e.g., data analysis, modeling, coding, problem solving). Collaboration was also part of how teachers made sense of CT and translated it into instruction. As implementation matured, teacher needs shifted from introductory CT examples toward more applied supports, including discipline-specific models, feedback on unit design, access to prior cohort work, and strategies for helping students recognize CT in classroom tasks.

Classroom implementation was more developed than the broader ecosystem of supports. BTCSEI made more progress changing instruction than changing the broader systems intended to support CS identity and pathway participation. Teacher professional learning and CT unit development helped move CT into classroom practice, while schoolwide routines, advising structures, career exploration, mentoring, and pathway supports were still developing. Administrator engagement strengthened over time, but the project had not yet established clear routines for sustaining CT as a schoolwide priority. Similarly, Pathful provided access to career exploration resources, but access to the platform and training on how to use it did not consistently lead to regular use.

Implementation strengthened as the project became better aligned to district and school conditions. BTCSEI did not unfold exactly as originally proposed. The final implementation

model was smaller than envisioned, with implementation occurring in three schools within one district rather than across a larger multi-district model. This reduced the scale of implementation, but it also created a more coherent context for planning, communication, and adaptation. As OCDE and AUHSD learned what participants and schools needed, they refined roles, CoP formats, funding structures, and supports. Implementation was strongest where expectations were concrete, roles were clear, and project structures fit the realities of school and district participation.

Students needed more explicit connections among CT, CS, careers, and pathways.

BTCSEI was designed to build CT skills as part of a broader effort to increase CS identity and expand access to CS and ICT pathways for female students and Latinx students. Students used CT-related practices in coursework; however, students did not always recognize those practices as CT or connect them to CS. Career exploration and mentoring were intended to make those connections more concrete by linking classroom CT experiences to course options, career fields, role models, and students' own future goals. Without those structured opportunities, CT instruction may strengthen students' problem-solving skills without fully supporting the identity, relevance, and pathway understanding students need to make informed decisions about future CS participation.

Future sustainability and replication depend on conditions, not just activities. BTCSEI offers useful lessons for other schools and districts, but those lessons are not limited to the specific activities used during the grant. The strongest parts of implementation depended on conditions that made the work feasible and useful, including clear roles, practical professional learning, collaboration time, discipline-specific examples, administrator support, student-facing CT language, and connections to advising and pathways. Future implementation efforts would need to preserve the core purpose of BTCSEI while adapting structures to fit local contexts. Long-term sustainability will depend on whether schools and districts continue to maintain and use the capacity, materials, routines, and relationships developed through the project so that CT becomes part of how schools support instruction and student planning over time.

Considerations for Interpreting Implementation Findings

Several considerations should be kept in mind when interpreting the implementation findings:

Implementation scope. BTCSEI was originally designed as a larger multi-district initiative, but implementation ultimately occurred in three schools within one district. This limited the scale of implementation and the extent to which findings can be generalized across districts or school contexts.

Changing cohorts and course contexts. Teacher cohorts changed each year as the project followed students across grade levels and expanded from Integrated Math 1 to Integrated Math 2 and Chemistry to a broader set of math, science, and computer science courses. Teacher survey findings should therefore be interpreted as annual pre-post findings for each cohort rather than as longitudinal change among the same teachers.

Student exposure and data completion. Student exposure varied based on course placement, teacher participation, and the courses included in each implementation year. Student survey and CT knowledge assessment findings provide useful evidence, especially for students with matched data, but complete longitudinal data were available for only a subset of students.

Measurement, observation, and self-report limitations. The student CT knowledge assessment had measurement limitations, particularly at the subscale level. Classroom observations captured single lessons during scheduled site visits and should be interpreted as snapshots of observed instruction rather than as a complete picture of each unit or course. In addition, many implementation findings rely on self-report data and should be interpreted alongside project records, participation data, classroom observations, focus groups, assessment results, and fidelity ratings.

Implementation Recommendations

The implementation findings point to several recommendations for future efforts to implement, sustain, or replicate CT and CS equity initiatives in secondary schools:

- **Build implementation infrastructure early.** Define roles, timelines, communication routines, purchasing, stipends, substitute coverage, data-sharing, student tracking, and participant follow-up before implementation begins.
- **Provide discipline-specific CT models.** Give teachers model units, annotated lessons, student work samples, and examples across content areas that show how CT fits within existing courses, standards, pacing, and instructional goals.
- **Treat collaboration as part of the intervention.** Build in time for teachers to review examples, adapt units, examine student work, and discuss implementation challenges.
- **Define administrator leadership routines.** Clarify how administrators will support CT through professional learning, unit review, classroom observation, teacher collaboration, school improvement planning, and communication with counselors or pathway staff.
- **Help students recognize CT in their coursework.** Support teachers in making CT more explicit through shared language, reflection, and connections between classroom tasks and broader CT practices.
- **Embed career exploration and advising.** Connect career exploration to coursework, advising, reflection, and future decision-making. Students need clear information about CS and ICT courses, how CT connects to them, and how course choices relate to future college and career options.
- **Plan for sustainability.** Focus on whether teacher capacity, CT units, administrator awareness, and implementation tools become part of regular school and district practice.
- **Design evaluation systems around implementation realities.** Account for changing cohorts, student mobility, incomplete survey participation, differences in exposure, and shifts in implementation design.

Outcomes Evaluation Summary

The intervention did not produce measurable differences in Grade 11 mathematics achievement between intervention and comparison schools. RCC compared Grade 11 mathematics SBAC scores for students at BTCSEI schools and business-as-usual schools using propensity score matching. Students at BTCSEI schools and comparison schools performed nearly identically, and years of exposure to BTCSEI-trained teachers did not predict higher scores. All group averages fell within the "Standard Nearly Met" achievement level, regardless of how many years of intervention a student received.

Grade 11 science scores were statistically, but not practically, lower for students at intervention schools, and students with more years of exposure did not benefit more. Students at BTCSEI schools scored approximately 2 points lower on the Grade 11 CAST than students at comparison schools (602.63 vs. 604.34). While statistically significant, the effect size was negligible, and both groups averaged within the same "Standard Nearly Met" achievement level. Within intervention schools, students with three years of exposure to BTCSEI-trained teachers scored slightly lower on the CAST than those with zero, one, or two years of exposure, again a statistically significant but practically small difference, with all averages remaining within the same achievement level.

Girls and boys performed similarly in mathematics, and girls showed a slight advantage in science. Within intervention schools, there were no significant differences in Grade 11 mathematics SBAC scores between girls and boys, and gains from Grade 8 to Grade 11 were comparable for both groups. On the CAST, girls scored marginally higher than boys, but the 2-point difference did not represent a meaningful difference in achievement level.

The gap in mathematics achievement between Latinx and non-Latinx students did not narrow, but Latinx students showed slightly larger science gains over time. Within intervention schools, Latinx students scored lower than non-Latinx students on the Grade 11 mathematics SBAC — a gap that reflected pre-existing differences present at Grade 8, with both groups increasing by approximately 45 points over time. On the CAST, however, Latinx students showed slightly larger gains from Grade 8 to Grade 11 than non-Latinx students (approximately 205 points vs. 199 points), a promising pattern that warrants cautious interpretation given the small effect size.

CS identity showed limited association with academic outcomes, with one exception in Grade 10. Student computational thinking confidence and CS identity were generally not significant predictors of Grade 11 SBAC or CAST scores across any year of the intervention. In Grade 10 only, students who reported stronger CS identity, particularly confidence in CS ability and belief in the usefulness of CS, tended to score higher on the Grade 11 mathematics SBAC. This pattern did not emerge in other years and should be interpreted with caution.

CS and ICT course access and enrollment remained low and stable across the intervention period. The number of CS and ICT pathway courses offered at each school did not increase meaningfully during the intervention. Overall enrollment in these courses remained

small, ranging from approximately 2% to 4.5% of students depending on the school and year. Enrollment rates were lower for female and Latinx students and did not grow over time, suggesting the intervention did not yet shift broader patterns of CS participation.

Success rates for female and Latinx students in CS and ICT courses were mixed across schools. One school showed a promising increase in CS course completion rates for female and Latinx students over the three intervention years. The other two schools showed smaller gains or a decline in Year 3. Because only three schools participated, these results cannot be generalized and should be interpreted alongside the implementation context at each site.

Considerations for Interpreting Outcome Findings

Several considerations should be kept in mind when interpreting the outcome findings:

Comparison group size. The pool of students at comparison schools was smaller than the pool at intervention schools, which is the reverse of what propensity score matching ideally requires. Although the matching procedure met standard acceptability criteria, approximately 17% of intervention students could not be matched. Findings from the between-school comparisons should be interpreted with this limitation in mind.

Reduced implementation scale. BTCSEI was originally designed for a larger multi-district model. Implementation ultimately occurred in three schools within one district, which limits the extent to which findings can be generalized to other schools, districts, or implementation contexts.

Course-taking data limitations. Only three schools participated in the intervention, making it impossible to draw statistically meaningful conclusions about the relationship between implementation fidelity and CS course access or enrollment patterns. Course-taking findings are presented descriptively and should not be interpreted as causal.

Distal outcome measures. Standardized test scores in mathematics and science are influenced by many factors beyond any single intervention, including prior academic preparation, classroom instruction across all subjects, school climate, and student background characteristics. Because these outcomes are distal to the BTCSEI intervention, which targeted CT integration and CS identity rather than math or science content directly, the causal pathway from intervention activities to measurable differences in standardized achievement is long and indirect. The absence of significant differences between intervention and comparison students should be understood in that context.

Conclusion

The BTCSEI project demonstrates that computational thinking can be integrated into core academic instruction in ways that are feasible for teachers and meaningful for students. The project made meaningful progress in building an instructional foundation for CT integration through teacher professional learning, CT-focused unit development, administrator engagement, and continuous improvement.

At the same time, CT integration alone is not enough to create a full ecosystem of supports for equitable CS participation. The broader goals of strengthening CS identity, career awareness, and future pathway participation require stronger connections across classroom instruction, school leadership, student reflection, career exploration, advising, and course-taking structures. BTCSEI offers a useful model for how schools can begin building a foundation for CT integration and CS equity, while also showing that continued work is needed to connect CT instruction to student reflection, career exploration, advising, and pathway participation.

Introduction

In January 2021, the Orange County Department of Education (OCDE) received an Education Innovation and Research (EIR) grant from the U.S. Department of Education to support the Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports project. OCDE partnered with Inflexion (formerly the Educational Policy Improvement Center) as a strategic implementation partner and internal implementation evaluator, and with Redwood Consulting Collective (RCC) as the external outcomes evaluator. The goal of the project was to increase enrollment and retention of female students and Latinx students in computer science (CS) courses by improving computational thinking (CT) skills, developing schoolwide and student-targeted CS identity, and creating an ecosystem of supports to facilitate equity and inclusion in CS. This summative report presents integrated implementation and outcomes evaluation findings from the BTCSEI project. The report documents how the project was implemented, the extent to which implementation occurred as intended, outcomes associated with student participation, and lessons learned to inform future efforts to expand equitable access to computer science education.

Statement of Need

While the nation is projected to become majority-minority by 2044, Orange County, California (the 6th largest county in the U.S. by population) reached that milestone in 2004. Orange County's diversity is a major asset to the regional and global economy, but notable inequities and disparities exist. For example, large discrepancies exist in computer science (CS) and Information and Communication Technology (ICT) pathway enrollment for Latinx students in Orange County. Although Latinx students represent just over half of the student population in Orange County high schools that offer ICT pathways, they represent only 31% of CS course and ICT pathway enrollments. Discrepancies are larger for some districts than others, and no other ethnic student groups show notable underrepresentation in CS courses. Similarly, female students represent nearly half of all students but less than 30% of students enrolled in CS or ICT pathways in the five years prior to the grant at schools with ICT pathways (CALPADS, 2014–15 to 2018–19). These disparities point to the need for strategies that expand equitable access to computational thinking and computer science opportunities for female students and students of color, who have been historically underrepresented in STEM.

About the Project

To address these disparities, the BTCSEI project was designed around an ecosystem of supports intended to strengthen students' access to, preparation for, and persistence in computer science coursework and pathways. The project focused on improving CT skills, developing schoolwide and student-targeted CS identity, and supporting equity and inclusion in CS. Specifically, the project responded to systemic and practical deficiencies (root causes) that contributed to four interconnected problems:

- Challenges of implementing whole-school change efforts in large secondary schools
- Lack of CS identity in schools and in students who are typically underrepresented in CS courses and fields
- Lack of exposure to and development of computational thinking skills as a critical foundation prior to engaging in CS coursework
- Lack of a continuum of supports for students historically underrepresented in CS to ensure more equitable access to and success in CS courses, and acquisition of CT skills and dispositions tied to the Next Generation Science Standards (NGSS) and the Information and Computer Technology (ICT) sector Career Technical Education (CTE) track.

Together, these deficiencies contributed to widening disparities in CS educational opportunities for students of color, especially female and Latinx students. The project was grounded in the premise that improving equitable access to CS coursework required a coordinated ecosystem of supports at the school, teacher, and student levels. This ecosystem included coaching for administrators, professional learning for teachers, development and implementation of CT-focused curricular materials, and student career exploration and mentoring. These components were intended to strengthen schoolwide readiness and coherence around CT, increase teacher knowledge and confidence to teach CT, expand students' CT/CS knowledge and career awareness, and increase exposure to diverse CS and CS-adjacent role models. Through these mediating conditions, the project sought to build schoolwide and student CS identity, expand CT instruction, improve CT skills among female and Latinx students, increase CS and ICT pathway participation, and ultimately reduce enrollment gaps in CS and ICT pathways. See Appendix A for the project logic model.

Project Goals

The project had three primary goals, each grounded in a theory of action linking project activities to intended student and school outcomes:

Goal 1: Build CT Skills through Academic Instruction Focused on Inclusive Practices and Culturally Relevant Teaching. If CT is embedded into core coursework, then more students will develop the foundation needed for CS, and more students will pursue formal CS coursework.

Goal 2: Build CS-Inclusive Identity through Social Emotional Learning and Exposure to Role Models. If inclusive social emotional instruction is incorporated into CS courses and students are exposed to role models, then students will develop stronger CS-inclusive identities, and more students will pursue and persevere in formal CS coursework.

Goal 3: Create an Ecosystem of Supports and Schoolwide CS Identity Through Community of Practice. If a diverse Community of Practice (CoP) is created, then schools can develop a CS ecosystem that supports students in building CS identity and accessing CS coursework.

Intervention Components

The project consisted of four primary intervention components designed to achieve the project goals: coaching for administrators, professional learning for teachers, development of curricular materials, and student career exploration and mentoring.

Coaching for Administrators

Portico (The Inflexion Approach) is grounded in the assumption that systemic change depends on schools articulating and communicating a shared vision for readiness and a set of beliefs, values, and mental models that define their identity. School, home, community, and business partners within a school's ecosystem all contribute to identity building. The Inflexion Approach further asserts that a school's identity should inform and be reflected in its organizational structure, including its systems and policies. In this model, Identity informs Structure; Structure supports Learning; and Learning empowers Readiness for all students.

California's Multi-Tiered System of Support (CA MTSS) is a comprehensive intervention framework that aligns academic, behavioral, and social emotional learning in a fully integrated system of support for all students. The goal is to close equity gaps through inclusive, equitable learning environments, strengthened educational systems, and family and community partnerships. A continuum of supports provides universal support for all students, supplemental interventions for small groups of students, and intensified interventions for individual students. Through the CA MTSS Framework, administrators were expected to articulate a range of universal, supplemental, and intensified supports for student development of computational and design thinking skills, CS identity, and engagement in CS courses and ICT pathways.

Professional Learning for Teachers

Professional learning was provided to educators to promote computational thinking and connections to CS, STEM, and other courses. CT forms the foundation of CS and represents a transferable skillset, particularly in math and science coursework aligned with the Common Core State Standards for Mathematics (CCSS-math) and the Next Generation Science Standards (NGSS).

A Community of Practice (CoP) supported the prototyping and testing of innovations at identified sites, review of data for continuous improvement and iterative innovation design, and development of practice profiles. The CoP began with a focus on teachers and site administrators and was intended to broaden over time to include counselors, students, parents, institutions of higher education, business and community members, and other partners.

Curricular Materials

Participating teachers collaborated on the **development of instructional units** focused on computational thinking. These units were developed beginning in summer professional learning sessions and continuing into the academic year. Teachers were expected to implement **two**

units per year, one each semester. After implementation, teachers reflected on the units and made modifications as needed.

Student Career Exploration and Mentoring

Identity is central to student decision making when considering which careers to pursue and what coursework is needed to support those pathways. As part of the project, strategies were implemented to develop student identity and self-awareness related to CS and to build a holistic school identity that fostered STEM aspiration among historically underserved students. School leaders used Portico and the Inflexion Approach to examine structures, systems, and policies and to support the development of a schoolwide CS identity that expanded access to CT and CS curriculum. To further develop CS identity, students engaged with Pathful, a platform designed to support college and career awareness, planning, exploration, and live industry connections.

Pathful Connect (formerly Nepris) was used to connect industry and subject-relevant STEM professionals to classrooms, bringing real-world relevance and career exposure to students. Pathful Connect provided opportunities for students to meet and engage virtually with role models from similar backgrounds and communities. Students were supported by trusted role models inside and outside the school, and students with additional barriers to engagement and inclusion in CS, including female and Latinx students, were intended to receive supplemental and/or intensified support from role models, as appropriate.

Pathful Explore (formerly Virtual Job Shadow) was used to help students explore career options and plan for life after high school. By providing interactive tools, assessments, and real-world exploration, Pathful Explore was intended to help students discover diverse career pathways and chart individualized paths.

Implementation Design

The implementation design is presented in Figure 1. Grant years spanned January to December, following the calendar year, while implementation years followed the academic year, beginning in August and concluding in May.

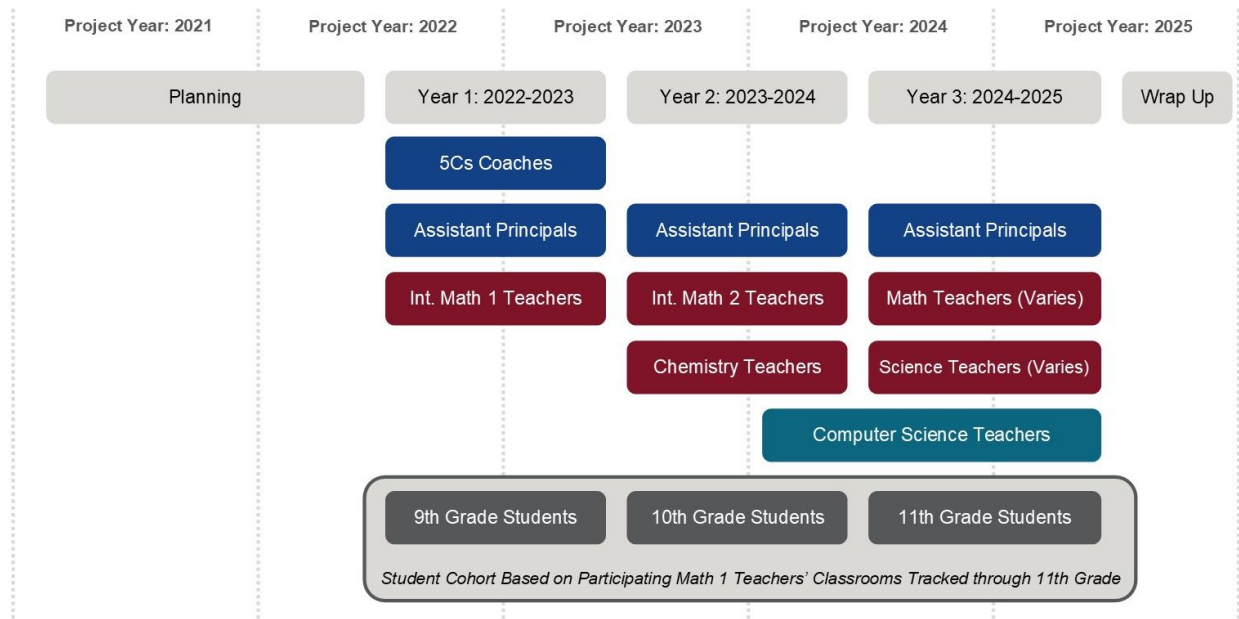


Figure 1. Implementation Design

The project included interventions at three levels: administrators, teachers, and students. In Year 1, 5Cs Coaches and assistant principals served as the administrator participants. However, at the request of Anaheim Union High School District (AUHSD), 5Cs Coaches discontinued their participation in Years 2 and 3. The project was originally designed for the same assistant principals to participate across all three years of implementation, contingent on their continuation in the same roles within their respective schools; however, there was some turnover in assistant principals throughout the project. Teacher participation followed a different pattern, with a different cohort identified for each year of the project based on the courses taught. Year 1 focused on Integrated Math 1 teachers, while Year 2 included Integrated Math 2 and Chemistry teachers. Computer science teachers joined the initiative in the latter half of Year 2, beginning in Spring 2024, and continued throughout Year 3. Year 3 also expanded to include math and science teachers from a variety of domains, including Anatomy and Physiology, Physics, AP Physics, AP Biology, AP Chemistry, Integrated Math 3, Math 2/3 Honors, Pre-Calculus, Statistics, and Applications of Functions, who served 11th-grade students. Participating students were identified based on enrollment in participating Math 1 teachers' classrooms during Year 1. This student cohort was then tracked through 11th grade to examine students' experiences and outcomes across multiple years of project implementation.

Participating Schools and Students

OCDE identified potential intervention schools by examining five-year CS course and/or ICT pathway enrollment data from Orange County high schools. Schools were considered eligible for inclusion if they had a 15% or greater discrepancy between the proportion of female students enrolled in CS/ICT and the district proportion of female students, and/or a 15% or greater discrepancy between the proportion of Latinx students enrolled in CS/ICT and the district

proportion of Latinx students. This process identified 49 high schools across 11 districts as potential intervention sites, with additional schools identified as potential comparison sites. Additional information about the original selection pool and CS/ICT enrollment discrepancies by district is provided in Appendix B.

Although multiple schools met the eligibility criteria, school and district capacity shaped final participation. Ongoing challenges related to the COVID-19 pandemic and substitute teacher availability limited schools' ability to take on additional grant activities beyond existing commitments. Ultimately, Anaheim Union High School District (AUHSD) agreed to engage in the project, and the project was implemented in three AUHSD schools: Anaheim High School, Cypress High School, and Loara High School. Additional demographic and performance characteristics for the participating schools are provided in Appendix B.

Student participation was tied to enrollment in participating teachers' course sections. In Year 1, Integrated Math 1 teachers were recruited, and ninth-grade students enrolled in participating Math 1 course sections were identified as student participants. In Year 2, Integrated Math 2 and Chemistry teachers were recruited, and tenth-grade students enrolled in participating teachers' course sections were included as student participants. Computer science teachers joined the initiative in the latter half of Year 2 and continued throughout Year 3. In Year 3, math and science teachers from a variety of domains who served eleventh-grade students were recruited, and students enrolled in participating course sections were included as student participants. Particular attention was given to students with multiple years of participation.

Structure of the Report

The remainder of this report is organized into two evaluation chapters. The first chapter presents the implementation evaluation conducted by Inflexion and includes the methods, findings, and discussion related to project implementation and implementation fidelity. The second chapter presents the outcomes evaluation conducted by Redwood Consulting Collaborative and includes the methods, findings, and discussion related to student outcomes associated with project participation. Together, these chapters provide an integrated summative account of the BTCSEI project while preserving the distinct purposes, methods, and contributions of the implementation and outcomes evaluation strands.

Implementation Evaluation: Building the Ecosystem of Supports

Prepared by

Jessica N. Jacovidis, PhD

S. Jeanne Horst, PhD

Rachel Phillips

inflexion

Implementation Design and Methodology

This chapter presents the implementation evaluation conducted by Inflexion. The implementation evaluation focused on the extent to which the BTCSEI intervention was delivered as intended (Breitenstein et al., 2010). Implementation fidelity data supported (a) a more nuanced understanding of implementation conditions that may have shaped student CS and/or ICT pathway course participation and completion, and academic achievement in mathematics; and (b) a determination of strategies suitable for intervention replication or testing in other settings. Two main fidelity questions guided the internal implementation evaluation:

1. To what extent was the intervention, guided by the CA MTSS framework and Inflexion Approach, implemented with fidelity?
2. Did high-fidelity implementation of the intervention increase access to, participation in, retention in, and performance in CS classes and ICT pathways for traditionally underrepresented student groups across treatment schools?

To address these implementation evaluation questions, Inflexion employed an embedded mixed methods design with a longitudinal component. In embedded mixed methods designs, certain types of data are better suited to answer certain types of research questions, and no single data source can fully answer any single research question. The triangulation approach of the mixed methods design allows the strengths of some methods to compensate for the weaknesses of others, ultimately providing a more complete and rigorous study (Brewer & Hunter, 1989; Creswell & Plano Clark, 2011). As such, Inflexion used multiple data sources to gather both quantitative and qualitative data, sometimes embedded in the same instrument, such as a teacher survey with quantitative and qualitative items (Creswell & Plano Clark, 2011). The longitudinal component allowed Inflexion to examine the same individuals at multiple time points and capture implementation journeys throughout the project. Together, these data were integrated through a common set of indicators compiled into an Implementation Fidelity Index, which allowed Inflexion to assess project implementation for each site and for the overall project.

Data Collection

A variety of quantitative and qualitative data collection methods were employed for the implementation evaluation of the BTCSEI project, including project records; teacher and student surveys; student knowledge assessments; administrator interviews; teacher and student focus groups; a coherence self-assessment; classroom observations; and event evaluations. These data were also used to complete the Implementation Fidelity Checklist as a measure of overall implementation for each school. All implementation evaluation instruments were developed by Inflexion in collaboration with OCDE project staff and reviewed by the Redwood Consulting Collaborative external evaluation team. These methods provided data that were used formatively to fine-tune project activities and summatively to assess project implementation. The data collection instruments and methods are described below.

Project Records Review

Inflexion partners examined project records to monitor and describe implementation of the BTCSEI project across the grant period. Project records included documents evidencing project implementation, such as project plans, recruitment materials, communication materials, meeting minutes, content of and participation in educator trainings, computational thinking units developed by participating teachers, and student work samples produced during computational thinking units. Records were also examined to determine whether and why any changes were made to project implementation. These data were provided to evaluators by OCDE project staff.

OCDE Project Staff Interviews

Inflexion conducted annual interviews with OCDE project staff to gather project-level perspectives on BTCSEI planning and implementation. The OCDE interview was conducted with the project principal investigator and project coordinator together. The protocol asked OCDE project staff to describe their roles and responsibilities; project planning, recruitment, and implementation efforts; the partnership with AUHSD; implementation successes and barriers; perceived benefits; lessons learned; and sustainability planning. OCDE project staff interviews were conducted each year of implementation. The OCDE project staff interview response rate was 100% each year. The Spring 2025 OCDE project staff interview protocol is included in Appendix C. Earlier versions of the protocol included the same core topics, with minor adaptations to reflect the stage of implementation.

AUHSD Project Staff Interviews

Inflexion conducted annual interviews with AUHSD project staff to gather district-level perspectives on BTCSEI implementation. The AUHSD interview was conducted with the district's key project contact and implementation partner. The protocol asked AUHSD project staff to describe their role and responsibilities, the district's role in project planning and implementation, the partnership with OCDE, implementation successes and barriers, district-level supports, perceived benefits, lessons learned, and sustainability planning. AUHSD project staff interviews were conducted each year of implementation. The AUHSD project staff interview response rate was 100% each year. The Spring 2025 AUHSD project staff interview protocol is included in Appendix D. Earlier versions of the protocol included the same core topics, with minor adaptations to reflect the stage of implementation.

Administrator and 5Cs Coach Interviews

Inflexion conducted interviews with school administrators at each participating school during each year of implementation. The administrator interview protocol included a common set of core topics, with slight adaptations by year to reflect changes in project implementation, participant roles, and the stage of the grant. Administrators were asked to provide feedback on their experiences with Portico, overall implementation of the project, project supports, benefits of project implementation, lessons learned, and sustainability. In Year 1, interviews were also

conducted with 5Cs Coaches because they participated in the administrator coaching component during the first year of implementation; because 5Cs Coaches did not participate during Years 2 and 3, they were not included in subsequent interview data collection. Administrator interviews were conducted in person during school site visits in April 2023, April and May 2024, and April and May 2025. All three participating schools completed administrator interviews each year, for a response rate of 100%. Appendix E includes the Spring 2024 administrator interview protocol, and Appendix F includes the 5Cs Coach interview protocol used during Year 1 implementation.

Coherence Review

To measure implementation, structural coherence, and systems of support across school sites, Inflexion asked administrators at each school to complete a self-assessment of implementation progress for the project. The coherence review focused on the schoolwide systems and structures in place to support grant activities. Specifically, the review asked leaders about their school vision, values, and beliefs; schoolwide computational thinking leadership and management practices; teacher mindsets and beliefs; structures in place to support teachers; and schoolwide computational thinking instruction and practices. These topics are rooted in the Inflexion Approach, which addresses deep-seated challenges and barriers to systemic change. The coherence review was completed by administrators each spring during implementation (March 2023, April 2024, and April 2025). Each participating school completed the coherence review during each administration, for a school-level response rate of 100%. The coherence review is included in Appendix G.

Teacher Perceptions and Practices Survey

Inflexion partners asked each participating teacher cohort to complete a survey about their perceptions and practices related to computational thinking at the beginning and end of their project participation. This survey took about 20 minutes to complete and included questions focused on knowledge related to computational thinking, teacher preparedness to use computational thinking strategies and equitable teaching practices, computational thinking self-efficacy, frequency of use for specific instructional practices, and perceptions of students' career self-efficacy. Additionally, subscale scores were calculated for the following scales: knowledge related to computational thinking, teacher preparedness to use computational thinking strategies, teacher preparedness to use equitable teaching practices, and computational thinking self-efficacy. These scales exhibited acceptable reliability (>0.70). Appendix H includes the 2025 Teacher Perceptions and Practices Post-Survey, which includes all items administered at pre-survey as well as additional items administered only at post-survey.

Because each implementation year included a different teacher cohort, the teacher survey was administered annually as a pre-post measure. The pre-survey was administered on the first day of the Summer Institute, and the post-survey was administered near the end of the implementation year. Table 1 summarizes teacher survey completion and matched samples by implementation year.

Table 1. Teacher Perceptions and Practices Survey Completion by Implementation Year

Implementation Year	Teacher Cohort	Active Participating Teachers	Teachers with Pre- and Post-Survey Data	Annual Response Rate
Year 1 2022-23	Integrated Math 1 teachers	13	13	100.0%
Year 2 2023-24	Integrated Math 2 and Chemistry teachers	21	20	95.2%
Year 3 2024-25	Math, science, and computer science teachers	22	22	100.0%

Note. The matched sample includes teachers who were active participants through the end of the implementation year and completed both the survey administrations. Two teachers withdrew in Year 1, and one teacher withdrew in Year 3. Year 3 included computer science teachers, as well as math and science teachers from a variety of domains (i.e., Anatomy and Physiology, Physics, AP Physics, AP Biology, AP Chemistry, Integrated Math 3, Math 2/3 Honors, Pre-Calculus, Statistics, Applications of Functions) who serve 11th-grade students.

Teacher Focus Groups

Inflexion researchers conducted focus groups with participating teachers at each participating school. The teacher protocol included a common set of core topics, with slight adaptations by year to reflect the participating teacher cohort and stage of implementation. Teachers were asked to provide feedback on their participation in professional development activities, their experiences developing and implementing CT units, their experience with Pathful, overall implementation of the project, supports they needed from their school or district, and benefits of project implementation. Teacher focus groups were conducted each spring during implementation. Table 2 summarizes teacher focus group participation by implementation year and school. Appendix I includes the 2024 teacher focus group protocol.

Table 2. Teacher Focus Group Participation by Implementation Year

Implementation Year	Anaheim High School	Cypress High School	Loara High School	Total Teachers
Year 1 2022-23	6 Math	3 Math	4 Math	13
Year 2 2023-24	7 Math 1 Science	2 Math 5 Science	4 Science	19
Year 3 2024-25	4 Math 4 Science 1 Computer Science	2 Math 5 Science 1 Computer Science	2 Math 2 Science 1 Computer Science	22

Classroom Observations

Inflexion partners developed a classroom observation checklist to use during on-site school visits. The checklist included components developed in partnership with the OCDE team and prioritized “look fors” related to computational thinking strategies and practices, social and emotional learning strategies, student engagement, and use of equitable teaching practices. The checklist included a false/partially true/true response scale to capture the presence or absence of each observation element. Additionally, researchers were asked to provide observation notes about any aspects of computational thinking activities and strategies observed during the class session.

Classroom observations were conducted each spring during implementation. In Year 1, Inflexion partners and Redwood Consulting Collaborative evaluators observed Integrated Math 1 courses across participating schools. In Year 2, Inflexion partners observed Integrated Math 2 and Chemistry courses. In Year 3, Inflexion partners observed participating teachers’ math, science, and computer science courses¹ across participating schools. Observations included classes where implementation of teacher-developed CT units was occurring, as well as classes in which the CT unit had already been implemented. Table 3 summarizes classroom observations by implementation year and school. The classroom observation checklist is included in Appendix J.

Table 3. Classroom Observations by Implementation Year and School

Implementation Year	Anaheim High School	Cypress High School	Loara High School	Total Teachers
Year 1 2022-23	6 Math	3 Math	4 Math	13
Year 2 2023-24	5 Math 2 Science	2 Math 5 Science	3 Science	17
Year 3 2024-25	3 Math 4 Science 1 Computer Science	2 Math 5 Science 1 Computer Science	2 Math 2 Science 1 Computer Science	21

Event Evaluation Forms

Educators attending professional learning events were asked to complete an event evaluation form to explore their perceptions of and experiences with the event. The form consisted of 36 items in seven categories (e.g., objectives; meeting planning and logistics; content; interactions with colleagues; outcomes; intent to use; and quality, relevance, and utility). These items were

¹ Year 3 included computer science teachers, as well as math and science teachers from a variety of domains (i.e., Anatomy and Physiology, Physics, AP Physics, AP Biology, AP Chemistry, Integrated Math 3, Math 2/3 Honors, Pre-Calculus, Statistics, Applications of Functions) who serve 11th-grade students.

rated on a 5-point Likert scale, ranging from *Strongly Disagree* to *Strongly Agree*; a *Not Applicable* response option was available for respondents who believed that the question did not apply to them. The form also included four open-ended items. The form was created by Inflexion partners and reviewed by OCDE project staff prior to its use. Appendix K includes the standard Event Evaluation Form; event-specific language was adapted as needed to reflect the professional learning activity being evaluated (i.e., Summer Institute or CoP).

Student Perception Survey

Inflexion partners asked participating students to complete a survey at the beginning of their first year and at the end of each year of participation in the project. The survey was administered online and took about 15 minutes to complete. It measured students’ confidence related to computational thinking, computer science identity, frequency with which their teachers used specific instructional practices, career decision self-efficacy, and college-going expectations. Additionally, subscale scores were calculated for the student confidence scale and for subscales of the computer science identity scale: Confidence in Ability to Learn CS Skills and Solve CS Problems, Interest in Learning Computer Science and Solving Problems, Perceptions of Belonging in Computer Science, Belief in the Usefulness of Learning Computer Science, and Perceptions of Being Encouraged to Study Computer Science. These scales exhibited acceptable reliability (>0.70). Appendix L includes the 2025 Student Perception Post-Survey, which includes the core items administered across survey administrations as well as additional items administered only at post-survey.

The pre-survey was administered in December 2022, and post-surveys were administered in May 2023, April 2024, and April 2025. An email invitation was sent to teachers requesting they administer the survey to their students during their class period. The email briefly introduced the purpose of the survey and provided instructions for completing the survey. Student survey data were analyzed in two ways. First, pre-post analyses were conducted within each implementation year using students with data for the relevant pre- and post-survey administrations. Second, a longitudinal analysis was conducted for students who had complete data across all four survey administrations. Table 4 summarizes student survey completion for the annual and longitudinal analyses.

Table 4. Student Perception Survey Completion by Administration

Implementation Year	Survey Administrations	Response Rates			
		Anaheim HS	Cypress HS	Loara HS	Overall
Year 1 2022-23	December 2022 Spring 2023	39.8%	48.1%	57.5%	47.6%
Year 2 2023-24	December 2022 Spring 2024	39.1%	46.9%	54.9%	46.1%
Year 3 2024-25	December 2022 Spring 2025	43.8%	32.7%	44.2%	41.9%

Implementation Year	Survey Administrations	Response Rates			
		Anaheim HS	Cypress HS	Loara HS	Overall
Longitudinal	December 2022				
	Spring 2023				
	Spring 2024	20.1%	24.7%	29.5%	24.3%
	Spring 2025				

Student Computational Thinking Knowledge Assessment

Inflexion partners asked participating students to complete a computational thinking knowledge assessment at the beginning of their first year and at the end of each year of participation in the project. This assessment provided a direct measure of students’ computational thinking skills. The knowledge assessment was administered online and took about 30 minutes to complete. Scores were calculated for the following scales: overall (total score), abstraction, algorithmic thinking, decomposition, evaluation, and pattern recognition.

Across administrations, the total score demonstrated stronger reliability than the subscales, though reliability was still limited in some administrations (ranging from 0.48 to 0.64). Subscale reliability estimates were lower than acceptable (ranging from 0.01 to 0.38). This may be a result of low variance, as overall scores were low and some items had limited or no variance; however, it could also suggest that the subscales are not stable. As a result, assessment findings should be interpreted with caution, particularly at the subscale level.

The pre-assessment was administered in December 2022, and post-assessments were administered in May 2023, April 2024, and April 2025. An email invitation was sent to teachers requesting they administer the knowledge assessment to their students during their class period. The email briefly introduced the purpose of the assessment and provided instructions for completing the assessment. Student computational thinking knowledge assessment data were analyzed in two ways. First, pre-post analyses were conducted within each implementation year using students with data for the relevant pre- and post-assessment administrations. Second, a longitudinal analysis was conducted for students who had complete data across all four assessment administrations, including the baseline assessment and all three annual post-assessments. Table 5 summarizes student computational thinking knowledge assessment completion for the annual and longitudinal analyses. The 2025 Student Computational Thinking Knowledge Assessment is included in Appendix M; the same assessment was administered at each time point.

Table 5. Student Computational Thinking Knowledge Assessment Completion by Administration

Implementation Year	Assessment Administrations	Response Rates			
		Anaheim HS	Cypress HS	Loara HS	Overall
Year 1 2022-23	December 2022				
	Spring 2023	33.1%	38.9%	43.5%	37.8%

Implementation Year	Assessment Administrations	Response Rates			
		Anaheim HS	Cypress HS	Loara HS	Overall
Year 2 2023-24	December 2022 Spring 2024	31.6%	38.9%	47.4%	38.5%
Year 3 2024-25	December 2022 Spring 2025	32.3%	21.0%	37.0%	31.9%
Longitudinal	December 2022 Spring 2023 Spring 2024 Spring 2025	11.2%	14.8%	20.8%	15.3%

Student Focus Groups

Inflexion partners conducted focus groups with participating students at each participating school. The student focus group protocol included a common set of core topics, with slight adaptations by year to reflect students' grade level, course context, and stage of participation in the project. Students were asked to provide feedback on their awareness of computational thinking, experiences with CT instruction, awareness of computer science and computer science identity, exposure to CS-related careers and role models, and future course-taking or pathway interests. Student focus groups were conducted in person during spring school site visits each year of implementation. Table 6 summarizes student focus group participation by implementation year and school. Appendix N includes the 2025 student focus group protocol.

Table 6. Student Focus Group Participation by Implementation Year and School

Implementation Year	Anaheim High School	Cypress High School	Loara High School	Total Students
Year 1 2022-23	8	13	9	30
Year 2 2023-24	9	10	7	26
Year 3 2024-25	15	11	13	39

Student Records

Inflexion examined student administrative records for participating students. These data, provided by AUHSD data staff, included course enrollment and completion data used to follow students throughout the project. For the implementation evaluation, student records were used to monitor student participation, describe course-taking patterns, and contextualize students' exposure to project activities. Student administrative records were also examined by Redwood Consulting Collective (RCC) as part of the external outcomes evaluation.

Implementation Fidelity Checklist

An Implementation Fidelity Checklist was used to measure implementation fidelity overall and by school site. The checklist was developed by Inflexion and OCDE, reviewed by RCC, and organized by key intervention component. Fidelity index scores were calculated by school and implementation year. These scores were used to assess the extent to which core components of the project were implemented as intended and to provide implementation context for interpreting project outcomes. See Appendix O for the Implementation Fidelity Checklist.

Data Analyses

Appropriate analytic techniques were employed for all implementation evaluation data collected. For quantitative measures, descriptive statistics (e.g., frequencies, percentages, means, standard deviations) were generated. Additionally, evaluators combined items into preexisting subscales when possible. For teacher survey analyses, matched pre-post data were used to examine changes within each teacher cohort's year of participation. For student survey and computational thinking knowledge assessment analyses, data were examined both by implementation year and longitudinally for students with data across all survey or assessment administrations. Implementation Fidelity Checklist data were summarized by school and implementation year.

Qualitative data (e.g., project records, interview and focus group data, and open-ended survey responses) were analyzed thematically and summarized where appropriate. Findings from multiple data sources were triangulated by intervention component to assess implementation, identify common successes and challenges, and provide context for interpreting project outcomes.

Project Implementation Results

This section presents findings related to implementation of the BTCSEI project across the full grant period. Findings are organized by the project's key intervention components and data collection instrument.

Component 0: OCDE and AUHSD Project Staff

Although not a formal intervention component of the project, OCDE and AUHSD project staff played central roles in planning, coordinating, adapting, and supporting implementation across the grant period. OCDE served as the grant lead and was responsible for overall project coordination, professional learning planning, partner communication, continuous improvement, and support for participating schools and teachers. AUHSD served as the district implementation partner and supported school participation, teacher recruitment, communication with school sites, coordination of district-level logistics, and alignment with district priorities. Because these roles shaped implementation across all four formal intervention components, findings related to OCDE and AUHSD project staff are presented first to provide context for interpreting the component-level findings that follow.

OCDE and AUHSD Project Staff Interviews

Inflexion conducted annual interviews with OCDE and AUHSD project staff to gather project- and district-level perspectives on BTCSEI planning and implementation. Interviews focused on staff roles and responsibilities, project planning and coordination, implementation successes and barriers, adaptations made over time, perceived benefits, lessons learned, and sustainability planning.

Recruitment and Implementation Context

Before implementation began, OCDE and its partners spent substantial time working to launch the BTCSEI project in a way that was both aligned with the original grant design and feasible for Orange County schools. The project was originally designed to reach a large number of schools across multiple districts, and OCDE made multiple efforts to recruit districts and schools for participation. These efforts included meeting with district and school leaders, visiting potential implementation sites, giving presentations about the project, holding open office hours, following up with interested districts, and offering flexibility in how districts and schools could participate.

These recruitment efforts took place during a difficult period for schools and districts. Many districts were still managing the effects of the COVID-19 pandemic, including staffing shortages, limited substitute availability, leadership transitions, and competing instructional priorities. Even when districts were interested in the project, they had to determine whether they had the capacity to commit to a multi-year initiative that involved teacher professional learning, school-level coordination, implementation support, and ongoing evaluation activities.

OCDE and its partners continued to adjust the proposed implementation approach in response to these conditions. The team explored ways to broaden participation, considered different school and course configurations, and discussed how the implementation design could be modified while preserving the core intent of the grant. These conversations included whether the project could include additional districts, additional schools, additional cohorts, or a widened student sample. The team also considered how possible changes to implementation would affect evaluation expectations, performance measures, reporting, and the ability to assess project outcomes.

After these recruitment and planning efforts, AUHSD moved forward as the district implementation partner. Although this was different from the original multi-district design, it allowed the project team to move from recruitment and planning into implementation with a district that was willing to commit to the work and engage in the coordination required to support schools, teachers, and students over multiple years.

Planning for AUHSD Implementation

Once AUHSD became the district partner, OCDE, AUHSD, Inflexion, and Redwood Consulting Collaborative worked to translate the project design into a district implementation plan. Anaheim High School, Cypress High School, and Loara High School were identified as the three participating schools. Planning focused on how to structure implementation within AUHSD's existing systems, how to support participating schools and teachers, and how to maintain alignment between project goals, district priorities, and evaluation requirements.

This planning period involved several consequential implementation decisions. The project team worked to clarify the intervention model, revise performance measures, develop the evaluation design, establish data-sharing processes, negotiate the Memorandum of Understanding (MOU), and prepare consent, survey, assessment, and reporting procedures. OCDE and AUHSD also worked through early decisions about participating courses, teacher recruitment, site-level roles, Summer Institute scheduling, Community of Practice (CoP) structures, Pathful purchasing, and how participating students would be identified and tracked for evaluation purposes.

Early planning identified Integrated Math 1 as the initial required course focus, with the intent of reaching a substantial proportion of ninth-grade students. Science participation was discussed as a possible extension but was not required in the first year. The district's Careers, Finance, and Technology course was also considered because of its potential connection to career exploration and computational thinking, though implementation ultimately centered on math in Year 1. AUHSD also identified 5Cs Coaches as Year 1 site-level supports, with the expectation that they would participate in both Portico and teacher professional learning.

These early decisions established the initial implementation structure and reflected the project team's effort to balance the goals of the original proposal with the practical conditions in participating schools. The planning year was therefore an important part of implementation rather than simply a delay before implementation began. It was the period when OCDE and AUHSD worked through the district, school, instructional, and evaluation conditions needed to launch the project in a way that was feasible, coherent, and aligned with AUHSD's systems.

Partnership and District Alignment

Once implementation began, the partnership between OCDE and AUHSD became a central condition for carrying out the project. OCDE and AUHSD had distinct but complementary roles. OCDE led the grant and supported the overall intervention model, while AUHSD helped determine how the work could be implemented within district procedures, timelines, and school structures. The AUHSD district liaison served as a key bridge in this process. Reflecting on the early implementation period, the AUHSD representative described the work as trying to understand *“what was the AUHSD system, what’s the OCDE system and what’s the EIR grant system and how did we want all of those systems to work together?”* This description captures one of the central tasks of the partnership: connecting the requirements of the grant with the systems and routines already operating within the district.

Over time, the partnership became more collaborative and responsive. Early implementation required OCDE and AUHSD to develop shared expectations, clarify decision-making processes, and create communication routines that allowed the work to move forward. As the project progressed, AUHSD became more than a district implementation site, and the district liaison became an important thought partner in shaping how the project operated. The AUHSD representative described this evolution by noting, *“My role has really evolved... I’m so grateful for the OCDE team. They have been highly, highly responsive to my suggestions and feedback, the teacher participant suggestions and feedback, administrator feedback. What we started with last year and where we are now has completely transformed.”* OCDE staff similarly described the AUHSD liaison as more than a district contact, but as a thought partner in the project.

A consistent theme across project staff interviews was the importance of aligning BTCSEI with AUHSD priorities rather than presenting it as a separate grant initiative. The AUHSD representative explained that OCDE was intentional about this alignment: *“They were very conscientious that they didn’t want the EIR work to feel like separate work.... they really wanted to see how they could use this to amplify the systems within our district.”* This framing shaped how the project was communicated to participants. As the AUHSD representative explained, *“The messaging here has always been, ‘Help us help you to help students. Here’s how we align with what you’re already doing. So, it’s not really anything extra. How can we just amplify and be a resource for you?’”*

This alignment was important because participating teachers and administrators were already managing multiple instructional priorities and implementation demands. By positioning computational thinking as connected to existing instructional goals, OCDE and AUHSD helped reduce the perception that BTCSEI was an additional initiative layered onto teachers’ work. This did not eliminate the time and coordination required for implementation, but it provided a clearer rationale for participation and helped project activities become more connected to AUHSD’s broader instructional context.

The strength of the partnership was also evident in how OCDE and AUHSD responded when challenges emerged. The responsiveness of the OCDE team was a recurring theme in AUHSD’s reflections. As the AUHSD representative noted, *“Anytime what I think is a grant-ending problem occurs, they’re like, ‘Oh, we’ll figure this out.’ They’re very understanding and*

flexible, which I think makes the teachers feel safe to ask questions and to reach out for support.” This flexibility helped build trust and created the conditions for ongoing problem-solving as implementation needs changed.

Adapting Structures to Support Implementation

The strength of the OCDE-AUHSD partnership was reflected in the project’s ability to adjust implementation structures over time. As implementation progressed, project staff refined the roles, schedules, funding processes, and participation supports needed to carry out the work across schools. These adjustments helped the project remain aligned with AUHSD procedures while also responding to what OCDE and AUHSD were learning from participants and school sites.

The MOU served as the formal mechanism for many of these adjustments. In addition to establishing roles, expectations, stipends, site funds, and resource allocations, the MOU was amended over time to address emerging implementation needs. These amendments included changes related to Pathful purchasing, stipend structures, substitute costs, site funds, leadership roles, CoP structures, and support for key district and school personnel. Although the amendment process required additional coordination, it helped keep the project responsive to district procedures and school-level needs.

Several adjustments were especially important for supporting participation. After Year 1, the administrator role shifted from 5Cs Coaches to assistant principals, reflecting changes in district responsibilities and creating a clearer connection to site-level instructional leadership. The CoP structure also shifted from virtual before-school meetings in Year 1 to quarterly in-person release days beginning in Year 2. This provided more dedicated time for collaboration, planning, and unit development. Financial supports were also refined as implementation needs changed, with stipends expanded to additional role groups and site funds used to support substitute coverage and instructional materials.

These adaptations illustrate the practical work required to implement the project over multiple years. The project depended not only on the design of the intervention, but also on the structures that made participation possible: release time, funding procedures, role clarity, and alignment with district systems. By continuing to adjust these structures, OCDE and AUHSD helped create conditions that allowed the project to move forward while maintaining its focus on computational thinking integration and expanded access to computer science pathways.

Communication and Continuous Improvement

Regular communication between OCDE and AUHSD supported implementation throughout the grant period. Monthly meetings, email communication, phone calls, and informal check-ins allowed project leaders to coordinate logistics, monitor participant experiences, address emerging concerns, and plan upcoming activities. These routines created a structure for keeping the project connected to district and school-level realities as implementation unfolded.

OCDE staff regularly sought input from the AUHSD liaison about district initiatives, site needs, and participant feedback. One OCDE representative described the monthly check-ins as an opportunity to compare what each partner was seeing and learning: “[We have] monthly check-ins and in those meetings we get to have those backend discussions about this is what we were talking about and planning, these were kind of our takeaways, what were you seeing at that meeting as well?” These conversations allowed AUHSD perspectives to inform project planning rather than being addressed only after decisions had already been made.

These communication routines were especially important when implementation conditions changed. Project leaders used established communication structures to respond to scheduling conflicts, substitute shortages, purchasing issues, participant workload concerns, staffing changes, and shifts in course assignments. Communication also helped the team identify when project structures needed to be adjusted, including changes to meeting formats, participant supports, funding processes, and professional learning expectations.

Across the three implementation years, OCDE and AUHSD used participant feedback, implementation data, and ongoing planning conversations to refine project activities. These refinements helped the project adapt without losing its focus on computational thinking integration and expanded access to computer science pathways. The project did not unfold exactly as originally designed, but the communication and continuous improvement structures developed by OCDE and AUHSD helped make implementation feasible within AUHSD’s systems and provide important context for the component-level findings that follow.

Component 1: Coaching for Administrators

The first component of the BTCSEI project focused on building administrator capacity to support computational thinking implementation across participating schools. The administrator coaching component was delivered through Portico, Inflexion’s leadership development program. Portico provided a structured set of leadership development activities, including self-paced learning modules, resources, individual coaching, cohort-based coaching, and webinars. These activities were aligned with the Inflexion Approach, which emphasizes the relationship among school identity, organizational structures, learning systems, and student readiness. In this model, Identity informs Structure; Structure supports Learning; and Learning empowers Readiness for all students (see Figure 2). In the context of BTCSEI, Portico supported administrators in examining how school identity, organizational structures, and systems of support could strengthen computational thinking implementation and expand opportunities for students.

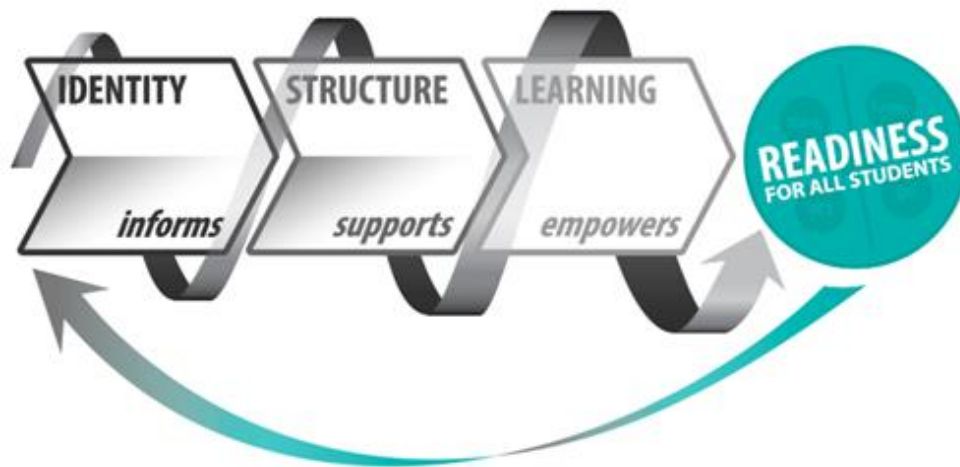


Figure 2. Inflexion Approach

For this project, the required Portico activities were individual coaching sessions (Copilot) and group cohort meetings (Counterpart). Participants also had access to Crowdscore webinars, which provided additional learning opportunities for school leaders.

Copilot sessions provided one-on-one coaching between a Portico coach and participating school leader. Meeting agendas were guided by the Portico learning sequence, the EIR grant context, and the specific needs of individual school leaders. Sessions included discussion of leadership practices, grant-related implementation questions, and opportunities for reflection. After each session, the coach provided follow-up resources aligned with the agenda and any specific requests from the school leader.

Counterpart meetings brought together participating administrators from the three schools. These meetings were designed to support cross-site collaboration and provide a structured space for administrators to discuss implementation progress, exchange ideas and resources, identify challenges, and reflect on schoolwide supports for the project. Each Counterpart meeting also included a general check-in on grant project activities.

Crowdscore webinars were one-hour virtual sessions available to a broader community of school leaders and focused on topics related to school improvement, equity, student voice, instructional leadership, belonging, family and community engagement, and systems change. For BTCSEI participants, these webinars provided additional opportunities to engage with related leadership topics and examples from other school contexts.

Participation in Portico changed over the course of implementation. During Year 1, 5Cs Coaches from each participating school participated in the administrator coaching component, while assistant principals had the option to participate in Portico activities. Beginning in Year 2, participation shifted to assistant principals only, and assistant principals participated in all required Copilot and Counterpart sessions during Years 2 and 3. This change reflected agreements with AUHSD and participating schools and shaped the structure of administrator engagement in later years.

Across the grant period, participating school leaders were offered 100 hours of administrator-focused professional learning through Portico between September 2022 and June 2025. These opportunities included individual coaching, cross-site cohort meetings, and broader leadership webinars. As shown in Table 7, school leaders were offered 29 Copilot sessions, 29 Counterpart meetings, and 42 Crowdscore webinars across the three implementation years.

Table 7. Administrator Professional Learning through Portico by Year

Implementation Year	Copilot Sessions	Counterpart Meetings	Crowdscore Webinars	Total Hours Offered
Year 1 2022-23	9	10	22	41
Year 2 2023-24	10	9	8	27
Year 3 2024-25	10	10	12	32
Total	29	29	42	100

The content of administrator professional learning also evolved over time. Early Portico sessions emphasized school community, school identity, shared vision, student readiness, leadership practices, and foundational supports for implementation. As implementation progressed, sessions increasingly focused on sustaining and expanding schoolwide change, including continuous improvement, teacher mindsets, empathy interviews, classroom visits, student motivation, student belonging and engagement, authentic relationships, resistance to change, data use, student voice, and family and community engagement. In the final year, Counterpart and Crowdscore topics continued to emphasize conditions for sustainable school improvement, including brave spaces, student empowerment, caring campus communities, trust building, learning walks, curriculum and instruction, and communication.

Coherence Review

To measure implementation, structural coherence, and systems of support across school sites, Inflexion asked administrators at each school to complete a self-assessment of implementation progress for the project. Specifically, the review asked leaders about their school vision, values, and beliefs; schoolwide computational thinking leadership and management practices; teacher mindsets and beliefs; structures in place to support teachers; and schoolwide computational thinking instruction and practices. At the end of each spring semester, each school administrator completed the coherence review for their school. Figure 3 presents coherence review ratings across the three years of implementation.

Year 1 Implementation (2022-23)

Anaheim High School	Cypress High School	Loara High School
School Vision, Values, and Beliefs	School Vision, Values, and Beliefs	School Vision, Values, and Beliefs
Schoolwide CT Leadership and Management	Schoolwide CT Leadership and Management	Schoolwide CT Leadership and Management
Teacher Mindsets and Beliefs	Teacher Mindsets and Beliefs	Teacher Mindsets and Beliefs
Supporting Teachers	Supporting Teachers	Supporting Teachers
CT Instruction and Practices	CT Instruction and Practices	CT Instruction and Practices

■ Undeveloped
 ■ Launching
 ■ Advancing
 ■ Fully Implemented

Year 2 Implementation (2023-24)

Anaheim High School	Cypress High School	Loara High School
School Vision, Values, and Beliefs	School Vision, Values, and Beliefs	School Vision, Values, and Beliefs
Schoolwide CT Leadership and Management	Schoolwide CT Leadership and Management	Schoolwide CT Leadership and Management
Teacher Mindsets and Beliefs	Teacher Mindsets and Beliefs	Teacher Mindsets and Beliefs
Supporting Teachers	Supporting Teachers	Supporting Teachers
CT Instruction and Practices	CT Instruction and Practices	CT Instruction and Practices

■ Undeveloped
 ■ Launching
 ■ Advancing
 ■ Fully Implemented

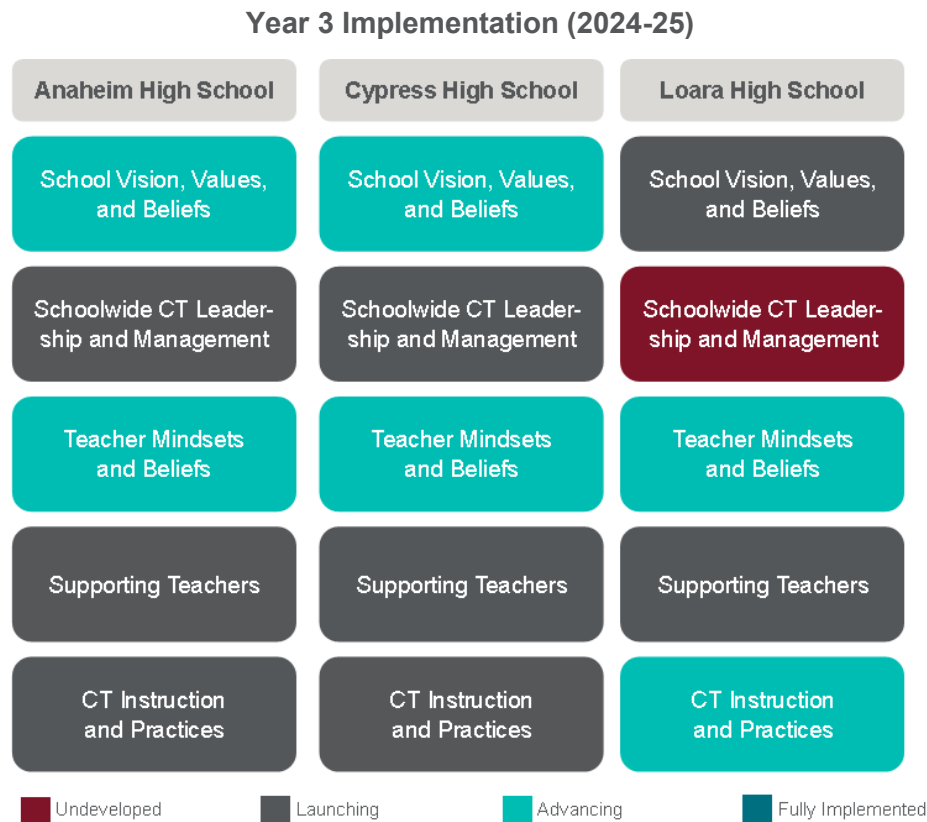


Figure 3. Coherence Review

Coherence review ratings show that schools made progress over the course of the grant, though progress varied by domain and school site. In Year 1, ratings across the three schools were largely at the launching stage. Early progress was most evident in teacher mindsets and beliefs, followed by school vision, values, and beliefs. This aligned with the early focus of implementation, as OCDE project staff intentionally addressed teacher mindsets and beliefs, while the Year 1 Portico journey emphasized school vision, values, and beliefs. Schoolwide CT leadership and management and structures to support teachers were less developed, while CT instruction and practices was rated at the launching stage across all three schools.

In Year 2, ratings showed additional progress in areas connected to schoolwide implementation. Teacher mindsets and beliefs remained a strong area across schools, and schoolwide CT leadership and management and structures to support teachers showed clearer development than in Year 1. This aligned with the continued focus on teacher mindsets and beliefs through project professional learning, as well as the Year 2 Portico emphasis on expanding CT schoolwide. At the same time, CT instruction and practices remained less consistent across schools, suggesting that broader schoolwide awareness and support for CT were developing before classroom-level CT practice was fully established.

By Year 3, coherence review ratings showed the strongest overall pattern of implementation across the grant period. Schools rated themselves highest on school vision, values, and beliefs; teacher mindsets and beliefs; and CT instruction and practices. These areas reflected the

cumulative focus of the project on schoolwide readiness, educator beliefs, and CT integration into classroom instruction. Progress in schoolwide CT leadership and management and structures to support teachers was more incremental, indicating that the systems and structures needed to fully sustain and scale CT implementation were still developing.

Overall, the coherence review suggests that the project supported the kinds of changes most closely connected to direct professional learning: shifts in educator understanding, greater attention to CT in instruction, and clearer connections between CT and schoolwide goals. The areas that remained less developed reflect a different level of change. Building schoolwide leadership structures and formal teacher support systems requires changes to roles, routines, decision-making processes, and shared ownership across the school, which are difficult to fully establish within a three-year implementation period. As a result, the coherence review points to meaningful progress in the conditions needed for CT implementation, while also showing that sustaining and scaling this work would require continued attention to the broader school systems that support instructional change.

Administrator Interview Summary

Administrator interviews were conducted annually with administrators from the three participating schools to understand their experiences supporting implementation of the computational thinking project. In Year 1, interviews were also conducted with 5Cs Coaches, who participated in the administrator coaching component during the first year of implementation. Interviews explored participants' project awareness and role clarity, experiences with Portico, implementation successes and challenges, perceived project benefits, and sustainability planning and lessons learned.

Project Awareness, Onboarding, and Administrator Role

In the first year of implementation, assistant principals and 5Cs Coaches entered the project with different levels of awareness and role clarity. Some participants understood the broad purpose of the project, especially its focus on mathematics, computational thinking, and helping students engage with problem solving in ways that went beyond traditional math instruction. Two assistant principals explained their understanding:

It had to do with math, and it had to do with readjusting the way the educators think about math. The type of knowledge and skill sets they're trying to develop in students was fundamentally different than the rote memorization of practical math or typical math classes. So that was my general understanding.

Well, I knew it was an OCDE math grant that our school was working with and a couple of our teachers were involved in. I also knew that the focus was computational thinking, and I knew that they were doing some work with a couple of our math teachers, our math department chair, and our 5Cs Coach.

In contrast, 5Cs Coaches described needing more clarity early in the project about implementation expectations and their role in supporting the work. Their comments focused on

the need for more shared planning, clearer communication, and a more explicit explanation of how assistant principals and 5Cs Coaches were expected to work together. For example, coaches shared:

It wasn't until after that first orientation meeting in the fall that I had an understanding of what my roles and responsibilities were.

I understood there was going to be six teachers or five teachers ... and that it was geared towards freshman classes. Once we got rolling, my understanding was that it was going to focus on math more. ... I had a hard time. That's, I think, one of my complaints that we'll probably get at later. That there was very little focus or drive. I think it was handed to 5Cs because admin had stepped away. They didn't want another thing on their plate. And so, the lack of direction was a little frustrating.

It's better to do things with people than to people. It did feel like it was done to us. ... No one knew what this was about at that time, right. And the time requirements before school. That was a big irksome part of it.

Having a clear direction is so important and what the role is as a supporting administrator over the program would be helpful.

Even in the first year, assistant principals recognized that their support mattered. Their role was not necessarily to lead classroom implementation directly, but to help create the conditions that allowed teachers to participate and share what they were learning. One administrator described this school-level support role as follows:

I think for me as an administrator to really help facilitate the work and work with whoever is leading that work ... to make sure they have access, time, resource that we can provide as a school ... and opportunities really to share out and to help make sure our school community is aware of the work that they're doing.

As implementation continued, the assistant principal role became clearer, particularly after Portico participation shifted to assistant principals only. By Year 2, assistant principals more consistently described themselves as facilitators, problem-solvers, and advocates for teachers. Their responsibilities included helping teachers use project funding, navigate procurement, arrange substitute coverage, communicate with district and project staff, and connect computational thinking to existing school goals. One assistant principal described the role as “really taking charge of supporting what the teachers need within their classroom, explaining how to use funding for their projects, and helping spread understanding across departments.” Another described the work as “helping teachers integrate computational thinking naturally into their curriculum rather than seeing it as an extra task.”

By Year 3, administrators were also describing their role in more instructional terms. They talked about visiting classrooms, learning what teachers were doing in professional learning, and using that knowledge to support classroom observations and instructional conversations. One administrator explained, “I tried to visit the classrooms of those teachers that are part of the

grant to see how are they using what they learned... I did that a couple times to see them in action.” Another described the importance of understanding the professional learning teachers were receiving so administrators could recognize and reinforce the work during classroom visits:

Learning about what the teachers are doing and some of the tools, some of the projects that they're working on and then they're bringing back to the classroom and then knowing what they're doing so that when I'm in the class, I can look for that or have conversation.

Portico

Portico served as the primary intervention component for assistant principals and 5Cs Coaches (Year 1 only). Through Portico, participants met with a coach and participated in peer coaching meetings (Counterpart meetings) with leaders from the other participating schools. In the first year, participants had varying levels of knowledge about Portico, and their experiences with the support model were mixed. Some participants appreciated the coaching, reflection time, and opportunity to think about their leadership role, while others were less clear about how Portico connected to computational thinking implementation. One coach stated, “*Actually, I didn't really see how Portico tied into the computational thinking part.*” Another coach found the Counterpart meetings more useful than the individual coaching because they provided an opportunity to hear how the other schools were approaching implementation:

For the Counterpart meetings, I felt like that was more, of the two, right, beneficial in terms of hearing what [the other participating schools] were doing, how collaborative each of the schools were as far as having the same outcomes, right, moving towards the same outcomes with their teachers implementing their projects for capstones. For the [Portico Copilot] meeting, honestly, I, and I think this was feedback, I wasn't getting much out of those meetings. ... I like talking to [the Portico coach]. ... But as far as outcomes with [the Portico coach], I don't feel like there was much there.

Other Year 1 participants described Portico more positively, particularly when the coaching connected to their own leadership and support for teachers. One coach described the experience as reflective, practical, and grounding:

Loved guidance. Loved the conversation. [The Portico coach] brings a wealth of knowledge. God, I mean not only as a 5C Coach but as a teacher, coming back in the classroom after ... years absence, that was a standout for my participation in this program. Portico, having a mentor, having that discussion, the flexibility. ... We're not driving. We're not doing all this nonsense. And it was one-on-one, and it was open, and inviting, and critical, and allowed time for reflection – made me really think about the program, the actual grant, but more importantly my role in trying to support these teachers as well as allowing me time and taking directions that I didn't anticipate. Have you thought of this, what about this. When we're talking about identity and building identity, when you look at the ... student

responses about the culture in the classroom. That went hand in hand with 5Cs, so that was nice. It was very grounding.

Another coach described Portico as “*kind of helpful, personally*” because it created time “*to discuss more than just the grant*” and to think about their leadership role. Participants also identified ways Portico could better support implementation in future years, including providing a clearer roadmap for the grant and more concrete tools for understanding, assessing, and supporting implementation.

As Portico participation shifted to assistant principals only, described the support model more consistently as a useful space for collaboration, role clarification, instructional leadership development, and problem-solving. For administrators who inherited the work after Year 1, Portico helped clarify their responsibilities. One assistant principal said they “*came in really blind*” but that Portico helped them “*define my responsibilities and figure out how to best support our teachers.*” Assistant principals also described direct participation in Portico as helpful for communication and coordination. One leader reflected, “*Last year, the 5Cs Coach would reach out to administration to organize things, but I think it’s more efficient having the administrator directly involved. It just works better this way.*”

Assistant principals valued having time with other administrators who were navigating similar implementation questions:

We all came in with a limited understanding of this grant, so we were figuring things out together. Being able to talk to other [assistant principals] and say, ‘Oh, I’m having that struggle too, what are you seeing?’ was extremely helpful. We don’t usually get this kind of dedicated space in our normal administrative meetings.

Assistant principals also described the Portico coach as an important source of structured reflection and support. They described one-on-one coaching as a chance to pause, reflect on progress, identify what still needed to be done, and consider how to better support teachers. They also described the coaching as directly connected to their existing responsibilities, rather than as an additional task.

By the final year, administrators continued to describe Portico as an important structure for reflection, collaboration, and support. Administrators valued having a dedicated coach and standing meetings that created a regular check-in, with one describing the coach as “*the most beneficial piece.*” Assistant principals also described the Counterpart meetings as a space for honest conversation about the challenges of supporting implementation while balancing the many other responsibilities of an assistant principal. One administrator shared:

I don’t know what I’m going to do without them. That’s one thing I can tell you, and I have expressed this to [the coach], that once the grant is done, I will totally miss my collaborative time with the other two principals... I think that those sessions provided me the space to be vulnerable as an assistant principal, the challenges we encounter every day, but also the passion that moves us.

Another administrator explained that Portico helped normalize the challenges assistant principals were experiencing and made them feel less isolated in the work:

I appreciate it when sharing out the challenges that we've had with not being fully accessible to our teachers or not being able to attend a training that maybe we wanted. Those are the things as assistant principals are expected to happen, but to know that I was not alone facing those challenges, to know that I could feel validated with my other colleagues, [the coach], being a former principal, always gave us that safe space to express how we felt and gave us wonderful articles to read through Portico and the reflection questions, the promoted conversations.

Implementation Successes and Challenges

Administrators and 5Cs Coaches described implementation as strongest when computational thinking could be connected to structures, routines, and priorities that already existed at the schools. In the first year, participants pointed to several factors that helped the project get started, including OCDE's onboarding, communication, and responsiveness. Participants also noted that stipends helped support teacher recruitment. At the school level, existing capstone or portfolio structures gave teachers a place to connect CT-focused units to work students were already expected to complete. One 5Cs Coach described this as a practical advantage because teachers were not building entirely separate projects for the grant:

I think because we had a system in place for teachers collaborating within PLCs projects, right, capstone-worthy projects, right, that system was already there and teachers already knew the components that should be there with a capstone, right. So, when it came time to develop their own projects for the EIR grant, they already knew what was available to them or actually what there needed to be to make something capstone. So, you got double dipping there. We got a project for EIR, and we have something that students could use for their capstone.

Collaboration time was one of the most important implementation supports across the grant period. Administrators and coaches described professional learning sessions, CoP meetings, release days, and planning time as giving teachers space to understand CT, develop units, compare ideas, and refine their work. In Year 2, one assistant principal noted, “*Teachers have benefited from collaborating. They are all learning more than if they worked alone.*” By the final year, administrators continued to identify collaboration time as central to implementation. One administrator explained, “*One of the biggest pieces for our teams here was that time together to really be intentional on how they can highlight and create opportunities for students engage with computational thinking.*”

The main early implementation challenge was helping teachers understand what computational thinking looked like in classroom instruction. Administrators and coaches did not describe teachers as unwilling to participate. Rather, teachers initially needed more concrete examples of how the language of CT connected to instructional practices they already used. One coach explained:

The biggest challenge, and I think it went through until we did the first lesson, was they felt like we had training but there were no examples. They didn't know what they were doing. And I think the people at [OCDE] wanted them to learn by doing it to kind of develop those lessons, but it was a big struggle ... at the beginning of the year. So, the first two days, they were very frustrated. They didn't feel like they took anything home with them like, "Oh, this is what I need to do," and kind of struggled even on our first pull-out day. And then, once they actually did the first lesson, it was like, "Oh, we already do this, but the examples weren't clear from [OCDE]." There was nothing like a project to look at and see, "Can you identify this as computational thinking," or seeing it in practice. ... I think vocabulary and then give an example of how they already use that, not knowing that they're doing it. So, the vocabulary around the steps that you use for computational thinking. And they could say, "This is a vocabulary," and either have them come up with an example, "When do you use that in your math class," so that they can make that correlation. "I already know this. I just didn't know that word for it."

This challenge appeared to lessen over time as teachers implemented units, saw examples from their own classrooms, and received revised supports from the project team. By the final year, administrators described teachers as more engaged and more able to see how computational thinking connected to existing instructional priorities. Administrators also noted that project supports improved over time. One administrator shared that teachers *"could see OCDE getting better and better in terms of the support or taking feedback and making adjustments."* Another described the project as having provided a strong foundation for teachers, saying, *"I think that your grant offered everything that was needed for you to plant the seed in our teachers and to move forward."*

At the same time, implementation continued to be shaped by practical school constraints. In the first year, participants identified meeting timing, substitute teacher availability, and unclear expectations as barriers. Substitute coverage was especially important because teacher release time depended on schools being able to cover classrooms. One coach described how staffing constraints affected planning time:

One major barrier, there was multiple but one of them, and it's outside our realm of control. For example, last week, we had a planning meeting for math teachers. We had to cancel that because we had 25 teachers out and not enough sub coverage, right.

Meeting timing also affected participation, particularly when teachers or coaches were expected to join while traveling between school responsibilities. The issue was not the value of the meetings, but the difficulty of fully engaging under those conditions.

In later years, the challenges shifted toward maintaining continuity. Teacher turnover and staffing instability affected the pool of teachers who could continue or expand the work. One administrator described how staffing changes disrupted implementation:

The first year, I think that what was presented, a lot of teachers wanted to be part of it... unfortunately, at the end of that year, we had a large surplus. So many of those teachers left, went to other schools, some left the district.

Administrators also described their own time constraints as a challenge. Several noted that competing responsibilities limited their opportunities to attend teacher trainings, participate in all project activities, or visit classrooms as often as they would have liked. As a result, administrators often relied on Portico meetings, conversations with teachers, and occasional classroom visits to understand how implementation was unfolding and how they could support participating teachers.

Project Benefits

Administrators and 5Cs Coaches identified benefits for students, teachers, and schools. Across interviews, they described the project as most beneficial when CT was connected to student engagement, teacher collaboration, access to STEM and computer science pathways, and instructional priorities already being emphasized across schools and the district.

For students, administrators described increased exposure to computational thinking, stronger engagement in hands-on learning, and opportunities to see CT as relevant beyond computer science courses. In the first year, one 5Cs Coach described how CT projects increased student voice because students had opportunities to choose what they were investigating. The coach also noted that this choice helped some students who did not see themselves as “*math-inclined*” engage more successfully:

I think the biggest one that we talked about on our last pull-out day was one of the teachers shared that, using computational thinking, it kind of increased. ... The projects that they designed increased student voice, so the students got to choose what they were looking at. And because of that, one of the teachers shared that a student who was not math-inclined, didn't think they were math-inclined, did something and they were like, “Oh, I can do this,” because it interested them. And then a couple of other teachers were like, “Yeah, they were interested in the cups project that they did,” and kind of brought in more student-centered, I guess. So, kids that didn't feel math-inclined were more successful, some of them.

As implementation continued, administrators described more visible examples of student engagement. One assistant principal described observing a chemistry lesson where students designed and tested hot air balloons, noting, “*I hadn't seen that level of engagement in quite some time. Students were explaining their designs, analyzing problems, and were excited to see their projects come to life.*” These examples helped administrators see CT not only as a computer science skill, but as a way to make core academic instruction more engaging and accessible.

By the final year, administrators consistently emphasized that computational thinking should be integrated into core academic content areas rather than limited to standalone computer science

courses. This was central to the project's access strategy: students who might not elect a computer science course could still develop CT skills through math, science, and other required classes. One administrator connected CT integration to the broader technological context students are growing up in:

Computational classes are absolutely aligned with what we are doing with our core subjects. Anything, especially in this generation of students, everything has to do with computerized things, computers, we depend on computers, the artificial intelligence... So, the thought of enhancing the opportunities for our students, especially promoting into our girls, it's fascinating.

Another administrator emphasized the access issue more directly, noting, *"I think if computational thinking was more intentional and integrating it into the core content areas, I think more students would benefit."* A third described computational thinking as a broader way of approaching problems that extends beyond a single class or subject: *"It's a way of thinking, it's a way of addressing issues, or when a problem is presented, of how to view it, what lens to see it... it's not only important in the science and the math class and all the classes, but beyond school."*

Administrators also perceived the project as expanding students' exposure to STEM and computer science pathways, particularly for girls and Latinx students. This perceived benefit was tied less to standalone computer science enrollment and more to the project's broader strategy of introducing computational thinking earlier and in core academic contexts. One administrator described the value of starting in ninth grade and continuing across students' high school experience by saying, *"I like the fact that it starts in freshman year... it follows them to give them those tools that they can apply into all their classes."* In Year 2, one assistant principal also observed increased interest among female students, stating, *"We are seeing more girls wanting to join STEM programs, and they are leaving with a desire to go into the sciences. I didn't see that level of interest last year."*

For teachers, administrators described the project as valuable because it created protected time, structure, and support for teachers to work together on CT integration. The benefit was not only that teachers received professional learning or instructional resources, but that they had time to think through how CT connected to what they were already teaching, develop lessons with colleagues, and rely on one another as they implemented the work. One administrator described this as *"the time that teachers had together to think about what they already do and how they can integrate what's being asked of them."* By the final year, administrators described participating teachers as increasingly collaborative and self-directed, with one administrator noting, *"The cohort of teachers are very self-driven, and they rely on each other too, to come together."* From the administrator perspective, this teacher collaboration was one of the project's most important benefits because it helped move CT from an individual teacher activity toward a shared instructional effort.

At the school level, administrators described the project as helping build awareness of computational thinking and its connection to broader instructional priorities. Administrators noted alignment with district and school priorities related to student voice, inclusive instruction,

Universal Design for Learning, translanguaging, and culturally responsive practices. This alignment helped position computational thinking not as a separate initiative, but as part of a broader instructional improvement effort. One administrator described this alignment by saying:

They're focusing on the same strategies like the UDL, the translanguaging, the student voice... all of those drivers that are being looked at, that are being trained as a whole school, as a whole district.

Sustainability and Lessons Learned

Across years, administrators and 5Cs Coaches described sustainability as depending on whether computational thinking could move from a grant-supported activity to a regular part of schoolwide instructional practice. Early comments were hopeful but cautious. Participants recognized that long-term implementation would depend on whether teachers saw value in CT, had enough confidence and background knowledge to keep using it, and could connect it to work already happening in their classrooms. One 5Cs Coach explained:

It's going to depend teacher on teacher, how much they see value in what they're doing in the classroom and making those connections, right. It might also depend on their own background on CT, right, and what they have experiences with it being able to leave them in. In the bigger picture, I would say three years is up. It might last one or two more years because it is part of their capstone project but those capstones could come and go.

Participants also recognized that sustainability would require the work to move beyond the original group of grant participants. In the first year, one administrator wondered whether the teachers being trained through the project could eventually extend CT concepts *“to the rest of the department or even bring those concepts to the school.”* By the second year, assistant principals were describing sustainability more explicitly as a planning issue. They emphasized the need to move from real-time adjustment to more deliberate implementation. One assistant principal explained:

Right now, we are figuring things out as we go. If we want this to last, we need to develop a structured plan early on instead of making adjustments in real time.

Administrators also described sustainability as depending on whether computational thinking could become part of regular lesson planning and professional learning structures rather than remaining tied to the grant. As one assistant principal explained, *“If computational thinking becomes a norm in lesson planning and curriculum development, then it won't depend on the grant—it will just be how we teach.”* Another connected sustainability to school leadership and professional development structures, noting, *“We need to make sure this doesn't fade away when new initiatives come along. If we embed it into our instructional goals and PD structures, it's more likely to last.”*

Teacher leadership was another recurring sustainability theme. Assistant principals noted that the teachers who participated in the grant had developed knowledge and experience that could support future implementation, particularly for new teachers or colleagues who had not been

part of the original cohort. As assistant principals explained, the work would need to be carried forward by teachers who had firsthand experience implementing CT:

The teachers who have gone through this training now have the expertise, but if we want this to continue, we need a way to train new teachers as they come in.

Having lead teachers who can guide new participants will add value. It's better when teachers hear from their colleagues who have firsthand experience rather than just from administrators.

By the final year, sustainability planning had become more concrete. Administrators discussed embedding CT into school plans, including the School Plan for Student Achievement; continuing collaboration time; using teacher leaders or grant participants as mentors; integrating CT into future professional development; and identifying school or state funds that could help maintain structures established through the grant. One administrator described efforts to connect the project to school planning, saying, *"We try to find ways to kind of braid the grant into our SPSA, our school plan for student achievement to try to keep it sustained where we can."* Administrators also discussed using available school funding to continue supporting the collaboration time, instructional materials, or classroom structures teachers had developed through the project.

Administrators emphasized that sustainability would also require broader awareness and ownership across the school. They recommended involving counselors, additional administrators, and teachers from other content areas so computational thinking would not remain limited to the grant cohort. One administrator suggested adding *"that counseling component to be more real on connecting our students with the meaningful opportunities that this can offer."* Another recommended broader staff awareness, explaining:

I feel like maybe one of the lessons would be for everyone to learn what is computational thinking... so that when the students are going from class to class... at least the other teachers are aware of it.

Administrators also recommended creating shared resources, sample lessons, videos, and content-specific examples to help additional teachers understand what CT integration looks like in practice. One administrator suggested creating *"a bank of resources where teachers can pull from anything like lessons... video clip of a lesson... where they could pull from these different ideas within the different content areas."*

Component 2: Professional Learning for Teachers

The second component of the BTCSEI project focused on professional learning for teachers. Professional learning was designed to introduce participating teachers to computational thinking (CT), support them in integrating CT into core academic instruction, and provide structured time for teachers to collaborate on classroom implementation. Each implementation year began with summer professional learning, during which teachers were introduced to CT concepts and instructional strategies and began planning CT-focused instructional units for use during the

academic year. Throughout each academic year, teachers continued participating in a Community of Practice (CoP). The CoP was designed to support ongoing collaboration, reflection, and continuous improvement as teachers developed, implemented, and refined CT instructional activities. Teacher participation varied by implementation year based on the courses and grade levels included in the project. Year 1 focused on Integrated Math 1 teachers, Year 2 included Integrated Math 2 and Chemistry teachers, and Year 3 included computer science teachers as well as math and science teachers from a variety of domains² who served 11th-grade students. This section presents findings related to teacher participation in professional learning, educator perceptions of professional learning events, and changes in teacher perceptions and practices related to computational thinking.

Teacher Participation

Teacher participation varied by implementation year based on the grade level and courses included in the project. In Year 1, the professional learning series focused on Integrated Math 1 teachers. Fifteen teachers started the project in July 2022; two teachers withdrew from the project, resulting in 13 participating teachers during Year 1 implementation. In Year 2, Integrated Math 2 and Chemistry teachers participated in the professional learning series, with 21 teachers starting the project in July 2023. Three computer science teachers joined the initiative in Spring 2024 and continued throughout Year 3. In Year 3, the continuing computer science teachers and math and science teachers from a variety of domains serving 11th-grade students participated in the project. Twenty-three teachers (including the three computer science teachers) participated in the Year 3 cohort in July 2024; one teacher withdrew from participation, resulting in 22 participating teachers during the final year of implementation.

Each implementation year included summer professional learning, CoP meetings, and instructional release time for school teams to develop, debrief, and refine computational thinking units. Across the grant, OCDE provided 144 hours of professional learning to participating teachers, exceeding the project target of 120 hours. Teacher participation remained high across implementation years, with active cohort sizes ranging from 13 to 22 teachers and few withdrawals once teachers began the project. Table 8 summarizes the professional learning structure by implementation year.

² Year 3 included computer science teachers, as well as math and science teachers from a variety of domains (i.e., Anatomy and Physiology, Physics, AP Physics, AP Biology, AP Chemistry, Integrated Math 3, Math 2/3 Honors, Pre-Calculus, Statistics, Applications of Functions) who serve 11th-grade students.

Table 8. Teacher Professional Learning Hours by Implementation Year

Implementation Year	Active Participating Teachers	Summer Institute Hours	CoP Meeting Hours	Instructional Release Time	Total Professional Learning Hours
Year 1 2022-23	13	12	12	24	48
Year 2 2023-24	21	12	24	12	48
Year 3 2024-25	22	12	24	12	48
Total		36	60	48	144

Note. Active participating teachers reflects the number of teachers who remained active in the project during the implementation year. Two teachers withdrew during Year 1, and one teacher withdrew during Year 3. Computer science teachers joined the initiative in Spring 2024 and continued throughout Year 3.

Perceptions of Professional Learning

Inflexion staff administered event evaluation forms at the conclusion of Summer Institute and CoP meetings across the three implementation years. Overall, attendees reported positive perceptions of the professional learning sessions across all three years, with mean ratings above 4.00 for all items in each year. Across years, the most consistently strong finding was that attendees experienced the Summer Institute/CoP meetings as having a warm and welcoming group environment. This was one of the highest-rated items in each implementation year. Other highly rated items varied somewhat by year, but generally reflected positive perceptions of the meeting environment, opportunities for participation, collaboration with colleagues, and support within the CoP. Although still rated positively, items related to increasing content knowledge and skills were among the lower-rated items across implementation years. Results are presented in Table 9.

Table 9. Overall Perceptions of Project Events by Implementation Year

Statement	Year 1 2022-23			Year 2 2023-24			Year 3 2024-25		
	N	M	SD	N	M	SD	N	M	SD
Objectives									
Objectives for the meeting were clear.	113	4.43	1.02	111	4.50	1.09	137	4.78	0.66
The objectives were accomplished.	125	4.30	0.99	112	4.58	1.03	137	4.64	0.73
Meeting Planning and Logistics									

Statement	Year 1 2022-23			Year 2 2023-24			Year 3 2024-25		
	N	M	SD	N	M	SD	N	M	SD
All necessary pre-materials (agenda or outline, readings) were sent in advance of the meeting.	130	4.55	1.01	112	4.56	1.06	138	4.72	0.77
The day and time of the meeting was convenient.	127	4.18	1.07	112	4.58	1.01	138	4.67	0.72
Pace of the meeting was adequate.	127	4.39	1.02	112	4.60	1.01	138	4.73	0.69
Length of the meeting was adequate.	130	4.45	0.93	112	4.51	1.07	138	4.66	0.72
The structure of the meeting supported and nurtured a collaborative environment.	130	4.55	0.97	112	4.69	0.96	138	4.84	0.57
The meeting was conducted in a way that respected my time.	130	4.63	0.90	112	4.64	0.91	138	4.81	0.65
I had adequate opportunities to express my views, thoughts, and/or ideas during the meeting.	130	4.64	0.96	112	4.77	0.86	138	4.83	0.65
We used our meeting time effectively.	129	4.48	0.98	112	4.62	0.92	138	4.75	0.68
Content									
The content was well organized and easy to follow.	130	4.39	1.06	112	4.59	0.91	137	4.67	0.70
The meeting covered the range of topics I expected it to cover.	130	4.34	1.05	112	4.52	1.00	137	4.63	0.73
The meeting addressed the topics in sufficient detail.	130	4.19	1.06	112	4.60	0.88	137	4.67	0.74
The meeting included time to think carefully about, practice, and evaluate the topics/new ideas being discussed.	129	4.36	1.05	112	4.67	0.89	138	4.74	0.70
I felt encouraged to contribute to the discussion.	129	4.57	0.98	112	4.77	0.86	138	4.81	0.67
The topics and materials were relevant to educators from my content area(s).	130	4.45	0.98	112	4.66	0.89	138	4.73	0.66
I learned from my peers during the meeting.	130	4.48	1.01	112	4.73	0.89	136	4.75	0.66
Interactions with Colleagues									
The Summer Institute/CoP meetings have a warm and welcoming group environment (e.g., attendees greet each other, show genuine interest in each other).	127	4.69	0.90	112	4.77	0.87	137	4.91	0.51

	Year 1 2022-23			Year 2 2023-24			Year 3 2024-25		
Statement	N	M	SD	N	M	SD	N	M	SD
Attendee questions and discussions triggered creative/innovative ways of thinking.	127	4.35	1.03	112	4.65	0.88	136	4.78	0.55
Attendee understandings and reflections frequently drove the direction of the meeting.	127	4.23	1.08	112	4.65	0.88	137	4.66	0.67
Attendees connected material from the meeting to their discipline, class, and/or their own life.	126	4.38	0.93	112	4.66	0.88	137	4.76	0.64
The Summer Institute/CoP meeting resulted in collaboration with colleagues.	127	4.50	0.98	112	4.70	0.90	137	4.85	0.55
I feel supported in my community of practice.	127	4.56	0.91	111	4.70	0.88	136	4.86	0.53
Outcomes									
The meeting increased my content knowledge relative to the topics presented or discussed.	129	4.02	1.13	112	4.42	1.05	137	4.42	0.79
The meeting increased my skills relative to the topic presented or discussed.	129	4.09	1.10	112	4.46	1.00	137	4.45	0.72
The meeting provided me with resources that I can access for future use.	128	4.29	1.00	112	4.53	1.00	137	4.59	0.74
This Summer Institute/CoP meeting was valuable to my teaching practices.	128	4.16	1.02	112	4.54	0.99	137	4.62	0.69
The Summer Institute/CoP meeting was beneficial for moving my thinking about computational thinking forward.	128	4.19	1.09	112	4.57	0.92	136	4.62	0.70
This meeting was a good use of my time.	129	4.20	1.07	112	4.63	0.88	135	4.69	0.67
Intent to Use									
The Summer Institute/CoP meeting met my expectations.	121	4.17	1.09	111	4.54	0.92	135	4.60	0.70
The knowledge and skills that I gained from this meeting can be incorporated into my work.	129	4.28	1.00	112	4.62	0.89	137	4.58	0.74
I feel supported to implement what I have learned in the Summer Institute/CoP meeting.	130	4.33	1.02	112	4.63	0.89	137	4.64	0.75
I will incorporate the new knowledge and/or skills into my teaching.	130	4.35	0.97	112	4.67	0.86	136	4.67	0.68

Statement	Year 1 2022-23			Year 2 2023-24			Year 3 2024-25		
	N	M	SD	N	M	SD	N	M	SD
Quality, Utility, and Relevance									
Overall, the information presented in the meeting was of high quality.	130	4.33	1.00	112	4.64	0.92	137	4.75	0.63
Overall, the information provided was useful.	129	4.35	1.00	112	4.63	0.89	137	4.69	0.66
Overall, the information and activities were relevant to my work.	130	4.34	1.02	112	4.66	0.85	136	4.70	0.66

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Teacher Perceptions and Practices Survey Results

The Teacher Perceptions and Practices Survey was administered to participating teachers at the beginning and end of each implementation year. Because each implementation year included a different teacher cohort, results should be interpreted as annual pre-post findings rather than longitudinal change for the same group of teachers across the full grant period. Survey findings reflect teachers' self-reported knowledge, preparedness, self-efficacy, instructional practices, and perceptions of students. These results provide useful evidence of how participating teachers experienced the professional learning and how their perceptions changed during their year of participation, but they should be interpreted alongside other implementation data, including focus groups, observations, unit artifacts, and project records.

Background and Experience Information

Before completing the survey items related to knowledge, preparedness, self-efficacy, and instructional practices, teachers provided demographic and experience information. As shown in Table 10, respondents represented all three participating schools each year, though the distribution by school varied across cohorts. The composition of participating teachers also shifted as the project expanded across grade levels and content areas. Year 1 respondents were all mathematics teachers, Year 2 included mathematics and science teachers, and Year 3 included mathematics, science, and computer science teachers. Across all three implementation years, most participating teachers were experienced educators, with more than three-quarters of respondents in each cohort reporting 10 or more years of experience.

Table 10. Teacher Demographic and Experience Information by Implementation Year

Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
School						
Anaheim High School	6	46.2%	7	35.0%	9	40.9%

Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
Cypress High School	3	23.1%	8	40.0%	8	36.4%
Loara High School	4	30.8%	5	25.0%	5	22.7%
Other (please specify)	0	0.0%	0	0.0%	0	0.0%
Total	13	100.0%	20	100.0%	22	100.0%
Gender						
Female	5	38.5%	11	55.0%	13	59.1%
Male	8	61.5%	9	45.0%	9	40.9%
Nonbinary	0	0.0%	0	0.0%	0	0.0%
Other (please specify)	0	0.0%	0	0.0%	0	0.0%
I choose not to respond	0	0.0%	0	0.0%	0	0.0%
Race(s)/Ethnicity (please select all that apply)						
American Indian or Alaska Native	0	0.0%	0	0.0%	0	0.0%
Asian or Asian American	5	38.5%	6	30.0%	6	27.3%
Black or African American	0	0.0%	1	5.0%	0	0.0%
Hispanic or Latinx	4	30.8%	6	30.0%	5	22.7%
Middle Eastern or Northern African	0	0.0%	1	5.0%	1	4.5%
Native Hawaiian or Other Pacific Islander	2	15.4%	0	0.0%	0	0.0%
White	2	15.4%	7	35.0%	11	50.0%
Other (please specify)	0	0.0%	0	0.0%	0	0.0%
I choose not to respond	0	0.0%	0	0.0%	0	0.0%
Subject (select all that apply)						
Mathematics	13	100.0%	7	35.0%	9	40.9%
Science	0	0.0%	13	65.0%	11	50.0%
Computer Science	0	0.0%	0	0.0%	3	13.6%
Other (please specify)	1	7.7%	2	10.0%	0	0.0%
Years of Experience as an Educator						
Less than 2 years	0	0.0%	0	0.0%	1	4.5%
2-5 years	1	7.7%	2	10.0%	2	9.1%
6-9 years	2	15.4%	2	10.0%	2	9.1%
10 years or longer	10	76.9%	16	80.0%	17	77.3%
I choose not to respond	0	0.0%	0	0.0%	0	0.0%
Years of Experience at Current School						
Less than 2 years	2	15.4%	0	0.0%	1	4.5%
2-5 years	1	7.7%	4	20.0%	3	13.6%

Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
6-9 years	2	15.4%	1	5.0%	3	13.6%
10 years or longer	8	61.5%	15	75.0%	15	68.2%
I choose not to respond	0	0.0%	0	0.0%	0	0.0%

Teacher Knowledge Related to Computational Thinking

Teachers rated their knowledge of computational thinking on a 4-point scale from *Not at All Knowledgeable* to *Extremely Knowledgeable*. As shown in Table 11, teachers reported increases in knowledge across all five items in each implementation year. These items focused on how computational thinking applied to teachers' subject areas, identifying and defining real-world problems, formulating solutions as sequential steps or rules, understanding the capabilities and limitations of computers, and evaluating whether a solution is fit for its intended purpose.

Table 11. Teacher Knowledge Related to Computational Thinking by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
How computational thinking applied to your subject area.	2.15	0.90	2.92	0.64	2.25	0.91	3.15	0.67	2.32	0.95	3.41	0.50
Identifying and/or defining real-world problems. (i.e., ambiguous and complex)	2.23	0.60	2.85	0.55	2.50	0.61	3.10	0.64	2.64	0.79	3.32	0.65
Formulating solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination.	2.31	0.75	3.15	0.55	2.25	0.79	3.30	0.80	2.45	0.86	3.23	0.69
Understanding the capabilities and limitations of computers.	2.46	0.78	2.92	0.49	2.10	0.72	2.80	0.70	2.45	0.86	3.05	0.84

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Evaluating that a solution is fit for its intended purpose.	2.31	0.48	3.08	0.49	2.45	0.94	3.05	0.60	2.73	0.94	3.32	0.72

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

A Teacher Knowledge scale score was calculated by averaging across the five items. Across all three cohorts, teachers began the year between *somewhat* and *moderately knowledgeable* about computational thinking and ended the year closer to *moderately knowledgeable* or higher. As shown in Figure 4, average knowledge scores increased from pre- to post-survey in each implementation year. In Year 1, average scores increased from 2.29 to 2.98. In Year 2, average scores increased from 2.31 to 3.08. In Year 3, average scores increased from 2.52 to 3.26. These increases were statistically significant each year: Year 1, $t(12) = -5.27$, $p < .001$, Cohen's $d = 1.46$; Year 2, $t(19) = -5.59$, $p < .001$, Cohen's $d = 1.25$; and Year 3, $t(21) = 6.49$, $p < .001$, Cohen's $d = 1.38$.

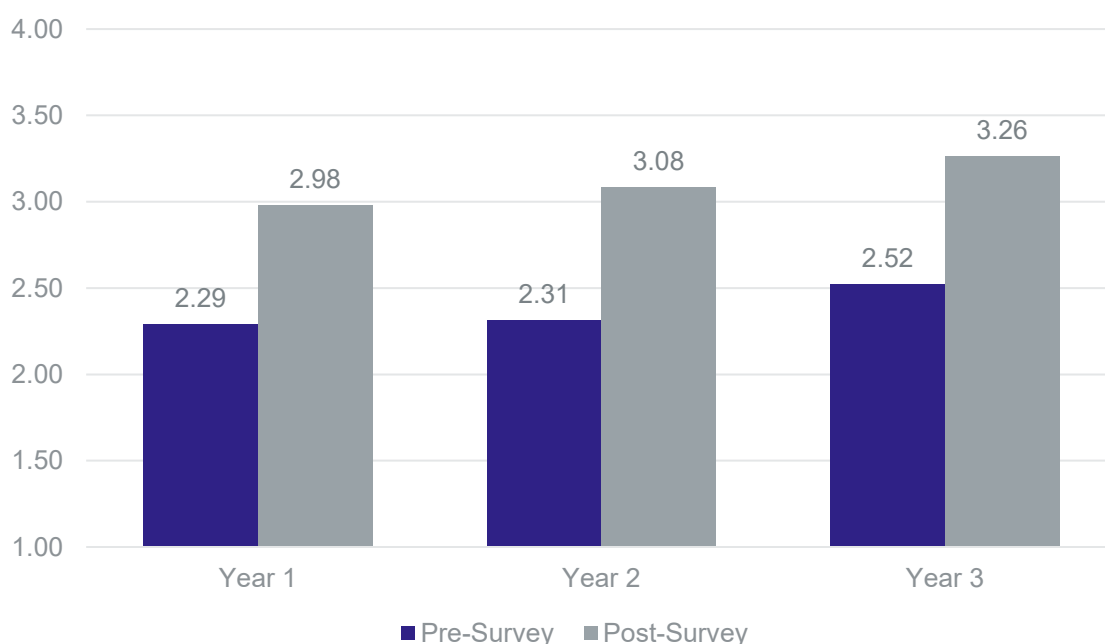


Figure 4. Average Teacher Knowledge of CT by Administration Across Years

Teacher Preparedness

Teachers also rated their preparedness to use computational thinking strategies and equitable teaching practices on a 4-point scale from *Not Adequately Prepared* to *Very Well Prepared*. Preparedness items were organized into two areas: Computational Thinking Preparedness and Equitable Teaching Practices Preparedness. The computational thinking items focused on teachers’ preparedness to embed CT into their subject area and instruct students in CT-related problem-solving practices. The equitable teaching practices items focused on teachers’ preparedness to use inclusive teaching practices, culturally responsive pedagogy, Universal Design for Learning (UDL), growth mindset, student agency, and related strategies. As shown in Table 12, teachers reported higher preparedness at post-survey than pre-survey across nearly all items in each implementation year. In general, teachers began the year reporting that they were *somewhat prepared* and ended the year reporting that they were closer to *fairly well prepared* or *very well prepared*. Gains were evident for both CT-focused instructional practices and equitable teaching practices.

Table 12. Teacher Preparedness for Computational Thinking and Equitable Teaching Practices by Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Embed computational thinking into your subject area.	1.69	0.48	3.00	0.71	2.00	0.79	2.95	0.60	2.23	1.02	3.14	0.64
Instruct students on how to identify and/or define real-world problems. (i.e., ambiguous and complex)	2.08	0.64	3.15	0.55	2.20	0.77	3.10	0.55	2.18	0.85	3.00	0.63
Instruct students on how to formulate solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination.	2.15	0.69	3.15	0.55	2.05	0.83	2.90	0.55	2.27	1.03	3.09	0.68

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Instruct students on the capabilities and limitations of computers.	1.92	0.76	2.62	0.65	1.75	0.72	2.40	0.60	2.09	1.02	2.86	0.83
Instruct students on how to evaluate that a solution is fit for its intended purpose.	2.23	0.60	3.00	0.43	2.25	0.79	2.90	0.45	2.24	0.89	3.10	0.62
Use inclusive teaching practices in your instruction.	2.62	0.77	3.31	0.63	2.80	0.70	3.40	0.50	2.68	0.78	3.36	0.49
Use culturally responsive pedagogy in your classroom.	2.31	1.03	3.08	1.00	2.65	0.81	3.20	0.70	2.36	0.90	2.95	0.65
Use Universal Design for Learning (UDL) in your classroom.	2.23	1.09	3.23	0.93	2.30	0.73	3.30	0.47	2.18	1.01	3.32	0.72
Meet the needs of diverse learners.	2.85	0.69	3.46	0.66	2.65	0.59	3.20	0.70	2.50	0.74	3.27	0.46
Tie student learnings into the context of culture.	2.31	1.11	3.08	0.95	2.45	0.51	3.00	0.65	2.23	0.75	2.68	0.65
Address inequities in STEM education and/or careers.	2.00	0.71	2.77	0.93	2.25	0.64	2.75	0.72	2.10	0.62	2.86	0.64
Emphasize and model a growth mindset.	2.69	1.03	3.15	0.80	2.90	0.79	3.40	0.50	2.77	0.81	3.36	0.58
Act as a facilitator, allowing students agency in their learning.	2.46	0.97	3.08	0.86	2.75	0.79	3.35	0.49	2.55	0.86	3.18	0.59

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Scale scores were calculated for both preparedness constructs. As shown in Figure 5, teachers reported statistically significant gains in preparedness to use computational thinking in teaching across all three implementation years: Year 1, $t(12) = -8.17$, $p < .001$, Cohen's $d = 2.27$; Year 2, $t(19) = -5.49$, $p < .001$, Cohen's $d = 1.23$; and Year 3, $t(21) = 5.82$, $p < .001$, Cohen's $d = 1.24$. Teachers also reported statistically significant gains in preparedness to use inclusive practices: Year 1, $t(12) = -4.87$, $p < .001$, Cohen's $d = 1.35$; Year 2, $t(19) = -5.93$, $p < .001$, Cohen's $d = 1.33$; and Year 3, $t(21) = 5.66$, $p < .001$, Cohen's $d = 1.21$. Together, these findings suggest that teachers ended each implementation year feeling more prepared to integrate computational thinking and use inclusive instructional practices.

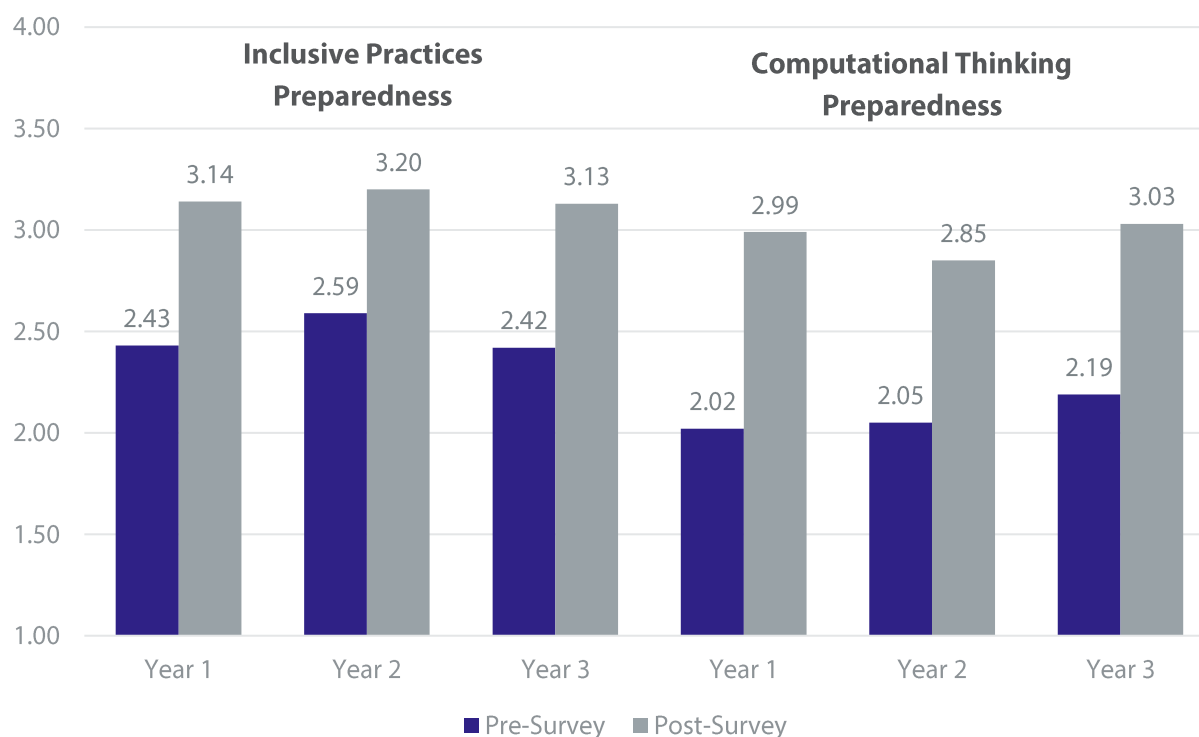


Figure 5. Average Teacher Preparedness by Administration Across Years

Teacher Self-Efficacy for Teaching Computational Thinking

Teachers rated their self-efficacy for teaching computational thinking on a 5-point scale from *Strongly Disagree* to *Strongly Agree*. As shown in Table 13, teachers reported increases from pre- to post-survey across the self-efficacy items in each implementation year. Teachers reported particularly high post-survey agreement with items related to welcoming student questions during CT activities, being able to answer students' questions, feeling confident using a CT concept again after teaching it once, and continually finding better ways to integrate CT into their subject area. Across cohorts, these results suggest that teachers not only reported greater confidence in their own CT knowledge but also increased confidence in facilitating CT-related learning with students.

Table 13. Teacher Self-Efficacy for Teaching Computational Thinking by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
When using computational thinking strategies, I welcome student questions.	3.85	1.41	4.83	0.39	4.60	0.50	4.80	0.41	4.55	0.96	4.73	0.88
At this time, I feel I have the necessary skills to teach computational thinking in my discipline.	2.92	1.04	4.17	0.58	3.10	1.02	4.30	0.57	3.14	1.25	4.14	0.99
I am typically able to answer students' questions during computational thinking activities.	3.46	0.78	4.42	0.90	3.32	0.89	4.50	0.61	3.19	1.21	4.41	0.80
At this time, I would feel comfortable inviting my administrator to evaluate my use of computational thinking in my discipline.	2.62	0.96	3.83	0.83	2.85	1.27	4.10	0.85	2.77	1.15	4.05	1.00
I feel comfortable improvising during computational thinking activities.	3.15	0.90	4.08	1.00	3.35	1.09	4.15	0.81	3.41	1.18	4.32	0.99
I teach computational thinking concepts as well as I teach most other concepts in my content area.	3.08	0.76	3.83	0.83	2.75	1.02	3.95	0.69	2.62	1.28	3.91	1.02

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
After I have taught using a computational thinking concept once, I feel confident using it again.	3.38	0.65	4.33	0.49	3.40	0.94	4.25	0.97	3.52	1.17	4.27	0.77
I know the steps necessary to teach effectively using computational thinking concepts.	2.54	0.78	3.92	0.79	2.45	1.05	3.95	0.76	2.55	1.22	4.09	0.87
I explain to students how computational thinking activities relate to the content of the course.	3.08	0.76	4.17	0.39	2.70	1.13	4.20	0.62	2.59	1.44	4.14	0.77
I am continually finding better ways to integrate computational thinking in my subject area.	3.23	0.73	4.33	0.49	3.00	1.08	4.55	0.51	2.95	1.50	4.32	0.78
I generally apply computational thinking strategies effectively.	2.85	0.56	4.00	0.60	2.70	1.03	4.05	0.69	2.82	1.26	4.10	0.94
I understand computational thinking concepts well enough to integrate them into my content area effectively.	2.62	0.96	4.08	1.00	2.50	1.00	4.00	0.73	2.73	1.35	4.18	0.85
I know how to make students interested in my content area using computational thinking.	2.92	0.90	3.75	0.62	2.70	0.98	4.10	0.64	2.64	1.18	3.86	0.94

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

A Teacher Self-Efficacy scale score was calculated by averaging across the items. As shown in Figure 6, average self-efficacy scores increased from 3.01 to 4.13 in Year 1, from 3.04 to 4.22 in Year 2, and from 3.04 to 4.19 in Year 3. These increases were statistically significant each year: Year 1, $t(11) = -6.50$, $p < .001$, Cohen's $d = 1.88$; Year 2, $t(19) = -7.49$, $p < .001$, Cohen's $d = 1.67$; and Year 3, $t(21) = 4.77$, $p < .001$, Cohen's $d = 1.02$. This suggests that teachers became more confident in their ability to teach computational thinking after participating in the project.

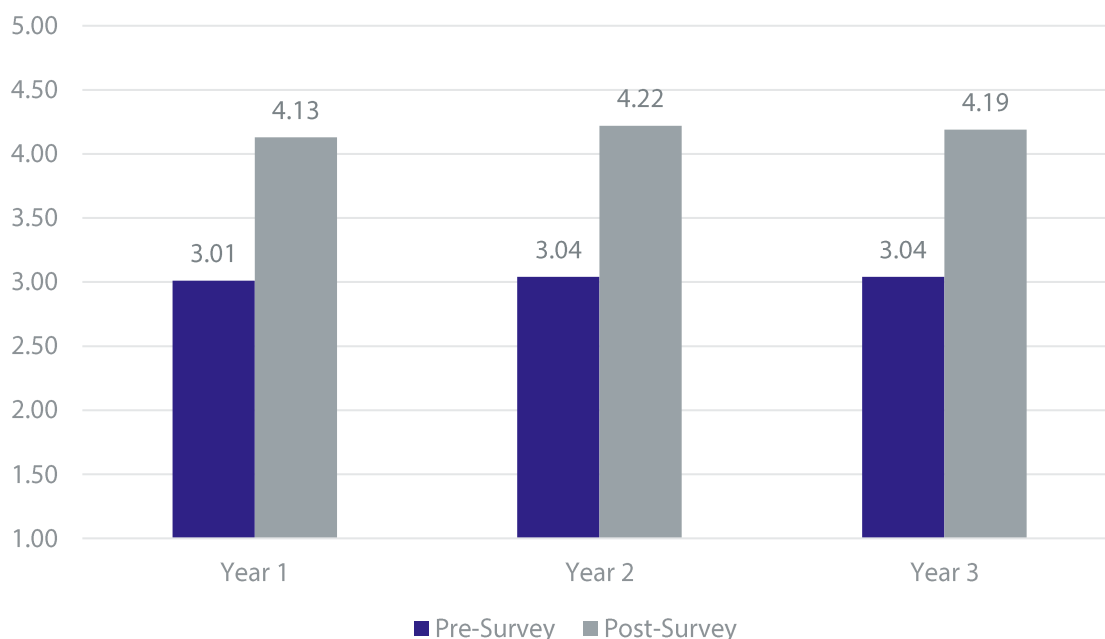


Figure 6. Average Teacher Self-Efficacy for Teaching Computational Thinking by Administration Across Year

Instructional Practices

Teachers also reported how frequently they used instructional practices aligned with computational thinking, using a 5-point scale from *Never* to *Daily*. As shown in Table 14, reported use of CT-aligned instructional practices generally increased from pre- to post-survey across the three implementation years. These results suggest that teachers reported using a wider range of CT-related strategies more frequently by the end of their participation year. Some practices were already used relatively often at baseline, including allowing students to manage their own work time, encouraging students to assess different approaches or solutions to a problem, emphasizing social and emotional learning, and providing students with multiple means of engagement. Other practices began at lower levels and showed growth during the year, including asking students to use computational models, design or assess computational models, prepare problems for computational solutions, create computational abstractions, and engage in programming-related activities. These patterns suggest that teachers entered the project already using some student-centered and problem-solving practices, while more CT-specific instructional practices became more common after participation.

Table 14. Frequency of Teacher Instructional Practices by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Ask students to set their own goals for learning.	2.92	0.86	3.17	1.11	2.05	0.89	3.00	0.86	2.14	1.04	2.82	1.14
Allow students voice and choice on projects and assignments.	2.46	0.97	3.33	0.89	2.60	0.94	3.25	0.97	2.76	1.00	3.09	0.68
Allow students to manage the work on their own projects without telling them what they should be doing.	1.85	1.07	3.25	1.14	2.40	1.27	3.10	1.17	2.73	1.08	3.23	1.31
Allow students to manage their own work time.	3.69	1.44	4.00	0.95	3.40	1.31	3.70	1.17	3.41	1.40	3.91	1.23
Ask students to engage in data practice such as collecting or creating data, manipulating data, and analyzing and visualizing data.	2.23	0.93	2.75	0.62	3.05	1.10	3.70	0.57	3.18	1.10	3.68	1.09
Ask students to use computational models to understand a concept.	1.77	1.01	2.75	1.06	2.60	1.19	3.60	0.68	2.68	1.21	3.59	0.85
Ask students to design, construct, and/or assess computational models.	1.38	0.65	2.75	1.22	1.90	0.85	2.95	0.89	2.36	1.18	2.95	1.13
Ask students to use computational models to find and test solutions.	1.62	0.77	2.75	1.22	1.70	0.86	3.05	1.08	2.27	1.12	3.32	1.13
Encourage students to prepare problems for computational solutions.	1.54	0.66	2.67	1.56	1.85	1.18	2.85	1.18	2.33	1.32	3.09	1.31
Engage students in activities related to and/or including programming.	1.38	0.65	1.92	1.00	1.25	0.55	2.20	1.28	1.95	1.29	2.55	1.47

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Assist students in selecting effective computational tools.	2.38	1.33	2.73	1.01	1.80	1.20	2.70	1.13	2.41	1.37	3.23	1.23
Encourage students to assess different approaches/solutions to a problem.	3.92	1.26	4.08	1.00	2.85	1.39	3.60	0.99	3.14	1.39	4.00	0.84
Ask students to develop modular computational solutions.	1.77	1.30	2.00	1.34	1.60	0.94	2.35	1.23	2.32	1.13	3.09	1.27
Ask students to create computational abstractions.	1.54	0.97	2.00	1.41	1.25	0.79	2.20	1.15	1.91	1.27	2.64	1.43
Encourage students to problem solve (e.g., troubleshooting, debugging) when something didn't work the way they wanted it to work.	3.54	1.45	3.83	1.19	3.11	1.49	3.85	0.99	3.76	1.34	3.91	0.97
Help students engage in systems-level thinking, including investigating a complex system as a whole, understanding the relationships within the system, thinking in levels, communicating information about the system and/or defining systems and managing complexity.	1.92	1.04	2.67	1.07	2.25	1.29	3.50	0.83	2.68	1.36	3.82	0.96
Help students connect what they are learning in a lesson or classroom activity to their own life.	3.46	0.78	4.00	0.85	3.35	1.09	4.05	0.89	3.32	0.95	3.73	0.77
Help students to connect what they are learning in a lesson to other disciplines.	3.17	0.94	3.17	0.83	3.15	1.09	3.70	0.80	2.95	0.79	3.64	0.79

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Emphasize social and emotional learning such as social awareness, relationship skills, self-awareness, and self-management.	3.54	1.45	4.00	0.85	3.30	1.13	3.80	0.83	2.86	1.15	3.45	1.01
Provide students with multiple means of engagement.	3.92	0.86	4.45	0.82	3.95	1.05	4.20	0.77	3.64	1.26	4.27	0.63
Provide students with multiple means of representation.	3.23	1.09	3.75	1.14	3.50	1.36	3.90	0.85	3.14	1.28	4.00	0.76
Provide students with multiple means of action and/or expression	3.23	1.09	3.58	1.24	3.60	1.19	3.85	0.88	3.18	1.10	3.86	0.83

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Teacher Perceptions of Students

Teachers were also asked about their perceptions of students' motivation and career awareness in the courses where they were implementing CT-related instruction. As shown in Table 15, teachers generally reported more positive perceptions of students at post-survey than pre-survey across implementation years. These items focused on students' motivation, understanding of how their interests relate to future career pathways, confidence in reaching career goals, awareness of available career pathway opportunities, and ability to identify resources or steps needed to reach career goals. Across cohorts, teachers reported the strongest post-survey ratings for students' awareness of career pathway opportunities and students' understanding of how their interests relate to future career pathways. Teachers also reported increases in perceptions that students could identify the resources or steps needed to reach their career goals.

Table 15. Teacher Perceptions of Students by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
My students are motivated to make things happen for themselves.	3.23	1.09	3.62	0.87	3.10	1.21	3.60	0.82	3.36	0.95	3.55	1.06

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
My students understand how their interests relate to their future career pathways.	3.15	0.90	3.92	0.64	3.00	0.97	3.95	0.83	3.41	0.96	3.77	1.07
My students are confident that they will reach their career goals.	3.31	0.75	3.46	0.78	2.85	0.99	3.55	0.69	3.32	0.99	3.73	0.98
My students are aware of the career pathway opportunities that are available to them.	3.08	1.12	3.92	0.76	2.90	1.12	4.00	1.03	3.18	1.05	4.09	0.61
My students can identify the specific resources or steps that they need to take to reach their career goals.	2.92	0.95	3.31	0.75	2.80	0.95	3.60	0.75	3.00	1.02	3.86	0.89

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Perceptions of Computational Thinking Professional Learning Experiences

On the post-survey, teachers rated their professional learning experiences related to computational thinking on a 5-point scale from *Strongly Disagree* to *Strongly Agree*. As shown in Table 16, teachers reported positive perceptions of the professional learning across all three implementation years. Ratings were consistently high for the extent to which professional learning provided time to think through, try, and evaluate new ideas; was valuable to teachers' practice; increased teaching effectiveness; supported changes in teaching methods; and included support for implementation. Teachers also reported that professional learning contributed to collaboration, particularly with colleagues in their own school during Years 1 and 2 and with colleagues across schools throughout the project. Ratings for coherence and connection to school improvement plans were somewhat lower than other areas, particularly in Year 1, but remained positive and increased in Years 2 and 3. Overall, teacher ratings suggest that the professional learning was perceived as relevant, useful, and supportive of classroom implementation.

Table 16. Perceptions of Computational Thinking Professional Learning Experiences by Year

Statement: “My professional learning experiences related to computational thinking have...”	Year 1 2022-23 (N = 13)		Year 2 2023-24 (N = 20)		Year 3 2024-25 (N = 22)	
	M	SD	M	SD	M	SD
been sustained and coherently focused, rather than short-term and unrelated	3.77	0.83	4.25	0.79	4.23	0.81
included time to think carefully about, try, and evaluate new ideas	4.15	0.90	4.70	0.57	4.64	0.66
been closely connected to my school’s improvement plan	4.00	0.91	4.05	0.83	4.18	0.73
resulted in more collaboration with colleagues in my school	4.77	0.44	4.75	0.55	4.18	1.01
resulted in more collaboration with colleagues in other schools	4.31	0.95	4.10	0.91	4.32	1.04
included the support necessary to implement what I have learned	4.38	0.77	4.40	0.68	4.27	1.08
been valuable to my practice as a teacher	4.54	0.66	4.65	0.59	4.45	0.91
increased my teaching effectiveness	4.38	0.65	4.60	0.68	4.41	0.96
led to changes in my teaching methods	4.38	0.65	4.45	0.94	4.41	0.96
included follow-up support as I implement what I have learned	4.69	0.48	4.30	0.86	4.32	0.89

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Perceptions of Communities of Practice (CoP)

Also on the post-survey, teachers also rated their perceptions of the CoPs. As shown in Table 17, teachers reported positive perceptions of the CoP structure across all three implementation years. Across cohorts, teachers generally agreed that the CoPs supported shared understanding of CT, collaboration with colleagues, knowledge exchange, and discussion of implementation challenges. Ratings were highest in Year 2 and remained positive in Year 3, though with somewhat more variation across items. Overall, teachers’ responses suggest that the CoPs were perceived as a useful structure for collaboration, support, and continued learning during implementation.

Table 17. Perceptions of Communities of Practice (CoP) by Year

Statement	Year 1 2022-23 (N = 13)		Year 2 2023-24 (N = 20)		Year 3 2024-25 (N = 22)	
	M	SD	M	SD	M	SD
Members of the CoP share a common goal to create inclusive classroom environments that sustain engagement from women and Latinx youth	4.69	0.48	4.80	0.52	4.27	1.08
Members of the CoP share a common goal to improve students' CT	4.77	0.44	4.85	0.49	4.36	1.09
Members of the CoP share a common understanding of the terminology and concepts related to CT	4.62	0.51	4.75	0.44	4.32	0.84
Members of my CoP have a variety of experiences and expertise	4.69	0.63	4.85	0.37	4.55	0.96
The CoP facilitated a knowledge exchange among members	4.62	0.51	4.85	0.37	4.45	0.86
The CoP fostered trust and respect among members through frequent interactions	4.69	0.63	4.85	0.37	4.50	0.96
My CoP provided the opportunity to develop multi-disciplinary relationships with other educators	4.00	1.08	4.55	0.60	4.27	1.08
My CoP provided the opportunity to establish lasting connections with educators from other schools	4.00	1.00	4.60	0.50	4.18	1.01
Participation in the CoP helped to alleviate my feelings of professional isolation	4.38	0.65	4.65	0.67	3.77	1.27
My CoP provided valuable professional learning opportunities that increased my effectiveness as an educator	4.23	0.73	4.80	0.41	4.41	1.05
The CoP provided me with an opportunity to discuss challenges in a nonjudgmental environment	4.62	0.65	4.85	0.37	4.27	1.16
I feel supported by my CoP	4.85	0.38	4.85	0.37	4.36	1.05
The CoP improved my ability to support my female students	4.38	0.87	4.60	0.60	4.09	1.06
The CoP improved my ability to support my Latinx students	4.38	0.87	4.55	0.69	4.09	1.06

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Obstacles to Implementation

Finally, teachers identified obstacles they encountered in implementing the project. As shown in Table 18, reported obstacles changed over time. In Year 1, the most frequently reported

obstacles were related to needing more guidance and examples for incorporating CT into the mathematics curriculum and creating CT-specific units. These findings are consistent with the early stage of implementation, when teachers were still developing a shared understanding of CT and how it could be integrated into existing coursework. By Year 3, the most frequently reported obstacle was not having enough time to plan and prepare lessons that incorporated computational thinking. This pattern suggests that as teachers became more familiar with CT and had more examples and supports available, implementation challenges shifted from understanding what to do toward having enough time to plan and carry out the work.

Table 18. Percentage of Participating Teachers Encountering Obstacles to Implementation by Year

Obstacle Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
I have not encountered any obstacles	2	15.4%	3	15.0%	3	13.6%
Not enough knowledge/understanding of computational thinking	6	46.2%	7	35.0%	3	13.6%
Not enough time to plan and prepare lessons that incorporate computational thinking	3	23.1%	7	35.0%	9	40.9%
Not enough time to implement lessons that incorporate computational thinking	5	38.5%	3	15.0%	3	13.6%
Not enough guidance on how to incorporate computational thinking units into Math curriculum	9	69.2%	1	5.0%	5	22.7%
Resources/materials/trainings are not high quality and/or easy to use	1	7.7%	0	0.0%	2	9.1%
Not enough examples and/or guidance on how to create computational thinking units or examples specific to computational	9	69.2%	5	25.0%	4	18.2%
Not enough examples and/or guidance on how to connect computational thinking to computer science and computer science pa	6	46.2%	7	35.0%	4	18.2%
Generally, too much information to easily digest and incorporate into teaching practices	1	7.7%	2	10.0%	4	18.2%
Not enough support from school leadership	2	15.4%	1	5.0%	1	4.5%
Not enough support from district leadership	2	15.4%	0	0.0%	2	9.1%
Not enough training or support from OCDE	2	15.4%	0	0.0%	0	0.0%

Obstacle Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
Student resistance to completing computational thinking units	7	53.8%	4	20.0%	4	18.2%
Unfinished student learning due to the COVID-19 pandemic	3	23.1%	1	5.0%	6	27.3%
I choose not to respond	0	0.0%	1	5.0%	0	0.0%
Other (please specify)	2	15.4%	2	10.0%	2	9.1%

Teacher Focus Groups

Teacher focus groups were conducted annually to understand teachers' experiences with the BTCSEI project and the implementation of computational thinking instruction. Across the three years, focus groups explored teachers' recruitment and initial understanding of the project, perceptions of professional learning and collaboration, implementation of computational thinking units across courses, perceived successes and benefits for teachers and students, and challenges and areas for continued support.

Recruitment and Initial Understanding of the Project

Teachers entered the project through different pathways and with varying levels of understanding about the project's purpose. Recruitment was often connected to the course teachers were assigned to teach as the project followed the student cohort into later math, science, and computer science coursework. In the first year, Integrated Math 1 teachers generally understood that they had been invited because of their course assignment, but many were less clear about the full purpose of the grant or how computational thinking connected to computer science equity. One teacher explained, *"We were told that Math 1 teachers will be part of this project. We were not forced, so it was our choice."* Another described the recruitment process more informally: *"We just walked in. We went in the principal's office. He just told us, and we said, 'Okay, we'll do this. We'll try it.'"* For some teachers, the project was something they were willing to try before they fully understood what participation would involve. As one teacher put it, *"I honestly didn't know what I was getting myself into, but I'm open for the challenge."*

Teachers' early understanding of the grant often included broad references to computational thinking, STEM, computer science, Latinx students, or underrepresented student groups, but the relationship among those ideas was not always clear at the start. In one focus group, teachers described that early understanding this way:

Teacher 1: The only thing I knew, it was to help Latinx students and ...

Teacher 2: STEM-related.

Teacher 1: ... get them towards more STEM-related careers. I think, in particular, it was computer science. But as we're doing this work, I noticed that it was not just Latinx students. I was like, "Oh, that's not what I had [thought] ... when I first was told about it."

Teacher 3: I would agree. I had a very loose, vague idea of what this EIR grant was about. I know that computer science was thrown around because [of] computational thinking. But I had a nebulous idea of what that actually entailed and what that would look like in the classroom.

This pattern continued as new teachers joined in later years. Some teachers entered with only a general sense that they would be developing and implementing a computational thinking unit. Others joined because they saw the project as a chance to collaborate with colleagues, try something new with students, or participate once the project reached the grade level or course they were teaching. One science teacher recalled being interested in the project, but unsure what implementation would involve:

They kind of gave us a very brief description of what it is, like computational thinking. So, I was intrigued. So that's why I kind of signed up. But no, not really. I didn't have really any idea of what we were getting into. I knew they were going to ask us to design a unit around it and whatnot, but I didn't really know, oh, what is computational thinking? What do we need to do about that?

For other teachers, recruitment was more directly connected to the project's movement across grade levels. One math teacher explained that they had known about the grant because of their department chair role, but had not previously participated because they were not teaching the relevant grade level:

I heard of the grants because I was a department chair, so I got an overview and I knew that it was the freshmen one year. Then the next year, the sophomores, then the juniors, I just hadn't been part of it. I wasn't teaching those grades. So, this year I'm teaching the apps of functions class, which are juniors. So, then I signed up for it.

Computer science teachers entered the project from a different starting point. Because computational thinking was already central to their courses, their questions were less about whether CT fit their instruction and more about how CT integration in math and science was expected to support the project's broader computer science goals. One CS teacher explained that their initial understanding was that the grant was intended to increase computer science enrollment among students of color and female students, but later reflected, *"It seems to me the goal is to increase computational thinking awareness in science and math classes."* This distinction mattered because teachers saw CT integration in core classes and computer science enrollment as related goals, but not the same goal.

Across years, the summer professional learning sessions played an important role in clarifying the project. In the first year, one teacher shared, *"When we went into those training days in*

August, that clarified a lot of things in relation to what is computational thinking.” Another described the shift that occurred during the Summer Institute:

When we did the summer thing, we said, “You know what? All the stuff that we were talking about, we already do in our classroom. So, I don’t know how things are going to change much.” But then we did realize that there is so much more thinking that they can do. They can look at problems a different way. Because when we do word problems in class, I never tell them to read the problem. I say, “Hey, just take the numbers and just work the numbers only.” And what’s interesting is because we’ve done that, our kids tend to always break down problems now. ... So, it’s worked out really well.

For many teachers, this was the central early realization: computational thinking was not entirely separate from their existing instruction. Rather, the project provided vocabulary, structure, and intentionality for practices they were already using or could strengthen. The summer training also helped teachers understand that the project was not only about CT in math, but about the relationship between CT, computer science, and equitable access to future opportunities. One exchange captured that moment of clarification:

Teacher 1: What shocked me in the August training was the connection between CT with the computer science element.

Teacher 2: I had no idea when we said ... and it didn’t change my opinion. It was like, “Oh, this has to do with computer science really and getting certain demographics, etc.” So, that I had no idea, and that was a little bit of a surprise. Not a bad one, but I...

Facilitator: Sure. It’s just it wasn’t ... that wasn’t clear to you before.

Teacher 2: It wasn’t. And when we started talking about computer science, I’m like, “Wait a minute. I’m a math teacher.”

Teacher 1: Yeah, same thing.

Teacher 3: Those two days of training were invaluable. Because, okay, you’re math teachers. Computational thinking. But what you do in your classroom, we want to see if we can then expand it to obviously the whole purpose of the grant. That’s where it made sense.

Teachers in later cohorts described a similar realization. A Year 2 teacher summarized the shift this way:

It was kind of nice to see that a lot of our lessons had some of those ideas in there, we just had never put it in that kind of frame. And so, a lot of our stuff is still really just highly relevant. And we were actually kind of proud of ourselves. We’re like, “Oh, look, we already do that. We already do that.” There was

obviously plenty of things that we could add, but yeah, it was nice to kind of see that we kind of already knew a lot of the stuff, just didn't have the framework.

By the final year, teachers' descriptions suggest that the project had become more familiar within participating schools, but onboarding still mattered. Some teachers had heard about the grant in earlier years, some were recruited by administrators or colleagues, and others joined because the project had reached the course they were teaching. One teacher recalled being told that the grant involved building and sharing lesson plans and thinking, *"that sounds great for my first year. Let's do that."* At the same time, teachers continued to enter the project with different levels of clarity about what computational thinking meant and what they would be expected to design or implement.

Perceptions of Professional Learning and Collaboration

Across the three years, teachers generally described the professional learning as useful when it was practical, collaborative, and connected to the work of developing CT units. Teachers valued the Summer Institute, CoP meetings, release days, and support from OCDE staff when those structures helped them define CT, identify where it already appeared in their instruction, and make decisions about how to design or refine classroom activities.

In Year 1, teachers described the Summer Institute as helpful because it gave them time to develop a shared understanding of CT before the school year began. They also appreciated that the training moved from definition to application. One teacher explained:

One of the things I liked, that during the summer was defining what is computational thinking, like the little summary page they gave us, because it says, "These are different avenues that you can go down." I thought that was very nice. But I think also what really helped out was ... they quickly turned it to like, ... "Find something that you think can relate to one of these and start going with it." And so that just made it nice for us.

Teachers also valued opportunities to talk with colleagues within and across schools, share ideas, and hear how others were approaching similar challenges. In Year 1, one teacher described the cross-school collaboration as useful because it allowed teachers to compare ideas and recognize that other schools were working through similar implementation questions:

We had a much more organic experience being able to talk to other schools and have that collaborative piece. ... There was a lot of good conversations going around and ideas that were thrown around. ... And also really affirming to see similar challenges across different schools.

In Year 2, teachers again described professional learning as helpful when it gave them time to understand CT expectations, think through the purpose of the work, and begin planning with colleagues. One chemistry teacher described the importance of having time to work through both the CT expectations and the project's equity goals:

I definitely benefited the most from having time to kind of wrap my head around what it is that we needed to do with computational thinking. So, the COPs were really good because that was actual time to work and think. It's hard to be creative when you're on the go the whole time. And so, the PDs that were given initially were really great at breaking down some of my apprehension in terms of what was intended for gearing this towards young ladies and gearing this towards the minority demographic. So going through that PD really helped me feel a little less defensive, if you will, and then more open to doing a better job, I think.

In some Year 2 teams, collaboration became a space for both planning and reflection. Teachers used project meetings to discuss what worked, what needed to change, how students responded, and how the same project needed to be adapted across classrooms. One math teacher described that process:

At the next EIR meeting, we kind of talked about what happened, what worked, what didn't work, what changes. Because we had the project, but then after that, ... [some teachers] had to make their accommodations and modifications. So, we all did the same project but I'm sure if you went into our class, we were all teaching the same project, but we were all teaching it differently to make the accommodations for our classes. So, we talked about things that worked, things that didn't work. We had a timeline where we're like, "Okay, this week we're all going to do it." But of course, things are changing in our classes, so somebody might've been a week later or a week earlier. So, we weren't necessarily doing the project at the exact same time because we had to make it work for our classes. ... And ... we looked at each other's examples from what the kids did.

In Year 3, teachers continued to value release time, planning time, and opportunities to brainstorm with colleagues because those opportunities were difficult to create within regular school schedules. One science teacher summarized the value of having time to step away from daily responsibilities and think with colleagues:

Time to work, I think. And then just being able to brainstorm with other people or kind of talk things out, because we don't really get the luxury of time to talk things out in our regular school days.

At the same time, teachers' experiences with collaboration were not uniform. Collaboration was most helpful when teachers had colleagues teaching similar courses or developing related units. It was less helpful when teachers were working in different content areas, did not have a natural partner, or were given open-ended collaboration time without enough structure. In the final year, this unevenness was especially visible for teachers who expected to work with others on a shared unit but instead experienced the work as more individual. One science teacher explained:

I was led to believe that the teachers were going to get together and collaborate and work on a unit, and then it was individual. And so that kind of threw me off in

the first stage where I was like, wait a minute, I'm supposed to be working with somebody else, but everybody's doing different things. How is this going to be? Collaboration is what it was sold to me.

Teachers' critiques of professional learning were generally about focus and usefulness, not about the value of professional learning itself. Some Year 2 teachers noted that repeated icebreakers, norm-setting, or other general activities felt less useful after the group had already established relationships and moved into unit development. As one teacher explained, "As math and science people, I feel like we just want to get to the point and move on and get what we're supposed to be doing."

By the final year, teachers continued to describe professional learning as most useful when support was specific and practical. In addition to release time and collaboration, teachers valued opportunities to get feedback on unit ideas, talk through possible changes, and think more deeply about where CT appeared in their lessons. One science teacher described how feedback from project staff and colleagues helped strengthen their planning:

I was doing lesson plans and working on things and then people like [OCDE project staff] would come up and say, what about this? Or how about including data and changing this? And that is when all these opening eye-opening experiences happen with me and just, it was really nice to get their input and then also my colleagues' input and raise my lesson planning up a level or two.

Implementing Computational Thinking Units Across Courses

In classroom implementation, CT took shape through the routines, tasks, and expectations of each course. Teachers were not implementing a single CT lesson or common project across all settings. Instead, they adapted CT to the content they were already responsible for teaching, using the framework to make problem-solving, data use, modeling, and reflection more visible within math, science, and computer science instruction. Across these units, students were asked to use course content to analyze data, compare options, model relationships, interpret results, troubleshoot problems, and explain their reasoning.

In the first year, Integrated Math 1 teachers described trying to embed CT into the regular flow of instruction rather than presenting it as a separate grant activity. One teacher explained that their team began talking about CT informally before the formal unit so students would experience the work as part of the course:

Even late first semester... We didn't make it that it was a special unit. So, we didn't stand up in front and say, "Hey, we're introducing this, and we're..." We tried to embed it from the very beginning. I remember we kept asking that in the August training is, "Even though our unit is in such and such month, in theory we should be talking about this the entire year, right?" And they're like, "Well, yeah, that would be great. But we can't ask you to do that because it's not part of the grant. But really you should." We started talking about it kind of informally when

we first started the school year. So, we didn't want to make it that when we finally got to our unit, "Hey, guys, it's time." We just masked like it was just...

For these teachers, implementation also involved naming the kinds of thinking students were already being asked to do. Teachers described using CT vocabulary to help students recognize that they were troubleshooting, checking answers, understanding relationships, and thinking in levels. Rather than treating these as general problem-solving habits, teachers used the CT language to make those practices more visible and transferable for students. Teachers also used the framework to think more deliberately about unit design. One teacher described the framework as useful because it *"makes it really intentional for us to sequence things a certain way"* and pushed teachers to make the purpose of the lesson clear for students: *"Here's the why. Here's the purpose."*

As the project moved into additional courses, teachers continued to adapt CT within the instructional demands of their content areas. In Year 2, Math 2 and Chemistry teachers described using CT to strengthen projects, support problem-solving, and make reasoning more explicit. In Chemistry, for example, one teacher described how the CT approach helped improve a hot air balloon engineering project by drawing attention to students' understanding of measurement and scale: *"I realized they don't understand the value of numbers. They understand numbers, but they don't understand what 10 centimeters versus 20 looks like. Building intentionality into the project made a huge difference in their thinking process."* In math, teachers described CT as a way to support more project-based instruction and help mathematical concepts make sense to students. One teacher reflected that the experience pushed them to do more project-based lessons *"so that the math makes sense to the kids."*

By the final year, CT implementation varied more visibly by discipline. Math teachers described units involving salary comparisons, weather patterns, mortgage payments, exponential functions, compound interest, graphing, transformations, and data interpretation. These units often used mathematics to help students analyze information, compare options, model relationships, and make sense of real-world decisions. One teacher described a unit in which students calculated mortgage payments for a possible dream house and reflected on housing affordability:

They were calculating monthly mortgage payments for a potential dream house of theirs, and that is also using exponential functions. So, a lot of them collecting data, interpreting data, especially they're reflecting the data because they're able to determine the cost of living in California and housing affordability is just, it was very eye-opening to them. I was reading some of those reflections today and they're like, wow, I didn't think it took this much to purchase a house. Especially when they're calculating the actual amount paid and the interest they're paying. It was a lot. And some were just shocked. I'm like, yeah, this is real world.

Science teachers described CT through disciplinary practices such as graphing, modeling, data interpretation, hypothesis testing, and troubleshooting. Teachers discussed units involving enzyme activity, anatomy data, physics modeling, conservation of momentum, car crashes, gravity, orbital motion, data collection, and simulations. In these examples, CT was less about

adding a new activity and more about making scientific reasoning more deliberate. One science teacher described planning an enzyme unit by identifying where students would graph results and interpret data, saying, “*We’re going to graph the activity of the enzyme here*” and “*make sure we read these graphs.*” The same teacher noted that graphing was already a regular part of instruction: “*With anatomy, every Wednesday we do graph of the week.*”

Computer science teachers described implementation differently because CT was already central to their courses. For them, the framework served more as a tool for reflection and intentional project design than as a new instructional addition. One computer science teacher explained:

I like looking at the CT framework... where it kind of breaks the CT practices into groups. One is data analysis; other one is like systems thinking. So, I like just seeing that and I actually use that a lot as I’m doing a new project, to kind of reflect back on how this fit with this. It just kind of gives me a point of view or reference.

Successes and Benefits for Teachers and Students

Teachers identified several benefits of the project for their own instruction and for students. For teachers, one of the clearest benefits was increased instructional intentionality. Many teachers did not describe CT as something entirely new. Instead, they described learning how to name CT practices, design around them more deliberately, and make those practices more visible to students. For some teachers, this meant calling attention to graphing, data analysis, modeling, systems thinking, troubleshooting, or problem decomposition. For others, it meant designing projects that asked students to use mathematics or science to make sense of realistic situations.

Teachers also described shifts in classroom practice. Some incorporated more graphing, modeling, technology use, data analysis, student reflection, and real-world problem-solving. A math teacher described moving toward curiosity and sense-making by having students work with data before receiving direct instruction: “*I have them analyze work that is given to them, data that’s given to them, and spark the curiosity, rather than me teaching them directly.*” Other teachers described using CT-related tasks to give students more opportunities to investigate, test ideas, make decisions, and explain their reasoning.

For students, teachers described benefits related to ownership, creativity, confidence, technology fluency, and future readiness. In Year 1, teachers saw students taking more ownership of their work when projects gave them room to make choices. One teacher described students as “*being more creative in their work,*” explaining that they told students, “*We want you to be your own person. ... there’s a title and stuff, but just make it you.*” Teachers also described the value of breaking larger tasks into smaller, more manageable parts. One teacher explained that this structure helped students persist through a project that may otherwise have felt overwhelming:

Before they wouldn't do what they were supposed to do and all of a sudden, they're trying to do too much at one time. The way it was broken down is you just do one thing a day. The end is going to be very, very simple. So, all you've got to do is just put everything in place and you're done. For the most part, most of them were doing and they were just like, "Hey, this was simple."

Teachers also saw benefits when CT units connected academic content to students' future goals. In one Year 1 focus group, teachers discussed an *"Is College Worth It?"* unit that asked students to compare long-term earnings across careers and think about postsecondary pathways. Teachers described the unit as a way to help students use mathematical reasoning to consider future options:

Teacher 1: Yeah, I think the Is College Worth It?, that one was really more like, what is the value of college or what is your longtime earnings going to look like compared to two different careers? And you should think about that as you start getting older and go into the future. I think that opened the eyes for people. They saw there's a big difference in total...

Teacher 2: Goal setting. Some of them really think that far in the future.

Teacher 3: Sure. So, I thought that was probably the main idea for that one, too. And also, some students said that college is not worth it, like, "Depending on what I'm going to do, I don't need college." And I thought that was cool, too. Some kids were like, "I'm going to be a realtor." "I'll go to some kind of school," they said, but it was really short. "And I can make a lot more money." And so, they had different perspectives, but at least they started looking at, like the grant, paid for the little app, so we can look at careers.

In Year 2, teachers described additional examples of students engaging more deeply with data, problem-solving, and computational thinking. In one chemistry classroom, students' response to a data analysis question changed the teacher's view of what students could do when they were given a more open-ended opportunity:

I was floored because I had never given my students an opportunity like that. They were taking the data, fiddling with it, and coming up with results. It wasn't just 'try this experiment and go,' but an opportunity where we didn't know which way it would go, and it took off.

Teachers also described moments when students began to see themselves as capable of computational thinking once they recognized that they had already used CT-related practices. One math teacher recalled, *"When you say computational thinking, they say, 'That's too difficult for me.' But then I tell them, 'Look, you did that.' And suddenly, they say, 'Oh, well, maybe I can do this. It's not as bad as I think.'"* Teachers connected these moments to broader shifts in student confidence, engagement, and willingness to participate in challenging work. For example, one teacher described a clinometer activity in which students measured objects outdoors and then questioned their own results: *"Some of them would be way off, and the kids*

were like, ‘Really? The new building is shorter than the flagpole? How did you get that?’ Then they sat there and figured it out together.”

The project also helped teachers attend more explicitly to technology fluency and future readiness. One science teacher observed, *“Even though they have the most sophisticated computer in their pocket, they don’t know how to Google properly. They don’t even know how to highlight two columns in Excel.”* Teachers used CT units and related activities to help students practice spreadsheet skills, data analysis, graphing, and other tools they saw as important beyond the immediate course. As one teacher explained, *“Now when I say, ‘Graph that data,’ they know what to do. If we do it right from the very start, they won’t go to college without knowing how to use Excel or basic spreadsheets.”*

Teachers also described benefits related to inclusive instruction. In Year 1, some teachers appreciated that the professional learning and CoP meetings included attention to students’ identities, interests, and classroom environment. One teacher explained that this focus encouraged more conversations with students about relevance: *“So what we tried to do is just have discussions with kids. ‘What are you interested in? And hey, do you know what we’re doing in here relates to that?’ I don’t think we would have ever done that without that further information in those monthly meetings.”* In later years, teachers connected inclusive instruction to accessibility, representation, and real-world relevance. Some teachers described using UDL strategies to make classroom activities more accessible for students. For example, one teacher described how listening to a reading reduced cognitive load for students, saying, *“All the cognitive load that I usually have of having a read turned into, oh, good, I can just listen to this, and I can markup while I was reading. Those are the types of things I want to implement in my class.”* Computer science teachers also emphasized representation through career exposure, interviews, guest speakers, and examples of professionals from diverse backgrounds. Teachers described these experiences as a way to help students see computer science as connected to *“real life people,”* rather than *“something somebody else does.”* They also noted the value of curriculum resources that included professionals from *“different countries, with different accents, skin tones, and nationalities.”*

Teachers also described benefits for themselves as professionals. Some said the project renewed their enthusiasm for teaching because they saw students engage differently with the work. One Year 2 teacher connected teacher learning, student engagement, and continued use of the work:

This isn’t just stuck with these kids—it’s stuck with the teachers. We’re going to use it again because we saw the difference it makes in the classroom. We feel proud too, not just the students. We feel like, ‘Oh my gosh, this was really cool.’ And that’s the whole point of being a teacher—to see that expression on their face when they get it.”

By the final year, teachers often expected to continue using at least parts of their CT units. They generally did not describe the units as finished products. Instead, they talked about revising activities, improving scaffolds, calling out CT practices more explicitly, and refining units over time. As one physics teacher said, *“I would love to use this more and improve it year by year.”*

Challenges and Areas for Continued Support

Although teachers were generally positive about the project, they also identified several areas where additional support would strengthen implementation. The most consistent challenge across years was not whether CT was valuable, but how teachers should recognize, design, and assess strong CT integration in their own courses. The project's open-ended design gave teachers flexibility to adapt CT to math, science, and computer science contexts, but that flexibility also created uncertainty. Teachers understood that CT could be embedded in existing instruction, but they wanted more guidance about when to make CT practices explicit, when to revise an existing lesson, and when to create something new.

This need for concrete examples appeared early in implementation. In Year 1, teachers wanted work samples, model lessons, and clearer examples of what CT integration could look like in practice. One teacher explained that the first year of implementation would create examples for future cohorts:

They did a good job supporting us, but we didn't have, really, any work samples to look at. But now this is year one done; each school should have some examples to show for next year. I think that's going to help out too, where they can say, "Well, what are we looking for?" There should be work samples that say, "Well, this is what we're looking for in this class. This is what they did last year." I think that will help out a lot.

Teachers were not asking for the project to be scripted for them. Rather, they wanted enough examples to understand the target and make informed decisions about how to adapt CT to their own classrooms. This continued in Year 2, when teachers asked for examples that would help them understand the relationship between CT, computer science, and their own math or science assignments. One chemistry teacher described wanting to experience a computer science activity directly:

I think I would've liked to have done some actual computer science things in some of our ... community of practice. Instead of doing 45 minutes of a norm, "Hey, let's do a computer science exercise together that your students would be doing in an intro to computer science class." And then we can go, "Oh, this is this, this is this." But I have no idea what they do in that class. ... And so, it would've been nice of having just even a couple of those, and then we could have made those connections directly with our assignments. ... So, I think that would, like do a little coding, do a little something so that we can go, "Oh, we can have them do basic coding to do this."

Other teachers made a similar point by asking for a video, live lesson, or clearer model of what CT looked like in a science classroom. The need was not simply for more information about CT, but for examples that helped teachers see how CT practices translated across content areas.

By Year 3, the need for clarity had become more refined. Teachers were no longer simply asking what CT was; they were asking how much change was expected when CT practices

were already embedded in their curriculum. This was especially visible in courses such as physics, where teachers could see connections to modeling, troubleshooting, and equations, but were less certain about whether strong CT integration required new activities, explicit vocabulary, computer science connections, or revisions to existing units. One physics teacher described the challenge this way:

I think what was really tricky about the implementation is trying to figure out what to actually change to support computational thinking. Because the curriculum we use, when we were going through the categories of things, like, okay, we're already doing this in our unit, and we tried getting help on that, but it wasn't very clear, more so than just make sure you call it out, even though we were already doing it, or try to come up with something brand new.

Time was also both a support and a challenge. Teachers valued release time and dedicated planning time because it allowed them to step away from regular school responsibilities, collaborate, and focus on unit development. At the same time, release time depended on substitute coverage and sometimes created additional work when teachers returned to their classrooms. One Year 2 chemistry teacher described the professional learning as beneficial, but also explained the cost of being away from class:

I think the least helpful ... was how many days I was absent from school, having to go to all of the PDs and all of the different meetings really set me back in terms of my classroom. So, leaving to go to the PDs, although the PDs were definitely beneficial, at home, I had to come back to clean up a mess every time. Especially it was so early in the school year, the kids still weren't under control, and they were not being nice to the subs. So being absent was probably the worst part.

Teachers also described some tension between the project's broader equity and inclusion goals and the immediate work of CT unit planning. Several teachers valued the project's emphasis on access, representation, and inclusive instruction, but some described those ideas as less fully connected to the day-to-day process of developing CT units. One teacher described the inclusion work and CT unit-planning work as “two parallel streets.” Computer science teachers raised a related challenge about the connection between CT integration and future course-taking. They questioned how CT exposure in core academic classes would translate into increased interest in computer science courses. As one CS teacher advised, the project should “be more explicit” about the purpose and “define what you want and how we're going to do that.” For computer science teachers, clearer alignment among CT instruction, course advising, recruitment, counseling, scheduling, and pathway participation would make the connection between classroom CT experiences and future CS enrollment more visible.

Component 3: Curricular Materials

Across the three implementation years, participating teachers collaborated on the development and implementation of instructional units focused on computational thinking. As shown in Table 19, classroom observations suggest a positive overall teaching environment, with teachers generally demonstrating effective classroom management, engaging students in the lesson, and supporting a warm and welcoming classroom environment. Observers also saw evidence that teachers embedded computational thinking into classroom activities and encouraged students to connect lesson concepts and skills to real-world applications. Across observed lessons, some computational thinking mindsets and skills were more commonly observed than others. Students were often observed engaging with CT mindset, decomposition, abstraction, algorithmic thinking, pattern recognition, interpretation, and modeling. Evaluation, refinement, generalizability, and human-computer interaction were observed less consistently. Because observations captured a single lesson during a classroom visit and we would not expect to see all CT mindsets, skills, and practices in every observed lesson, findings should be interpreted as examples of how CT appeared during observed instruction rather than as a complete picture of each unit. Overall, classroom observations suggest that the curricular materials helped teachers incorporate computational thinking into classroom instruction and connect CT concepts to existing course content and classroom activities.

Table 19. Classroom Observation Results by Implementation Year.

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
Classroom Management										
The teacher clearly posted, presented, and/or discussed the learning targets for the lesson.	0.0%	100.0%	0.0%	100.0%	15.4%	61.5%	0.0%	94.0%	0.0%	100.0%
The teacher demonstrated effective pedagogies for engaging students in the lesson (e.g., brainstorming, think-aloud sessions, question answering, or posing open-ended remarks, etc.).	0.0%	100.0%	25.0%	75.0%	15.4%	76.9%	6.0%	88.0%	0.0%	100.0%
The teacher was responsive to student engagement and adjusted his/her/their strategies accordingly.	18.8%	75.0%	0.0%	100.0%	15.4%	84.6%	6.0%	94.0%	0.0%	100.0%
The teacher acted as a resource person, working to support and enhance student learning (rather than directing it).	12.5%	87.5%	25.0%	75.0%	23.1%	61.5%	18.0%	70.0%	0.0%	75.0%
The teacher infused the curriculum with technology to strengthen his/her/their instructional delivery.	18.8%	75.0%	0.0%	75.0%	15.4%	69.2%	0.0%	82.0%	0.0%	100.0%
Students appeared to understand the lesson and task assignments. [Check via questions asked, engagement]	18.8%	81.3%	25.0%	75.0%	15.4%	84.6%	0.0%	94.0%	0.0%	75.0%
Classroom Environment										
The teacher has established a warm and welcoming classroom environment (e.g., greets students by name, shows genuine interest in students).	18.8%	81.3%	0.0%	100.0%	7.7%	84.6%	0.0%	100.0%	0.0%	100.0%
Student-teacher and student-student Interactions were positive, courteous, and respectful.	12.5%	81.3%	25.0%	75.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
The teacher seemed to value and attempted to build on the experiences, knowledge, and cultures students bring to the classroom.	0.0%	87.5%	25.0%	50.0%	0.0%	69.2%	12.0%	88.0%	0.0%	50.0%
The teacher provided activities that nurtured a collaborative environment.	18.8%	75.0%	0.0%	100.0%	23.1%	76.9%	6.0%	88.0%	0.0%	75.0%
The teacher encouraged active participation from all students.	18.8%	50.0%	0.0%	100.0%	15.4%	84.6%	6.0%	88.0%	0.0%	75.0%
Students freely shared their ideas and listened to each other's ideas.	18.8%	68.8%	25.0%	75.0%	0.0%	92.3%	6.0%	88.0%	0.0%	75.0%
Teacher and/or student questions triggered divergent modes of thinking (higher level thinking).	37.5%	43.8%	25.0%	25.0%	0.0%	7.7%	18.0%	64.0%	0.0%	75.0%
Student Agency										
Students were given the opportunity to make their own goals for learning and/or manage their own work time without being told what they should be doing.	25.0%	75.0%	50.0%	25.0%	23.1%	38.5%	29.0%	18.0%	50.0%	50.0%
Students had a voice and choice in their projects and/or assignments.	25.0%	31.3%	25.0%	75.0%	23.1%	15.4%	50.0%	50.0%	50.0%	50.0%
Students designed or implemented their own products during the class session.	0.0%	25.0%	25.0%	75.0%	7.7%	46.2%	6.0%	47.0%	0.0%	75.0%
Students were encouraged and supported to reflect on and assess their own learning in an ongoing way.	18.8%	68.8%	25.0%	50.0%	7.7%	46.2%	12.0%	76.0%	0.0%	75.0%
Students connected what they were learning in the lesson or classroom activity to other disciplines and/or their own life.	31.3%	68.8%	0.0%	50.0%	15.4%	23.1%	18.0%	76.0%	0.0%	75.0%

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
Positioning and Teaching Computational Thinking										
The teacher used the term “computational thinking” in his/her/their delivery of content.	6.3%	31.3%	25.0%	25.0%	0.0%	0.0%	0.0%	53.0%	0.0%	0.0%
The teacher and/or students used computational thinking vocabulary (e.g., identifying patterns, ordered steps/sequencing, troubleshooting, etc.).	12.5%	37.5%	25.0%	0.0%	7.7%	46.2%	6.0%	70.5%	0.0%	75.0%
Computational thinking was embedded into the class rather than a separate add-on activity.	6.3%	43.8%	0.0%	100.0%	7.7%	69.2%	18.0%	82.0%	0.0%	75.0%
The teacher clearly linked today’s lesson to previous learning about computational thinking.	0.0%	31.3%	25.0%	50.0%	7.7%	7.7%	6.0%	53.0%	0.0%	25.0%
The teacher placed the current unit/lesson in a learning progression, connecting for students the unit and lesson to prior or future work in computational thinking and/or computer science.	12.5%	31.3%	50.0%	50.0%	7.7%	23.1%	23.0%	59.0%	0.0%	50.0%
The teacher used relevant analogies and made cross-curricular connections explicit (e.g., comparing iterative product development to the writing process).	6.3%	25.0%	25.0%	0.0%	0.0%	0.0%	6.0%	76.0%	25.0%	75.0%
The teacher encouraged and facilitated students to connect the concepts and skills in the lesson to real-world applications (this may be achieved through the content of the lesson itself and/or extensions and examples provided or solicited from students).	18.8%	37.5%	0.0%	75.0%	0.0%	69.2%	6.0%	82.0%	0.0%	75.0%
The teacher modeled computational thinking strategies by working through a problem using a think-aloud strategy and physical representations/drawings.	12.5%	62.5%	0.0%	0.0%	0.0%	69.2%	0.0%	76.0%	0.0%	50.0%

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
Opportunities to Develop Computational Thinking Mindsets and Skills										
CT Mindset: Students were comfortable dealing with open-ended problems and exhibited confidence dealing with complexity.	31.3%	31.3%	25.0%	50.0%	30.7%	46.2%	29.0%	65.0%	0.0%	100.0%
Problem Identification: Students identified or were given complex, interdisciplinary, real-world problems that could be solved computationally, including evaluating whether it was appropriate and feasible to solve the problem computationally.	0.0%	25.0%	50.0%	25.0%	7.7%	15.4%	29.0%	47.0%	0.0%	75.0%
Decomposition: Students identified or were given complex real-world problems that could be solved in many ways and were asked to break the problems into manageable smaller parts.	25.0%	18.8%	75.0%	25.0%	30.7%	23.1%	23.0%	53.0%	0.0%	75.0%
Abstraction: Students assessed the information given to them about a problem and determined which facts were important and which were not in solving the problem; students removed unnecessary detail to reduce complexity.	0.0%	18.8%	0.0%	75.0%	15.4%	30.7%	0.0%	71.0%	0.0%	100.0%
Algorithmic Thinking: Students formulated solutions that could be represented as a set of ordered steps (sequencing) and then did them in a particular order to solve the problem or accomplish the task in a way that could be repeated by others (using the steps, or algorithm).	31.3%	43.8%	25.0%	50.0%	0.0%	92.3%	6.0%	59.0%	0.0%	50.0%

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
Pattern Recognition: Students identified patterns and commonalities within a particular problem set, sequence, or data set (e.g., all use the Pythagorean Theorem).	12.5%	43.8%	0.0%	0.0%	7.7%	76.9%	0.0%	82.0%	0.0%	50.0%
Brainstorming: Students worked systematically through each subproblem to develop a set of potential solutions. Students brainstorm alternative explanations/solutions with the result that most students came up with at least one alternative to their solutions or the class's solution to the lesson challenge.	0.0%	25.0%	25.0%	0.0%	0.0%	0.0%	6.0%	35.0%	0.0%	75.0%
Testing: Students made predictions, estimates, and/or hypotheses related to their problem(s) and potential solutions. Students systematically tested their computational solutions by considering all scenarios and potential consequences.	0.0%	68.8%	25.0%	25.0%	15.4%	30.7%	12.0%	35.0%	0.0%	50.0%
Troubleshooting: Students identified and fixed errors using a systematic process that included identifying likely causes of errors and testing/re-testing as needed.	12.5%	43.8%	25.0%	0.0%	0.0%	23.1%	6.0%	53.0%	0.0%	75.0%
Interpretation: Students were encouraged to interpret data and explain relationships related to their problem(s) and potential solutions, with students taking most of the initiative and responsibility.	25.0%	12.5%	0.0%	75.0%	15.4%	23.1%	12.0%	70.0%	0.0%	75.0%
Modeling: Students created visualizations (e.g., graphs, pictures, models, pseudo-code, etc.) that demonstrated their understanding of a problem and their solution(s).	0.0%	25.0%	0.0%	75.0%	0.0%	69.2%	0.0%	41.0%	0.0%	75.0%

Item	Year 1 2022-23		Year 2 2023-24				Year 3 2024-25			
	Non-CT Unit (N = 13)		CT-Infused Unit (N = 4)		Non-CT Unit (N = 13)		CT-Infused Unit (N = 17)		Non-CT Unit (N = 4)	
	Partially True	True	Partially True	True	Partially True	True	Partially True	True	Partially True	True
Evaluation: Students analyzed and evaluated multiple potential solutions (their own and/or their classmates') to determine the best solution (most efficient and effective combination of steps and resources) while ensuring the solution is fit for its intended purpose.	12.5%	12.5%	0.0%	25.0%	15.4%	0.0%	12.0%	17.0%	0.0%	75.0%
Refinement: Students worked to improve their solution(s) to increase efficacy, usability, and generalizability.	0.0%	6.3%	0.0%	25.0%	0.0%	0.0%	17.5%	17.5%	0.0%	50.0%
Generalizability: Students generalized or transferred ideas, solutions, and/or the problem-solving process from one problem area to another.	0.0%	12.5%	0.0%	0.0%	0.0%	7.7%	6.0%	47.0%	0.0%	50.0%
Human-Computer Interaction: Students discussed human-computer interactions and/or the capabilities and limitations of computers for problem solving.	0.0%	6.3%	0.0%	0.0%	7.7%	0.0%	0.0%	18.0%	0.0%	25.0%

Component 4: Student Career Exploration and Mentoring

The fourth component of the BTCSEI project focused on expanding students’ awareness of computer science and computer science-related careers. This component was intended to help students connect classroom-based computational thinking experiences to future coursework, career pathways, and real-world applications of CS. Through Pathful Connect and Pathful Explore, students were expected to engage in career exploration activities, learn from industry professionals and role models, and build a broader understanding of how CT and CS are used across fields. In the context of BTCSEI, student career exploration and mentoring were designed to support the development of CS-inclusive identities and strengthen students’ awareness of future opportunities connected to computational thinking and computer science. This section presents findings related to student perceptions, student computational thinking knowledge, and student focus group responses.

Student Perceptions Survey Results

The Student Perceptions Survey was used to examine changes in students’ perceptions of computational thinking, computer science identity, instructional experiences, career decision-making, and college-going expectations over the course of project participation. Results were analyzed in two ways. First, annual cross-sectional analyses examined changes from baseline to each year’s post-survey for students with matched data in that implementation year. Second, a longitudinal analysis examined change over time for students with complete survey data across all four administrations.

Cross-Sectional Analysis of Student Perceptions Survey

Before completing the perception items, students provided demographic and background information. Table 20 presents demographic information for students with matched pre- and post-survey data in each implementation year. Across the three annual cohorts, Anaheim and Loara accounted for the majority of matched survey respondents each year, while Cypress represented a smaller proportion of respondents. Gender representation was generally balanced across cohorts, with similar percentages of students identifying as female and male. Across all three implementation years, the majority of students identified as Hispanic or Latinx, ranging from 74.0% in Year 1 to 76.7% in Year 3.

Table 20. Student Demographic and Background Information by Implementation Year

Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
School						
Anaheim High School	160	38.6%	157	39.1%	176	48.2%

Statement	Year 1 2022-23		Year 2 2023-24		Year 3 2024-25	
	N	%	N	%	N	%
Cypress High School	78	18.8%	76	18.9%	53	14.5%
Loara High School	177	42.7%	169	42.0%	136	37.3%
Total	415	100.0%	402	100.0%	365	100.0%
Gender						
Female	199	48.0%	188	46.8%	166	45.5%
Male	196	47.2%	197	49.0%	181	49.6%
Nonbinary	5	1.0%	4	1.0%	3	0.8%
Other (please specify)	1	0.2%	2	0.5%	2	0.5%
I choose not to respond	14	3.4%	9	2.2%	11	3.0%
No Response	0	0.0%	2	0.5%	2	0.5%
Race(s)/Ethnicity (please select all that apply)						
American Indian or Alaska Native	5	1.2%	7	1.7%	6	1.6%
Asian or Asian American	37	8.9%	41	10.2%	31	8.5%
Black or African American	13	3.1%	13	3.2%	6	1.6%
Hispanic or Latinx	307	74.0%	298	74.1%	280	76.7%
Middle Eastern or Northern African	4	1.0%	3	0.7%	2	0.5%
Native Hawaiian or Other Pacific Islander	4	1.0%	4	1.0%	2	0.5%
White	51	12.3%	50	12.4%	38	10.4%
Other (please specify)	17	4.1%	13	3.2%	15	4.1%
I choose not to respond	17	4.1%	20	5.0%	19	5.2%

Student Confidence Related to Computational Thinking

Students were asked to rate their confidence using computational thinking strategies and practices on a 5-point scale from *Not at All Confident* to *Extremely Confident*. As shown in Table 21, mean scores generally increased from pre- to post-survey across the three annual cohorts. These increases suggest that students reported greater confidence with CT-related problem-solving strategies after participating in project activities. Increases were generally larger for items focused on identifying, organizing, and evaluating solutions than for items focused specifically on using technology to solve problems. This suggests that students' confidence grew most consistently in general CT practices, while technology-specific confidence changed less.

Table 21. Student Confidence Related to Computational Thinking by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Identifying and/or defining real-world problems. (i.e., ambiguous and complex)	3.11	0.92	3.21	0.90	3.12	0.88	3.33	0.90	3.14	0.89	3.46	0.90
Identify patterns in problems.	3.15	1.03	3.28	0.97	3.15	0.98	3.40	0.94	3.15	0.95	3.52	0.88
Create a list of steps to solve a problem.	3.09	1.01	3.22	1.00	3.13	0.99	3.37	0.92	3.15	0.94	3.46	0.93
Brainstorm several solutions to a problem.	3.04	1.01	3.18	0.96	3.02	1.00	3.36	0.88	3.08	0.96	3.38	0.90
Determine whether a solution will meet its intended goal.	3.11	0.96	3.15	0.96	3.11	0.99	3.26	0.89	3.14	0.94	3.38	0.89
Consider possible intended and unintended outcomes of a solution.	2.96	0.99	3.15	0.95	2.95	0.96	3.28	0.94	3.00	0.94	3.38	0.93
Identify the best solution from a set of solutions.	3.05	1.05	3.24	0.96	3.10	1.01	3.38	0.94	3.16	0.98	3.38	0.88
Identify where your solution went wrong and brainstorm possible ways to fix it.	3.22	1.04	3.27	0.98	3.21	1.04	3.47	0.93	3.22	0.98	3.47	0.92
Choose the best technology to assist with solving a problem.	3.05	1.06	3.17	1.03	3.05	1.03	3.18	0.97	3.11	0.99	3.24	1.01
Use computers or other technology to help solve real-world problems.	3.18	1.13	3.18	1.02	3.17	1.11	3.24	1.08	3.20	1.11	3.27	1.03

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Create a computer program to solve a problem.	2.33	1.07	2.58	1.12	2.29	1.05	2.46	1.15	2.41	1.09	2.57	1.16
Understand what computers can and cannot do.	3.09	1.17	3.24	1.06	3.06	1.16	3.27	1.05	3.07	1.16	3.35	1.05

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

A student confidence scale score was also calculated by averaging across 12 CT confidence items. As shown in Figure 7, average confidence scores increased each year from pre- to post-survey. Year 1 scores increased from 3.03 to 3.15, Year 2 scores increased from 3.03 to 3.24, and Year 3 scores increased from 3.07 to 3.32. Each annual increase was statistically significant. The Year 1 increase was small, with a small effect size, Cohen's $d = .17$. The increases in Years 2 and 3 were larger, with moderate effect sizes, Cohen's $d = .31$ and $.34$, respectively.

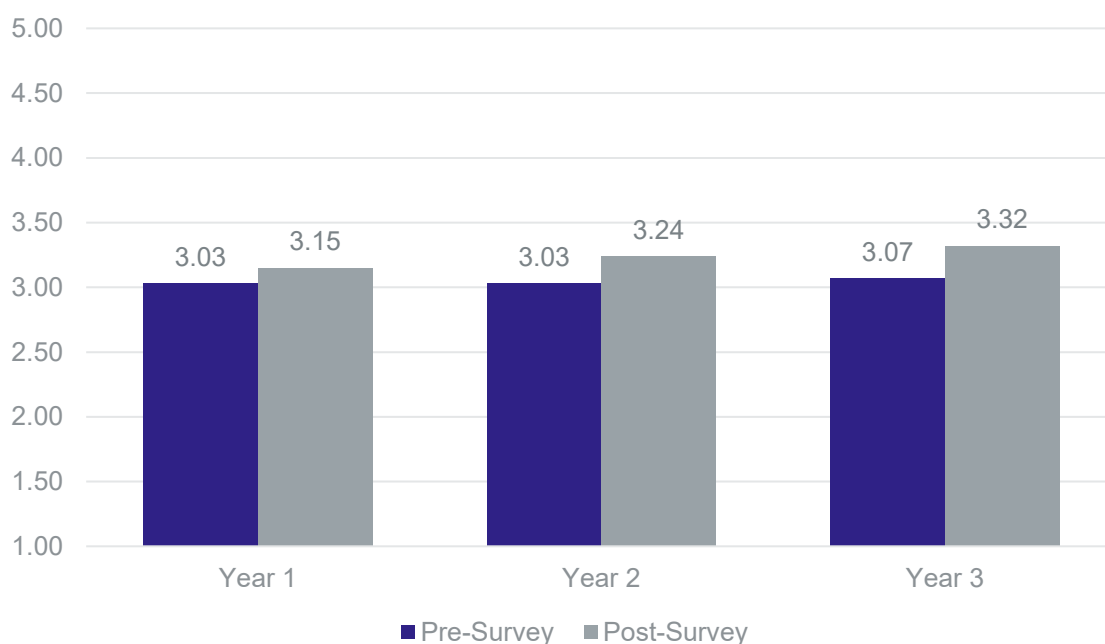


Figure 7. Average Student Confidence by Administration Across Years

Student Computer Science Identity

Students also responded to 25 items related to computer science identity on a 5-point scale from *Strongly Disagree* to *Strongly Agree*. As shown in Table 22, ratings generally increased from pre- to post-survey across the three implementation years. The most consistent gains were

related to students' encouragement and exposure to computer science. Students reported stronger agreement with items related to knowing people connected to computer science, having others discuss or encourage computer science, and receiving positive feedback about their computer science work. Students also reported modest increases in their sense of belonging and interest in computer science, though average ratings generally remained in the low-to-mid range.

Table 22. Student Computer Science Identity by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
I have self-confidence when it comes to computer science.	2.65	1.08	2.73	1.06	2.70	1.07	2.76	1.04	2.67	1.06	2.8	1.05
I would take additional computer science courses if I were given the opportunity.	2.48	1.11	2.60	1.08	2.50	1.10	2.60	1.10	2.52	1.10	2.7	1.14
I feel comfortable in computer science.	2.74	1.06	2.75	1.04	2.74	1.03	2.71	1.01	2.75	0.99	2.8	1.03
Knowledge of computer science will help me earn a living.	2.96	1.08	2.99	1.01	3.01	1.06	3.12	1.00	3.05	1.06	3.1	1.05
A friend or peer has encouraged me to study computer science.	2.30	1.17	2.48	1.16	2.31	1.20	2.48	1.19	2.35	1.15	2.5	1.17
I am confident that I can solve problems by using computing.	2.84	1.10	2.91	1.01	2.82	1.10	2.88	1.05	2.87	1.03	2.9	1.03
I hope that my future career will require the use of computer science.	2.42	1.15	2.52	1.04	2.39	1.09	2.50	1.07	2.45	1.11	2.6	1.10
I feel I belong in computer science.	2.10	1.12	2.32	1.07	2.09	1.12	2.28	1.09	2.18	1.14	2.3	1.09
Learning to use computing skills will help me achieve my career goals.	2.71	1.10	2.72	1.00	2.79	1.13	2.84	1.06	2.85	1.11	2.9	1.08

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Someone I know has given me the desire to study computer science.	2.20	1.12	2.40	1.11	2.25	1.14	2.32	1.15	2.34	1.16	2.4	1.13
I can learn computer science without a teacher to explain it.	2.15	1.13	2.39	1.08	2.15	1.08	2.30	1.14	2.2	1.08	2.4	1.13
I like to use computer science to solve problems.	2.47	1.11	2.61	1.06	2.47	1.11	2.55	1.08	2.54	1.11	2.6	1.06
I feel accepted by my peers in computer science.	2.78	1.01	2.84	0.93	2.83	0.98	2.88	0.96	2.85	0.96	3	0.93
Computing skills used to understand computer science material can be helpful to me in understanding things in everyday life.	2.77	1.04	2.85	0.98	2.85	1.00	2.95	0.99	2.85	0.96	2.9	0.97
Someone I know has praised my work in computer science.	2.31	1.11	2.54	1.08	2.33	1.08	2.50	1.12	2.38	1.07	2.6	1.12
I am sure I could do advanced work in computer science.	2.40	1.12	2.58	1.10	2.48	1.09	2.57	1.15	2.5	1.09	2.6	1.06
The challenge of solving problems using computer science appeals to me.	2.42	1.11	2.63	1.04	2.49	1.08	2.60	1.05	2.53	1.08	2.7	1.05
I know someone like me who uses computer science in their work.	2.41	1.23	2.55	1.13	2.40	1.19	2.53	1.17	2.46	1.20	2.8	1.13
I'll need a mastery of computer science for my future work.	2.46	1.11	2.52	1.03	2.47	1.07	2.51	1.08	2.47	1.06	2.7	1.08

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Someone I know has discussed with me the computer science field.	2.47	1.19	2.60	1.16	2.41	1.17	2.63	1.20	2.46	1.18	2.8	1.11
I think I will do well in computer science.	2.59	1.07	2.66	1.05	2.63	1.06	2.71	1.10	2.64	1.03	2.7	1.08
I like writing computer programs.	2.28	1.13	2.51	1.10	2.32	1.14	2.42	1.08	2.34	1.14	2.5	1.09
I know a lot of students like me who are interested in computer science.	2.28	1.18	2.43	1.08	2.27	1.12	2.39	1.12	2.29	1.12	2.5	1.11
Computer science is a worthwhile and necessary subject.	2.69	1.06	2.76	1.01	2.70	1.05	2.83	1.02	2.77	1.03	2.9	1.07
Someone in my family has encouraged me to study computer science.	2.23	1.22	2.40	1.09	2.24	1.21	2.40	1.25	2.26	1.21	2.5	1.20

Scale scores were calculated for five computer science identity constructs: Confidence in Ability to Learn Computer Science Skills and Solve Computer Science Problems, Interest in Learning Computer Science and Solving Problems, Perceptions of Belonging in Computer Science, Belief in the Usefulness of Learning Computer Science, and Perceptions of Being Encouraged to Study Computer Science. As shown in Table 23, mean scores increased from pre- to post-survey for each subscale in each implementation year. Across years, the largest increases were consistently observed for Perceptions of Being Encouraged to Study Computer Science. The smallest increases were generally observed for Belief in the Usefulness of Learning Computer Science, which had the highest baseline scores among the CS identity subscales.

Table 23. Student Computer Science Identity Subscale Scores by Implementation Year

Statement	Year 1 2022-23 (N = 403)				Year 2 2023-24 (N = 392)				Year 3 2024-25 (N = 359)			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Confidence in Ability to Learn Computer Science Skills and Solve Computer Science Problems	2.53	0.87	2.65	0.88	2.53	0.87	2.65	0.89	2.58	0.83	2.69	0.87
Interest in Learning Computer Science and Solving Problems	2.41	0.93	2.57	0.90	2.41	0.93	2.54	0.89	2.48	0.91	2.60	0.93
Perceptions of Belonging in Computer Science	2.45	0.90	2.58	0.85	2.45	0.90	2.56	0.84	2.50	0.85	2.68	0.83
Belief in the Usefulness of Learning Computer Science	2.72	0.87	2.77	0.82	2.72	0.87	2.85	0.82	2.80	0.84	2.89	0.86
Perceptions of Being Encouraged to Study Computer Science	2.30	0.95	2.49	0.94	2.30	0.95	2.47	0.96	2.35	0.95	2.58	0.96

Career Decision Self-Efficacy

Students also rated their career decision self-efficacy, including items related to future goals, career awareness, and connections between computational thinking and possible career pathways. Students responded to 11 items on a 5-point scale from *Strongly Disagree* to *Strongly Agree*, with an option for *Don't Know*. Across the annual cohorts, students reported relatively high career decision self-efficacy at baseline, particularly for items related to motivation, confidence in reaching career goals, and understanding how their interests and skills relate to future career pathways. Because these areas were already rated highly, changes from pre- to post-survey were generally modest. The clearest growth occurred on items that connected computational thinking to students' futures. Across years, students reported more positive perceptions that studying computational thinking could help them learn about possible career pathways, increase their engagement in their future, strengthen their attitudes about a

future in STEM, and motivate them to find a rewarding career. Table 24 presents career decision self-efficacy results by implementation year.

Table 24. Student Career Decision Self-Efficacy by Implementation Year

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
I am motivated to make things happen for myself.	4.34	1.50	4.35	1.50	4.38	1.52	4.65	1.33	4.4	1.49	4.62	1.39
I understand how my interests, skills, and talents relate to my future career pathways.	4.48	1.47	4.46	1.44	4.53	1.46	4.57	1.38	4.52	1.43	4.55	1.34
I am confident I can reach my career goals.	4.36	1.45	4.29	1.45	4.39	1.46	4.54	1.30	4.42	1.40	4.42	1.39
I have connected my interests to a career I might want to do someday.	4.37	1.50	4.37	1.50	4.33	1.53	4.58	1.34	4.42	1.45	4.55	1.37
I am aware of the career pathway opportunities that are available to me.	4.31	1.44	4.23	1.49	4.28	1.47	4.45	1.33	4.30	1.41	4.50	1.36
I know the specific resources or steps that I need to take to reach my career goals.	4.12	1.44	4.10	1.51	4.01	1.44	4.20	1.31	4.08	1.41	4.28	1.38
Even if I experience setbacks, I know I will achieve my career goals.	4.13	1.46	4.18	1.42	4.18	1.45	4.43	1.26	4.20	1.40	4.42	1.38

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Studying computational thinking will help me learn something new about possible career pathways (including STEM careers).	3.61	1.60	3.68	1.50	3.50	1.60	3.74	1.47	3.56	1.59	3.90	1.48
Studying computational thinking will contribute to a positive change in my engagement in my future.	3.60	1.59	3.60	1.52	3.51	1.57	3.75	1.50	3.52	1.59	3.86	1.44
Studying computational thinking will contribute to a positive change in my attitudes about a future in STEM.	3.48	1.63	3.62	1.51	3.39	1.60	3.64	1.47	3.45	1.62	3.79	1.46
Studying computational thinking will help me feel more motivated to find a career that is rewarding.	3.49	1.62	3.57	1.55	3.46	1.61	3.67	1.50	3.50	1.61	3.83	1.46

Note. N = number of respondents, M = Mean, SD = Standard Deviation.

Postsecondary and Work Plans

Students were also asked about their work and education plans after high school. Across the three annual cohorts, many students expected to work either full time or part time after high school, and a substantial proportion were still unsure about their work plans. In Years 2 and 3, fewer students reported being unsure about their work plans at post-survey than at pre-survey, suggesting some movement toward clearer postsecondary planning. Students' education plans showed a similar pattern. Across cohorts, the largest proportion of students planned to attend a 4-year college or university program. The percentage of students planning to attend a 2-year college or university program increased from pre- to post-survey in each implementation year,

while the percentage of students who were unsure about their education plans decreased. Most students reported that education beyond high school was very important at both pre- and post-survey. However, students also identified barriers that could affect postsecondary participation. The most common reasons students selected for potentially discontinuing education beyond high school were cost or affordability, needing or wanting to work, and not liking school. These findings suggest that while most students valued education beyond high school, practical barriers remained important considerations in their postsecondary planning. Table 25 presents students' work plans, education plans, perceptions of the importance of education beyond high school, and possible reasons for discontinuing education beyond high school.

Table 25. Student Work and Education Plans by Implementation Year.

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	N	%	N	%	N	%	N	%	N	%	N	%
Work Plans After High School												
I plan to work full time	97	27.0%	110	30.6%	96	30.6%	101	27.6%	90	27.4%	83	25.2%
I plan to work part time	112	31.2%	108	30.1%	123	30.1%	152	41.5%	101	30.7%	137	41.6%
I do not know	122	34.0%	119	33.1%	121	33.1%	86	23.5%	108	32.8%	83	25.2%
Other	28	7.8%	22	6.1%	26	6.1%	27	7.4%	30	9.1%	26	7.9%
Education Plans After High School												
Attend a 2-year college or university program	59	16.4%	71	19.8%	65	17.8%	70	19.1%	51	15.5%	77	23.4%
Attend a 4-year college or university program	159	44.3%	163	45.4%	158	43.2%	167	45.6%	154	46.8%	150	45.6%
Attend a technical school or specialty training program	16	4.5%	15	4.2%	20	5.5%	23	6.3%	16	4.9%	26	7.9%
I do not know	100	27.9%	79	22.0%	98	26.8%	77	21.0%	83	25.2%	54	16.4%
No more education	20	5.6%	21	5.8%	18	4.9%	19	5.2%	21	6.4%	11	3.3%
Other	5	1.4%	10	2.8%	7	1.9%	10	2.7%	4	1.2%	11	3.3%
Importance of Education Beyond High School												
Not important	5	1.4%	9	2.5%	7	1.9%	8	2.2%	7	2.1%	15	4.6%
Somewhat important	74	20.6%	84	23.4%	91	24.9%	109	29.8%	79	24.0%	60	18.2%
Very important	228	63.5%	212	59.1%	219	59.8%	214	58.5%	203	61.7%	215	65.3%

Statement	Year 1 2022-23				Year 2 2023-24				Year 3 2024-25			
	Pre		Post		Pre		Post		Pre		Post	
	N	%	N	%	N	%	N	%	N	%	N	%
Don't know	33	9.2%	41	11.4%	27	7.4%	25	6.8%	23	7.0%	27	8.2%
Choose not to respond	19	5.3%	13	3.6%	22	6.0%	10	2.7%	17	5.2%	12	3.6%
Reasons for Discontinuing Education Beyond High School												
No reason, I will definitely go	150	36.1%	137	33.0%	148	36.8%	148	36.8%	135	41.0%	155	47.1%
It costs too much/I can't afford it	99	23.9%	119	28.7%	102	25.4%	106	26.4%	85	25.8%	95	28.9%
I don't need college for my planned job	28	6.7%	35	8.4%	26	6.5%	38	9.5%	18	5.5%	21	6.4%
I'm just not interested	41	9.9%	53	12.8%	36	9.0%	50	12.4%	29	8.8%	28	8.5%
I need or want to work	61	14.7%	77	18.6%	56	13.9%	82	20.4%	57	17.3%	66	20.1%
I want to join the military	21	5.1%	24	5.8%	19	4.7%	22	5.5%	13	4.0%	19	5.8%
I don't want to be away from home	37	8.9%	19	4.6%	34	8.5%	21	5.2%	30	9.1%	10	3.0%
I just don't like school	64	15.4%	70	16.9%	56	13.9%	61	15.2%	50	15.2%	39	11.9%
Choose not to respond	58	14.0%	62	14.9%	57	14.2%	54	13.4%	55	16.7%	39	11.9%

Longitudinal Analysis of Student Perceptions Survey

Longitudinal student perception survey results were examined for students with complete survey data across all four administrations. Because the longitudinal analysis was limited to selected overall scale scores, this section focuses on Student Confidence Related to Computational Thinking and Student Computer Science Identity.

Before completing the perception items, students provided demographic and background information. Table 26 presents demographic information for students included in the longitudinal survey sample. The longitudinal sample included 212 students, with the largest proportion from Loara High School (42.9%), followed by Anaheim High School (38.2%) and Cypress High School (18.9%). Gender representation was generally balanced, with 48.1% of students identifying as female and 47.6% identifying as male. Most students in the longitudinal sample identified as Hispanic or Latinx (74.5%).

Table 26. Longitudinal Student Demographic and Experience Information

Statement	N	%
School		
Anaheim High School	81	38.2%
Cypress High School	40	18.9%
Loara High School	91	42.9%
Total	212	100%
Gender		
Female	102	48.1%
Male	101	47.6%
Nonbinary	2	0.9%
Other (please specify)	1	0.5%
I choose not to respond	6	2.8%
No Response	0	0.0%
Race / Ethnicity		
American Indian or Alaska Native	2	0.9%
Asian or Asian American	25	11.8%
Black or African American	3	1.4%
Hispanic or Latinx	158	74.5%
Middle Eastern or Northern African	1	0.5%
Native Hawaiian or Other Pacific Islander	2	0.9%
White	26	12.3%
Other (please specify)	7	3.3%
I choose not to respond	9	4.2%

Student Confidence Related to Computational Thinking

Students rated their confidence using computational thinking strategies and practices on a 5-point scale from *Not at All Confident* to *Extremely Confident*. A Student Confidence Related to Computational Thinking scale score was calculated by averaging across the confidence items. Figure 8 presents average student confidence scores across the four survey administrations. Student confidence related to computational thinking increased steadily across the project period. Average scores increased from 3.03 at baseline in 2022 to 3.16 in 2023, 3.20 in 2024, and 3.30 in 2025. The increase from baseline to the Year 3 post-survey was statistically significant, $t(211) = 5.09$, $p < .001$, Cohen's $d = 0.35$. This finding suggests that students who completed all four survey administrations reported meaningful growth in their confidence using CT strategies and practices over time.

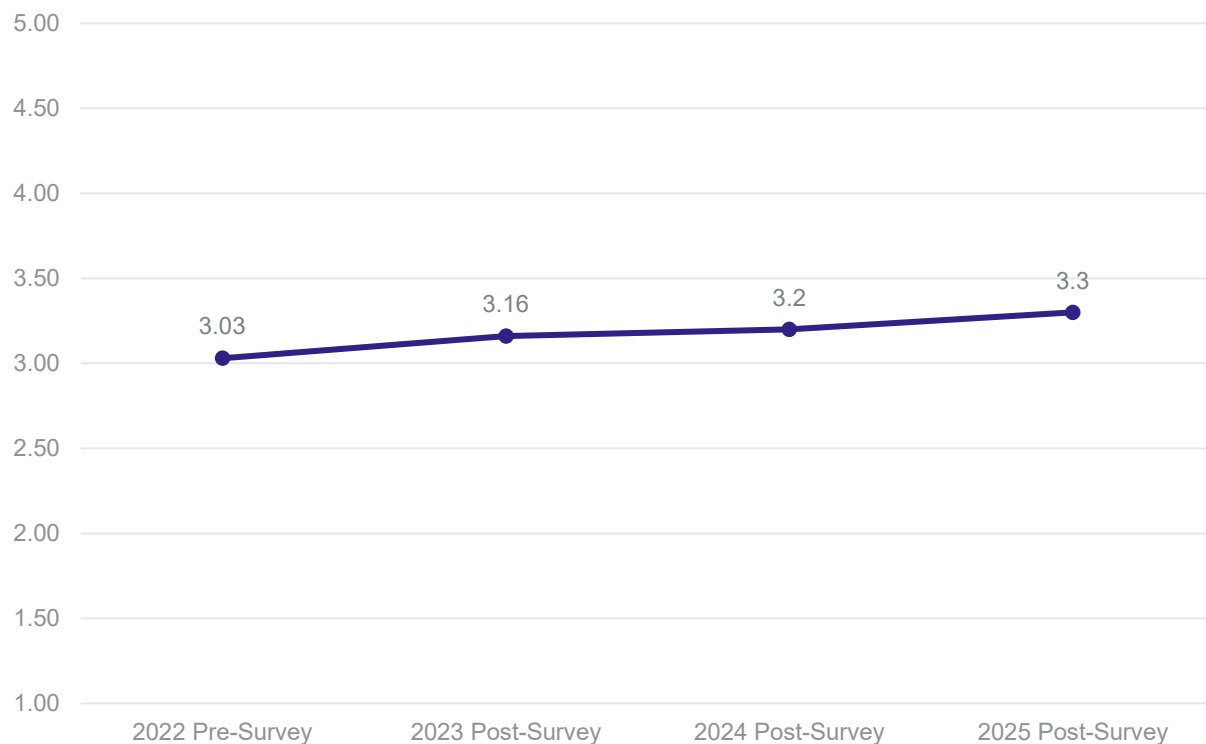


Figure 8. Longitudinal Student Confidence Related to Computational Thinking Scores Across Years

Student Computer Science Identity

Students also responded to items related to computer science identity, including their confidence, interest, sense of belonging, perceptions of usefulness, and perceptions of encouragement in computer science. Students responded to 25 items on a 5-point scale from *Strongly Disagree* to *Strongly Agree*. An overall Student Computer Science Identity score was calculated by averaging across the survey items. Figure 9 presents average student computer science identity scores across the four survey administrations. Student Computer Science Identity scores increased overall from baseline to the final survey administration, though the pattern was less consistent than the growth observed for CT confidence. Average scores increased from 2.51 at baseline in 2022 to 2.58 in 2023, remained essentially unchanged at 2.57 in 2024, and increased to 2.68 in 2025. The increase from baseline to the Year 3 post-survey was statistically significant, $t(208) = 2.50$, $p = .013$, Cohen's $d = 0.17$. Although statistically significant, the effect size was small, suggesting modest growth in students' computer science identity over the project period.

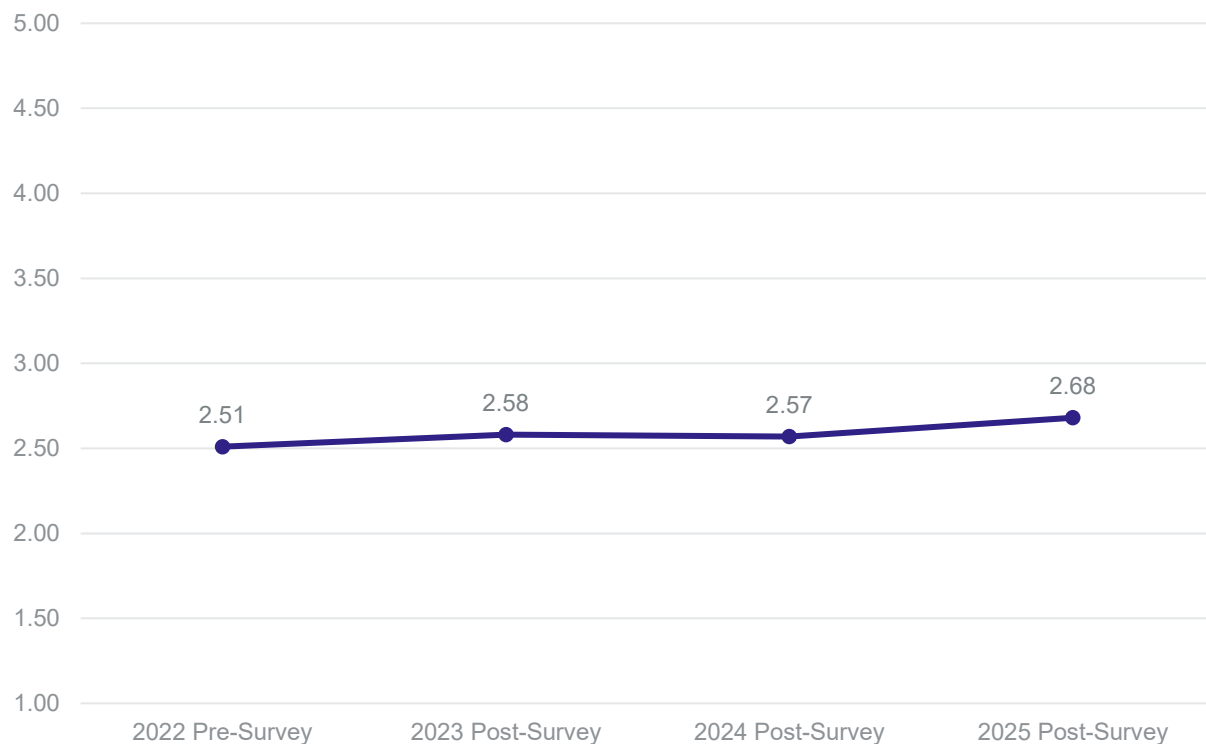


Figure 9. Longitudinal Student Computer Science Identity Scores Across Years

Together, the selected longitudinal findings suggest that students who completed all four survey administrations reported growth in both CT confidence and computer science identity. Growth was stronger and more consistent for CT confidence, while changes in computer science identity were more modest. These results should be interpreted alongside the cross-sectional findings, which provide a more detailed view of annual changes across the full set of survey constructs.

Student Computational Thinking Knowledge Assessment Results

The student computational thinking knowledge assessment was used to examine changes in students' CT knowledge over the course of project participation. Results were analyzed in two ways. First, annual cross-sectional analyses examined changes from baseline to each year's post-assessment for the students with matched data in that implementation year. Second, a longitudinal analysis examined change over time for students with complete assessment data across all four administrations. As noted in the methodology section, results should be interpreted with caution because assessment reliability was limited, particularly at the subscale level.

Cross-Sectional Analysis of Computational Thinking Knowledge Assessment

Across the annual cohort analyses, students began with relatively low scores on the computational thinking knowledge assessment. Average pre-assessment scores were similar across years, ranging from 7.43 to 7.55 correct responses out of 25. Figure 10 displays average overall computational thinking scores by implementation year. Average scores increased from pre- to post-assessment in each implementation year. In Year 1, scores increased from 7.55 to 8.93. In Year 2, scores increased from 7.43 to 9.41. In Year 3, scores increased from 7.51 to 9.99. The Year 3 increase was statistically significant, $t(277) = 10.48$, $p < .001$, Cohen's $d = 0.63$.

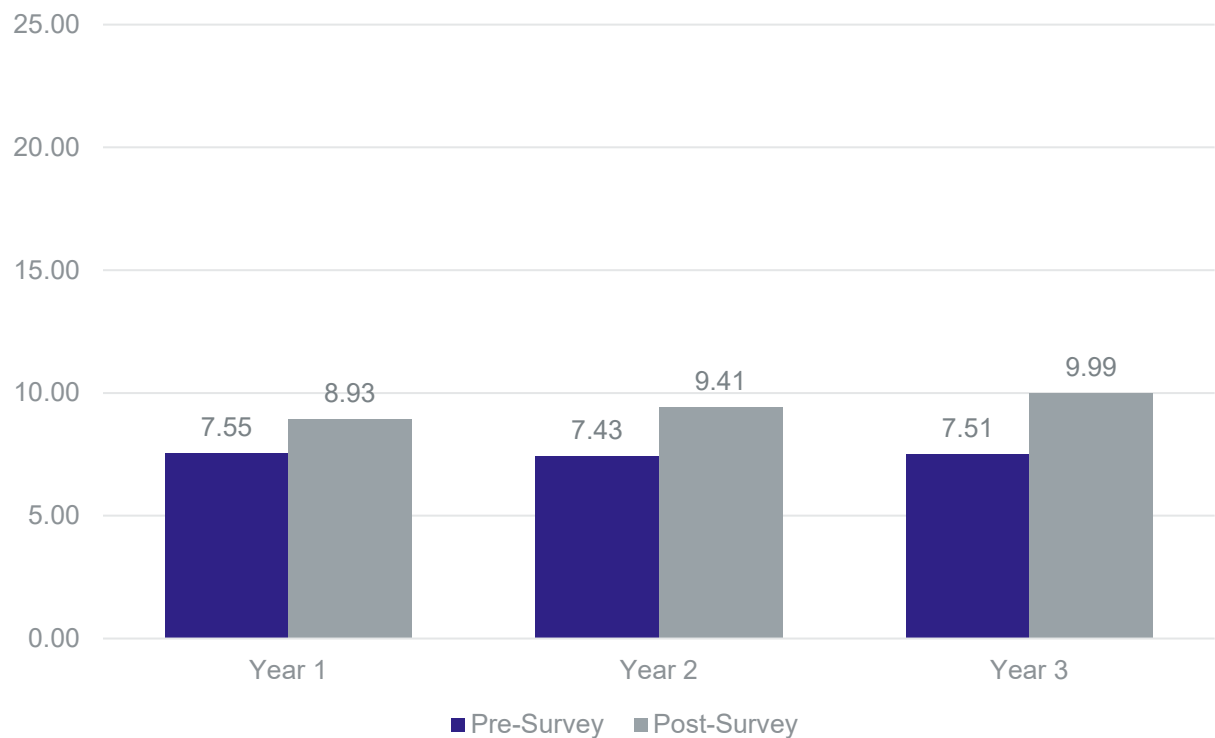


Figure 10. Student Computational Thinking Assessment Scores by Administration Across Years

Table 27 presents raw total correct scores overall and by subscale for each year's cohort. Subscale results followed a similar pattern across years. Students scored highest on Pattern Recognition at both pre- and post-assessment, and Pattern Recognition scores increased in each implementation year. Students scored lowest on Abstraction at pre-assessment across all three years, though Abstraction scores also increased from pre- to post-assessment. These results suggest that students showed growth in CT knowledge during each implementation year, while also indicating that some CT dimensions, particularly abstraction, remained more challenging.

Table 27. Raw Total Correct Scores Overall and by Subscale by Implementation Year

Scale (Number of Items)	Year 1 2022-23 (N = 330)				Year 2 2023-24 (N = 336)				Year 3 2024-25 (N = 278)			
	Pre		Post		Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Overall (25)	7.55	2.94	8.93	3.15	7.43	3.06	9.41	3.43	7.51	2.98	9.99	3.68
Abstraction (4)	0.72	0.75	1.15	0.94	0.72	0.78	1.41	1.05	0.74	0.79	1.38	1.06
Algorithmic Thinking (9)	2.64	1.44	3.08	1.52	2.61	1.48	3.01	1.43	2.67	1.46	3.37	1.55
Decomposition (4)	1.31	0.97	1.46	0.97	1.22	0.93	1.57	0.99	1.28	0.96	1.67	1.10
Evaluation (5)	1.72	1.10	1.78	1.12	1.70	1.13	2.04	1.14	1.69	1.08	2.08	1.18
Pattern Recognition (3)	1.15	0.76	1.45	0.80	1.17	0.76	1.38	0.76	1.13	0.78	1.49	0.84

Longitudinal Analysis of Computational Thinking Knowledge Assessment

The longitudinal analysis included students with complete computational thinking assessment data across all four administrations. Among this group, average scores increased steadily over time, from 7.77 correct responses at baseline in 2022 to 9.33 in 2023, 9.64 in 2024, and 10.23 in 2025. The increase from baseline to the Year 3 post-assessment was statistically significant, $t(132) = 7.43$, $p < .001$, Cohen's $d = 0.64$. Figure 11 displays average computational thinking scores across time.

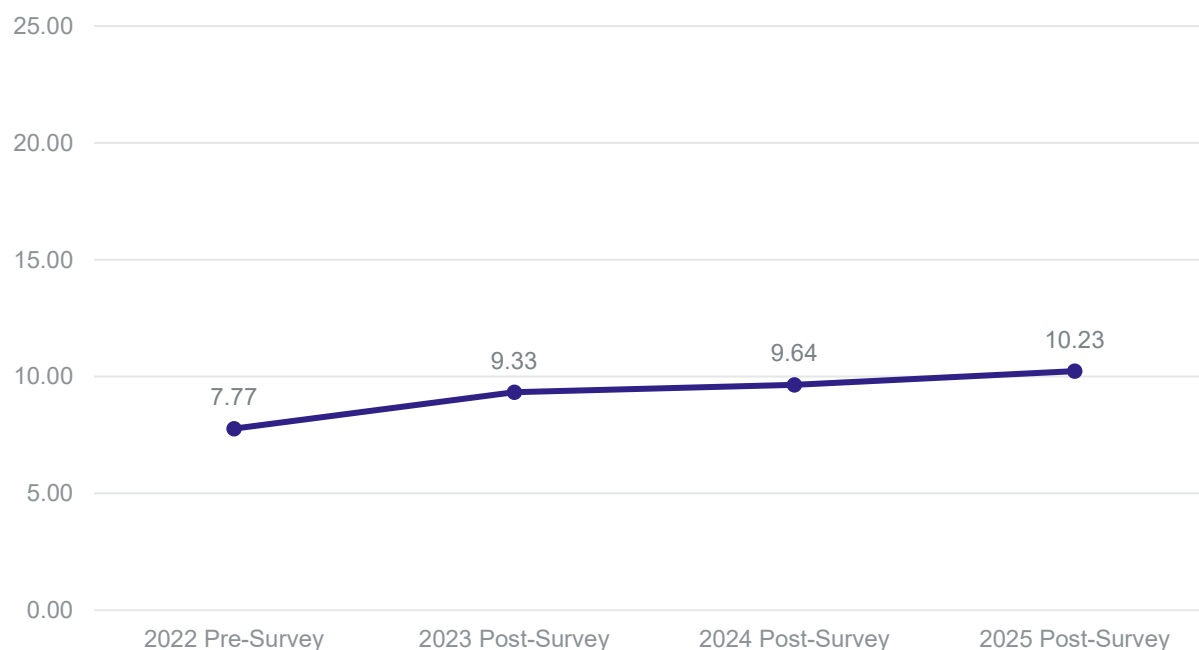


Figure 11. Longitudinal Computational Thinking Assessment Scores Across Years (N = 133)

Table 28 presents raw total correct scores overall and by subscale for the longitudinal sample. As with the annual cohort analyses, students in the longitudinal sample scored highest on Pattern Recognition. At baseline, students scored lowest on Abstraction. Across later administrations, Abstraction and Algorithmic Thinking remained among the lower-scoring subscales. Overall, the longitudinal findings provide evidence of measurable growth in CT knowledge across the project period. At the same time, average scores remained below half of the total possible score by the final administration, suggesting that students' CT knowledge increased but continued to be an area for development.

Table 28. Longitudinal Raw Total Correct Scores Overall and by Subscale (N = 133)

Scale (Number of Items)	2022 Pre-Survey		2023 Post-Survey		2024 Post-Survey		2025 Post-Survey	
	M	SD	M	SD	M	SD	M	SD
Overall (25)	7.77	2.74	9.33	3.08	9.64	3.59	10.23	3.58
Abstraction (4)	0.71	0.74	1.29	0.99	1.47	1.06	1.53	1.04
Algorithmic Thinking (9)	2.86	1.47	3.11	1.40	3.05	1.44	3.38	1.47
Decomposition (4)	1.25	0.94	1.50	0.99	1.61	0.94	1.75	1.15
Evaluation (5)	1.82	0.99	1.86	1.11	2.06	1.16	2.07	1.21
Pattern Recognition (3)	1.13	0.75	1.58	0.78	1.45	0.77	1.50	0.79

Student Focus Groups

Student focus groups were conducted annually with students from the participating schools to understand their experiences with the BTCSEI project and related computational thinking activities. Focus groups explored students' understanding of computational thinking, perceptions of CT units in their classes, experiences with career exploration, perceptions of computer science, and future coursework and career interests.

Defining Computational Thinking

Across the grant period, students' understanding of computational thinking varied. Some students reported little or no familiarity with the term, while others associated it with general learning behaviors such as focusing, collaborating, asking questions, or *"thinking outside of the box."* Students were generally more specific when computational thinking had been explicitly named in class. In Year 1, one student described a classroom routine in which the teacher connected assignments to specific CT practices: *"For my teacher, he writes the computational thinking part in the assignment. So, each assignment we have, we have to write which one of them corresponds with the assignment."* Students in that group described CT as connected to problem-solving and also made connections between computational thinking, math, and computer science.

Students also recalled other moments when teachers explicitly named computational thinking in class. One student said, *"Our teacher introduced computational thinking in Math 2 and*

Chemistry,” while another remembered that “we had to break down three separate things—identifying, understanding, and design.” By the final year, some students could point to similar examples across courses. One student described learning about CT through a physics assignment that asked students to explain how they used computational thinking during a project. Another remembered a math teacher referring to CT across multiple years: “My math teacher, she said it twice every year where she’ll just bring it up here and there. ‘Oh, you use your computational during this.’”

In other focus groups, students had heard the term but were less able to explain it. One Year 2 student described the issue directly: *“I remember hearing my teachers talk about it and mention it, but it was never explained.”* Other students could connect computational thinking to broader ways of thinking, even if they were not fully confident in their definitions. As one student explained, *“It might be a mindset of how you think and how you work with what you know and try to make sense of it.”* Another student made a similar connection, saying, *“CT makes me think of ways to solve specific problems.”*

By the final year, some students were able to describe computational thinking in more specific terms. A computer science student described CT as *“thinking like a computer and thinking how programs work,”* explaining that it meant thinking *“step by step and algorithmically.”* Another student described a similar process: *“It’s an easy way to break down a big problem into steps. Instead of worrying about that big picture, you can focus on taking it one step at a time.”*

However, students’ responses showed that familiarity with CT practices did not always mean students could define computational thinking. Some students recognized that they were using CT-related skills in class but also noted that the terminology was not always emphasized. As one computer science student explained, *“We’re using computational thinking and using those skills, but we’re not necessarily, that’s not being pointed out to us.”* Another student made a similar observation: *“We might not know what computational thinking is, but we definitely practice it. A lot of teachers have done it a lot.”* Further, one computer science student captured the challenge of defining computational thinking directly:

I don’t think we have a good definition of the term and it’s very superficial of our understanding of the term. So, I think it’s hard for us to define something when we don’t really know deeply about it, about the term.

Making Connections in the Classroom

Students described CT-related practices across math, science, and computer science coursework. In math, students connected CT-related practices to breaking down problems and working through steps. Students who discussed a linear equations unit described learning to deconstruct questions and problems. One student explained, *“I think it helps you break down a question more, with the kind of material that they taught us. I think especially if it’s computer science. Looking at a problem in a different way from multiple angles really helps.”* In another focus group, students said the work was easier to understand because the teacher *“does it step-by-step, and it’s super clear”* and *“goes into depth or uses real-life problems to actually explain it.”*

In science, students connected CT-related practices to investigation, data, and problem-solving. One student connected computational thinking to a unit on the nitrogen cycle, explaining, *“At the beginning, I kind of thought about it. Does it mean thinking of ways to better something? Because right now we’re doing the nitrogen cycle, and we’re researching ways to make it more effective and not as dangerous when produced in mass.”* Another student described this work across multiple science classes:

For my science classes, especially AP Bio this year and then honors biology, we do a lot of that. Gathering data, collecting data, creating data, analyzing data, and then making graphs based on data as well.

In computer science, students described CT-related practices through the process of planning, organizing, and debugging code. Students discussed breaking programs into smaller parts, reading code line by line to understand how it worked, and troubleshooting when the code did not run as intended. One computer science student described using pseudocode as a planning step before writing the final program: *“I first have to create a pseudo code for it if I really want to understand it,”* and then implement it in Java. Other students described building larger programs from smaller pieces of code, which required them to think through the sequence, structure, and logic of their work.

Perceptions of Computational Thinking Units

Students’ strongest memories of CT units and activities were connected to hands-on, applied, or real-world projects. Across the focus groups, students described graphing tasks, science investigations, engineering and design challenges, and computer science assignments. The activities students remembered most often involved creating something, testing an idea, comparing options, revising a design, or applying classroom learning to a real-world situation.

Students described CT units as more engaging when they involved active participation rather than lecture-based instruction. One student summarized the appeal of project-based work this way:

I feel like projects are really better. It just gets you more involved. If you just sit there and lecture them about it, I highly doubt anyone’s going to listen. So, if you do a project that’s more hands-on, artsy, or in a way that gets their attention, it’ll definitely expose them to computer stuff.

At the same time, students did not describe hands-on projects as easy. Students discussed challenges related to math, precision, sequencing, creativity, trial and error, and persistence. One student described the basketball modeling project as challenging, saying, *“The basketball portion was hard. It took a lot of tries to get it right.”* Another student described projects as helpful for understanding but also personally challenging, explaining, *“I think that mainly in the projects, it’s just the creativity that helps with understanding. But this is just not my thing.”*

Projects stood out when students could connect the task to a real-world problem or personal interest. In science, an oyster-related acid-base experiment was memorable because it connected classroom learning to an environmental problem:

So, in this bay, the oysters were dying, and we had to figure out how acidic the ocean was. It was cool because I'm kind of into the animal stuff. We had to think about what we could do to prevent the oysters from dying, and that was kind of interesting for me.

By the final year, students continued to describe hands-on projects as memorable, particularly when they involved creating, testing, or revising something. One student remembered the rocket activity positively, saying, *"I liked the rocket one. It was pretty... you got to make your own and then you get to see other people's rocket ships too."* Another student described the value of applying what they had learned: *"I liked the creative process, how at the end of learning all this information and how to basically apply it and use it and make it something in front of you."*

Some students described the process involved in completing these projects. One student described a physics project that required planning, testing, and revision:

One of the projects that we did was building a rocket and launching it and I had to do a lot with computational thinking because I couldn't just straight up build it in one day. I had to draw, plan it out with my group mates and then we started testing it multiple times to make sure it wouldn't explode or fall apart. And then on launch day we finally came up with the final design, and it was able to launch successfully after carefully planning and designing it.

Students also described the demands of this kind of work. One student described an optimization project by saying, *"It was a really cool project, but it required a lot of steps, and then you had to make sure your steps were correct in order so the box would actually fit."* In another focus group, a student said a hot air balloon project was difficult because *"it'll have to be very proportionate,"* while another said the hardest part was making *"a blueprint with all the math on it."* Other students connected hands-on work to independence and persistence. One computer science student said they liked that the work was *"more hands-on instead of the teacher lecturing me,"* because *"I could actually figure it out myself."* Another student described needing patience, explaining, *"I can't just skip steps or skip resources or instructions just because I'm really impatient."*

Students also noted that projects were harder to follow when the connection among activities was unclear. One student described some math projects as disconnected from one another: *"One time, we had to make a whole city. Then now, we're shooting basketball hoops and making a push out of it. That's weird. They're really random."* Another student suggested that CT needed to be reinforced more consistently, saying, *"Maybe create more lessons based around it, to really establish it as one of those things we have to know."*

Career Exploration and Pathful

Career exploration was an important part of students' project experiences, but student recall varied across years. In Year 1, students most clearly remembered Pathful as part of the *"Is College Worth It?"* unit, where they explored careers, income, education requirements, and possible pathways. Students described the platform as useful because it helped them see

career options, compare pathways, and think about what preparation different careers required. One student said they liked “*having the idea of what you needed to do to prepare if you want to do that, the pathway,*” because it helped them “*sort of plan it out.*” Another student explained that the tool gave them “*insight of stuff that I might want to consider being when I’m older.*”

For some students, the career exploration activity also shaped how they thought about future education. One student reflected:

I kind of feel like the project convinced more people to choose to go to college because some of the jobs that didn’t require college didn’t really pay them money. And once they saw, if they went to college and went to all of these programs, they saw how much they would be making. For example, my friend, she’s saying, ‘Maybe I should go to college.’ And I feel like, if you go to college and get your degrees and all that, people respect you more. They see, ‘Oh, wow. She went through all that.’

Students’ career aspirations were also shaped by family members, personal experiences, and encouragement from people they trusted. Several students named family members as models for the careers they wanted to explore or as people who helped make a pathway feel more concrete. For example:

My cousin, she’s studying to be in medical. And I think she’s the only person in my family who wants to be in the medical field. So, I think it’s interesting.

My grandpa actually has cancer, so I was looking into majoring in oncology because I’ve gone to the hospital with him and seen the things that they do. And I was really interested in that.

My cousins and my aunts happen to be real estate agents, and they talk to me a lot about how they got there, what they did in school, what colleges they went to. So, it’s inspiring me to shoot for the stars.

Students also described family members as important sources of encouragement. One student said, “*For me, my parents are very supportive of the ideas that I want to do. They encourage me to follow what I want to do. If I mentioned that I’d like to do something, they’d support me and tell me that I could do it.*” Another student connected their parents’ encouragement to education, explaining, “*My mom and my dad did inspire me because they told me they weren’t able to get the education they get to get a higher job, so they tell me to get as much education as I can to go to a four-year college.*”

By the final year, students’ recall of Pathful was mixed. Some students remembered using Pathful or a similar tool to explore careers, complete a survey, or identify careers aligned with their interests. Among students who remembered it, comments were generally positive. One student said, “*I liked it because it allowed me to think of my future and what I could possibly do.*” Another described it as “*somewhat helpful because I could check out some careers that would match with my interests.*” A student described Pathful as broadening their awareness of possible careers:

I feel like Path helped a lot with connecting you to... different things that you didn't even think were careers. I saw a lot of different careers that I didn't even know existed.

Perceptions of Computer Science

Students' perceptions of computer science were mixed across the three years. Some students described computer scientists in stereotyped ways. They imagined a computer scientist as “a very smart person” with a “pushed-back hairline [and] glasses,” who sits at a desk all day “typing” on computers, “doing their magic,” “coding,” or “hacking.” Other students had broader views. One student explained:

They can do everything because the job that I want involves computer science, stuff like that. So, I don't technically think it's coding specifically. I think it's a lot of things. They can be writing things down on the computer, it can be coding, it can be a lot of things.

For some students, reluctance to pursue computer science was not only about perceived difficulty. It was also about whether they could imagine CS as active, social, creative, or connected to the kinds of work they wanted to do. One student explained:

I think I like to actually be doing things. And I feel when I think of computer science, I just imagine sitting at a table in front of you. I know there's a lot of options [but] that's what I think of. And I don't really like doing that. I really want to do things.

Other students described computer science as involving “too much screen,” “time-consuming,” “a lot of work,” “draining,” or “unmotivating.” One student put the concern in social terms: “I need human interaction to function. If no one's talking to me and I'm just staring at a box, I can't do that.”

At the same time, students recognized that CS-related skills could be useful in fields outside of computer science. One student connected computing to both automotive technology and game development:

... being a technician but also a game developer. ... For both career paths would be because I used to code back in elementary school as a program that we used to have. For automotive would be because my dad, at his age, started working on cars, and right now, I helped him work with cars, especially right now we're working on electric cars ...

Students with more direct CS exposure sometimes described computer science in more expansive terms. Some described programming as imaginative and creative, while others emphasized the broad applicability of CS. One student said, “Computer science can apply to almost anything. Almost every career needs some computer science type of thing in their jobs.” Still, many students remained hesitant or uninterested. Some described CS as “cool, but not for me,” while others said they were not interested in coding or technology, had already chosen

different career goals, or did not know enough about CS beyond coding to find it appealing. One student said, *“I could see myself using it for research or something else, but as a career path, no.”* Another explained, *“I think it could be beneficial for the future, but I think you need a lot of patience to do it. And I don’t think I have that.”* For some students, limited exposure also shaped their perceptions. One student said, *“If I actually took a class and learned more about it, I think I would give it a try.”*

Plans to Take Computer Science

Students’ plans to take computer science or ICT-related courses varied. Some students were interested in learning more about computers, coding, cybersecurity, or technology-related courses. One student said, *“It looks very interesting to learn more about the computer. There could be a lot of things I don’t know.”* Another said they were interested because *“there’s a lot to learn from computers since they’re so advanced and there’s so many different things you can do with them.”* Students also acknowledged that computer science might feel difficult at first. When asked whether a computer science class sounded difficult, several students said, *“a little.”* One student explained, *“After you learn it was going to be easy, but at first, trying to learn all the steps and all the little details, it’d be challenging at first.”* Other students were interested in technology-related coursework because their intended careers would require computer use.

Many students did not plan to take computer science or were unsure. Some students said they had *“thought about it, but no,”* while another said, *“Maybe? It depends on how my schedule looks.”* Others said, *“Not next year”* or *“Not sure.”* Some students explained that they wanted to focus on other areas. One student said, *“No, I don’t think so. I was thinking about it, but I wanted to focus on other stuff.”*

Students with direct CS course experience described a different set of possibilities. Some had already taken AP Computer Science, cybersecurity, introductory computer science, or a related course. One student said, *“I took AP Computer Science, so I think that counts,”* while another shared, *“I took half a year doing cybersecurity.”* Some students described future plans connected to computer science, engineering, data, or technology. One computer science student shared, *“I already got into computer science. That’s my major at UC San Diego, and I’m really excited about the opportunities I have.”*

Suggestions to Increase Computer Science Interest

Students offered several suggestions for increasing interest in computer science. Their comments focused on making CS feel more relevant, accessible, and connected to students’ interests or future plans. Students suggested that teachers include *“more computer assignments,”* *“talk even more about it,”* and help students see how CS connects to careers, income, lifestyle, and real-world applications.

Students also suggested that adults should encourage computer science interest more intentionally. One student said, *“I think because it’s not a very popular choice, especially when choosing your career. So, I think encouraging it like everything else would be important.”*

Another student emphasized that CS-related knowledge could support many career pathways, not only computer science careers:

For me, I think to encourage it more because the amount of possibilities for not just becoming a computer scientist though, but with the benefits that come with the knowledge and pretty much that could help you out with any other part of your career pathway. For example, for me, I really want to get to automotive technology, so pretty much all that computer program, because right now our vehicles of the future are going to be more electric.

Students also described instructional supports that would make CT and CS more approachable. They suggested group work, opportunities to hear peers' questions, slower pacing, authentic real-world projects, and activities students could relate to. One student suggested that teachers present skills at a *"slower pace, because I would be stuck on the first two steps and everybody else would be almost finishing."* Others suggested making projects more authentic and real-world, with one student saying, *"Make it something they can relate to."*

Implementation Fidelity

The Implementation Fidelity Checklist was used to assess the extent to which each core BTCSEI component was implemented as intended at each participating school. For each component, school-level scores were compared with predetermined thresholds for adequate implementation. Schools were considered to have implemented a component with fidelity when the school-level score met or exceeded the threshold for that component and implementation year. Table 29 summarizes implementation fidelity by component, school, and implementation year. Overall, implementation fidelity varied by component, school, and implementation year. The project was implemented most consistently in areas connected to teacher professional learning and classroom CT unit development, while implementation was less consistent for components that depended on changing administrator participation structures or integrating student-facing career exploration tools into classroom practice.

Table 29. Implementation Fidelity by Component, School, and Implementation Year

Component	Year	Anaheim HS	Cypress HS	Loara HS
Component 1: Coaching for Administrators	Year 1	No	No	No
	Year 2	Yes	Yes	Yes
	Year 3	Yes	Yes	Yes
Component 2: Professional Learning for Teachers	Year 1	Yes	No	Yes
	Year 2	No	Yes	Yes
	Year 3	Yes	Yes	Yes

Component	Year	Anaheim HS	Cypress HS	Loara HS
Component 3: Curricular Materials	Year 1	Yes	Yes	Yes
	Year 2	Yes	Yes	Yes
	Year 3	Yes	Yes	Yes
Component 4: Student Career Exploration and Mentoring	Year 1	N/A	N/A	N/A
	Year 2	No	No	No
	Year 3	No	No	No

Note. “Yes” indicates that the school met the fidelity threshold for the component during the implementation year. “No” indicates that the school did not meet the fidelity threshold. “N/A” indicates that the component was not applicable or not measured during that implementation year.

Component 1: Coaching for Administrators. All three schools did not meet the fidelity threshold in Year 1 but met the threshold in Years 2 and 3. This pattern reflects the shift from Year 1, when 5Cs Coaches were the primary Portico participants and assistant principal participation was optional, to Years 2 and 3, when assistant principals participated in the required Copilot and Counterpart activities. These findings suggest that administrator coaching became more consistently implemented once the participant role shifted more clearly to assistant principals.

Component 2: Professional Learning for Teachers. Fidelity varied by school during the first two years and was met across all three schools in Year 3. Anaheim and Loara met the threshold in Year 1, while Cypress did not. In Year 2, Cypress and Loara met the threshold, while Anaheim did not. By Year 3, all three schools met the threshold. This pattern suggests that the teacher professional learning component was generally implemented as intended, with some school-level variation in participation before becoming more consistent across sites in the final year.

Component 3: Curricular Materials. All three schools met the fidelity threshold in every implementation year. This was the most consistently implemented component of the project and indicates that participating teachers across Anaheim, Cypress, and Loara consistently engaged in the expected CT unit release time, curriculum development, and classroom implementation activities.

Component 4: Student Career Exploration and Mentoring. The fidelity threshold was not met at any school in Years 2 or 3 and was not applicable in Year 1. Fidelity for this component was based on use of Pathful Connect and Pathful Explore, and the ratings indicate that these tools were not integrated consistently enough across classrooms to meet the school-level implementation threshold. However, this finding should be interpreted narrowly. Student focus group findings indicate that some students did experience career exploration activities and found them useful. The fidelity results show that the specific Pathful-related implementation expectations were not met consistently across schools.

Conclusion & Recommendations

The Building Toward Computer Science Equity and Inclusion (BTCSEI): Developing an Ecosystem of Supports project was designed to increase enrollment and retention of female students and Latinx students in computer science (CS) courses by improving computational thinking (CT) skills, developing schoolwide and student CS identity, and creating an ecosystem of supports to facilitate equity and inclusion in CS. This section presents conclusions and recommendations from the implementation evaluation. It focuses on what was learned about how the BTCSEI project was implemented, what supported or limited implementation, and what may be useful for future sustainability or replication. The outcomes evaluation chapter includes its own conclusions and recommendations related to student outcomes.

Key Takeaways from the Implementation Evaluation

BTCSEI was organized around four intervention components intended to work together to support CT integration across participating schools. Component 1 focused on administrator coaching through Portico. Component 2 provided professional learning for teachers through Summer Institutes and Communities of Practice. Component 3 supported teachers in developing and implementing CT-focused curricular materials within participating courses. Component 4 focused on student career exploration and mentoring, primarily through Pathful and related classroom experiences. Across these components, OCDE and AUHSD provided the coordination needed to translate the grant design into district and school-level implementation. The key takeaways below interpret what was learned across these components, with attention to where implementation was strongest, where the broader ecosystem was less fully developed, and what the findings suggest for sustainability and replication.

Key Takeaway 1: Instructional Implementation Was the Strongest Part of the Model

BTCSEI built a strong instructional foundation for CT integration. The clearest implementation strength was at the teacher and classroom levels. Across the grant period, teachers developed greater knowledge of CT; participated in professional learning and Communities of Practice; created CT-focused units; and implemented CT within math, science, and computer science courses. The project was able to move CT from a broad grant goal into classroom-level practice. CT was not only discussed as an equity strategy or future pathway skill; it became something teachers planned for, and students experienced through regular coursework.

CT integration was strongest when it supported work teachers were already doing. The project was most successful when CT could be connected to existing instructional routines, including professional learning, collaboration, unit planning, and classroom instruction. Teachers were not being asked to create a separate CT course or replace their existing content. They

were being asked to identify how CT could deepen disciplinary learning and make problem-solving practices more explicit. The findings suggest that CT integration became more feasible when teachers could connect it to tasks they already valued, such as data analysis, modeling, scientific inquiry, coding, simulations, graphing, interpretation, and problem solving.

Teacher collaboration was part of the implementation model, not just a support. CT integration required teachers to translate broad concepts into specific classroom practices. That work was difficult to do independently, especially when teachers were learning how CT applied across different disciplines and grade levels. The CoP structure and quarterly release days created time for teachers to interpret CT together, compare examples, revise units, and work through implementation challenges. The broader takeaway is that collaboration was not simply helpful for morale or buy-in; it was part of how teachers made sense of CT and turned it into instruction.

Teacher needs changed as implementation matured. Early in implementation, teachers needed clearer examples of what CT meant and how it could appear in their courses. As the project progressed, their needs became more applied and more specific. Teachers wanted examples across disciplines, feedback on unit design, access to work from prior cohorts, and strategies for helping students recognize CT in the work they were already doing. This suggests that the professional learning component was helping teachers move beyond initial awareness.

Key Takeaway 2: Classroom Implementation Was More Developed Than the Broader Ecosystem of Supports

The project made more progress with classroom implementation than with the full ecosystem of supports. BTCSEI was designed as an ecosystem, not only as a teacher professional learning initiative. The project's components were intended to work together so that CT became part of classroom instruction, school leadership, student identity development, career exploration, and future pathway awareness. The implementation findings suggest that the parts of the ecosystem closest to the direct project activities changed first. Teacher professional learning and CT unit development created a foundation for classroom implementation, while broader schoolwide routines and student-facing pathway structures were still developing. This does not diminish the progress made through teacher learning and CT unit development. Rather, it suggests that building a full ecosystem of supports is a developmental process: classroom-level implementation can begin within a grant period, but the work must continue outward into school leadership structures, advising, career exploration, and pathway systems to become more coherent and sustainable.

Administrator engagement strengthened, but leadership routines were still emerging. Administrator coaching became more clearly connected to implementation after the project shifted from 5Cs Coaches to assistant principals. Administrators increasingly understood the project and supported implementation through communication, resources, substitute coverage, classroom visits, and connections to school priorities. The remaining need was not simply more administrator awareness; it was a more defined set of routines for how administrators would continue supporting CT after the grant. For CT to move from classroom practice to a sustained

schoolwide priority, leaders would need regular ways to recognize CT in instruction, support teacher collaboration, connect the work to school improvement planning, and keep CT and CS pathway conversations visible over time.

Career exploration and mentoring were intended to be part of the broader ecosystem of supports, but access and training did not translate into regular student-facing implementation. Component 4 was designed to help students connect CT and CS to future coursework, careers, role models, and their own interests. Pathful provided a platform for career exploration, and teachers had access to the tool and related supports. However, access to the platform and training on how to use it did not consistently lead to use. Pathful implementation did not meet fidelity thresholds in Years 2 or 3, and mentoring did not become a consistent part of the project. The issue is not that students had no career-related experiences; rather, student-facing pathway supports were not built into classroom routines, advising structures, or schoolwide practices in ways that supported regular implementation.

Sustainability depends on whether CT becomes part of school routines. BTCSEI created important implementation assets, including teacher capacity, CT-focused units, administrator awareness, and materials that could support continued work. The sustainability question is whether those assets become part of regular school and district practice. If CT remains tied primarily to the teachers who participated in the grant, implementation may fade as roles, courses, and priorities change. If CT is built into professional learning, teacher collaboration, unit refinement, administrator routines, career exploration, and advising, the work is more likely to continue beyond the grant period.

Key Takeaway 3: Implementation Strengthened as the Project Became Better Aligned to District and School Conditions

Adaptation helped make implementation more feasible. BTCSEI did not unfold exactly as originally proposed. The final implementation model was smaller than originally envisioned, with implementation occurring in three schools within one district rather than across the larger multi-district model. This reduced the scale of implementation and should be considered when interpreting the scope and generalizability of findings. At the same time, implementation within one district created a more coherent context for planning, communication, and adaptation. As OCDE and AUHSD learned more about what schools, administrators, teachers, and students needed in order to participate, they refined the structures around the work. In this context, changes to roles, CoP formats, funding structures, and supports should be understood as part of the project's implementation learning rather than only as deviations from the original design.

Role alignment shaped participation. Several important implementation changes reflected a better fit between project expectations and participant responsibilities. The shift from 5Cs Coaches to assistant principals aligned the administrator component more closely with school leadership authority. The move from virtual before-school CoPs to quarterly meetings gave teachers more usable time for collaboration and unit development. Refinements to stipends, site funds, and support roles helped address the practical demands placed on participants and

schools. These changes helped make participation more feasible because they brought project expectations closer to participants' roles, schedules, and responsibilities.

Fidelity was strongest where expectations were concrete and role-aligned. The fidelity findings support this broader implementation pattern. Curricular materials met fidelity thresholds across schools and years, and teacher professional learning became more consistent over time. Administrator coaching also strengthened once the role was more clearly aligned with assistant principals. By contrast, fidelity was weaker where implementation depended on student-facing routines that were less embedded in daily practice, particularly Pathful-related career exploration. This suggests that fidelity in a complex school-based initiative depends not only on whether activities are offered, but also on whether expectations are clear, roles are aligned, and implementation structures fit the context in which the work is taking place.

Key Takeaway 4: Students Needed More Explicit Connections Among CT, CS, Careers, and Pathways

CT was present in students' coursework, but it was not always visible to students.

Student focus group findings suggest that many students engaged in CT-related practices through their coursework. Students described breaking problems into steps, identifying patterns, organizing information, using logic, testing ideas, and working through challenges. However, students did not always define these practices as CT or connect them to a broader understanding of CS. These findings suggest that CT can be embedded in instruction without students fully recognizing the practices they are using. To build CT confidence and CS identity, students need opportunities to name those practices, reflect on how they are using them, and understand how they connect to CS.

CT exposure did not automatically create a clear pathway connection. Student survey and assessment results showed growth in CT confidence and knowledge and focus group findings indicated that students were engaging in CT-related thinking. However, increased exposure did not consistently translate into a clear understanding of CS, a strong personal connection to CS, or firm intentions related to future CS coursework. Students can benefit from CT instruction and still not see CS as relevant, accessible, or connected to their futures. BTCSEI was grounded in the idea that earlier CT exposure could help expand access to CS coursework and pathways, but the implementation findings suggest that this connection has to be intentionally built through shared language, advising, course information, and classroom connections to future opportunities.

Students needed structured opportunities to connect CT experiences to CS, careers, and pathway decisions. BTCSEI was designed to build CT skills as part of a broader effort to increase CS identity and expand access to CS and ICT pathways for female students and Latinx students. Student findings suggest that many students were using CT-related practices in coursework, including breaking problems into steps, identifying patterns, organizing information, using logic, testing ideas, and working through challenges. However, students did not always recognize those practices as CT or connect them to CS. Career exploration and mentoring were intended to make those connections more concrete by linking classroom CT experiences to

course options, career fields, role models, and students' own future goals. Without those structured opportunities, CT instruction may strengthen students' problem-solving skills without fully supporting the identity, relevance, and pathway understanding students need to make informed decisions about future CS participation.

Key Takeaway 5: Future Sustainability and Replication Depend on Conditions, Not Just Activities

The strongest parts of BTCSEI point to the conditions needed for future implementation.

The project offers useful lessons for other schools and districts, but those lessons are not limited to the specific sequence of activities used during the grant. The strongest parts of implementation depended on conditions that made the work feasible and useful for participants, including clear roles, practical professional learning, dedicated collaboration time, discipline-specific examples, administrator support, student-facing CT language, career exploration routines, and connections to advising and pathways. These conditions help explain why some components became more fully implemented than others.

Replication should focus on coherence rather than copying the model exactly. Future implementation efforts would need to preserve the core purpose of BTCSEI while adapting structures to fit local contexts. The goal is not to reproduce each activity without regard to district and school conditions, but to build a coherent set of supports that allows CT to become visible in instruction, meaningful to students, supported by administrators, connected to career and course pathways, and sustained through school routines. In this sense, the project offers a model for how districts might organize CT and CS equity work, but not a fixed template that can be applied the same way in every setting.

Sustainability requires ownership beyond the grant-funded structures. By the end of the project, BTCSEI had helped build capacity and generate resources that could support continued CT integration. However, long-term sustainability will depend on whether schools and districts continue to maintain and use those resources after the grant period. This includes carrying forward the routines and responsibilities that made implementation possible, such as teacher collaboration, CT unit refinement, administrator support, shared materials, career exploration, and pathway communication. Sustainability is less about preserving every grant activity and more about whether the work becomes part of how schools support instruction and student planning over time.

Implementation and Methodological Considerations

Several implementation and methodological considerations should be kept in mind when interpreting these findings. These considerations are not separate from the implementation story. They reflect the realities of studying a multi-year initiative that was adapted over time, implemented across changing course contexts, and dependent on participation from district staff, school leaders, teachers, and students.

First, the project's final implementation design differed from the original proposal. BTCSEI was originally designed as a larger multi-district initiative, but implementation ultimately occurred in three schools within one district. This limited the scale of implementation and the extent to which findings can be generalized across districts or school contexts. At the same time, the AUHSD implementation model provided a more focused view of what it took to implement the project within one district system. Findings should therefore be interpreted as evidence from a smaller and more coherent implementation context rather than as evidence from the broader multi-district model originally envisioned.

Second, teacher cohorts changed each year. This was part of the implementation design, which followed students across grade levels and expanded from Integrated Math 1 in Year 1 to Integrated Math 2 and Chemistry in Year 2 and a broader set of math, science, and computer science courses in Year 3. As a result, teacher survey findings should be interpreted as annual pre-post findings for each cohort rather than as longitudinal change among the same teachers across the full grant period. Differences across years may reflect changes in implementation, but they may also reflect differences in participating teachers, course contexts, content areas, and students served.

Third, student data should be interpreted with attention to exposure, participation, and completion rates. Student survey and CT knowledge assessment findings provide useful evidence, especially for students with matched data. However, students' exposure to the intervention varied based on course placement, teacher participation, and the courses included in each implementation year. Complete longitudinal data were also available for only a subset of students. These data are useful for understanding patterns of change among students who completed the measures, but they should not be interpreted as representing every student's full experience across the project period.

Fourth, the student CT knowledge assessment had measurement limitations. The overall assessment score provides useful information about change in CT knowledge, but subscale reliability was limited. As a result, the overall assessment findings can support broad conclusions about change in CT knowledge, while subscale findings should be interpreted as descriptive patterns rather than strong evidence of change in specific CT domains. This distinction is important because the project focused on multiple CT practices, but the assessment was better suited to examining overall change than drawing fine-grained conclusions about each subdomain.

Fifth, classroom observations captured single lessons during scheduled site visits. Because observations were snapshots of instruction, they should not be interpreted as a complete picture of each teacher's unit, course, or overall instructional practice. We would not expect all CT mindsets, skills, and practices to appear in every observed lesson. Observation findings are most useful for understanding examples of how CT appeared during instruction, the kinds of classroom conditions in which CT was implemented, and which CT practices were more or less visible during observed lessons.

Finally, many implementation findings rely on self-report data from administrators, teachers, students, and project staff. These data are important because they capture participant

experiences, perceptions, and sensemaking over time. However, self-report findings should be interpreted alongside project records, participation data, classroom observations, focus groups, assessment results, and fidelity ratings. The strength of the implementation evaluation comes from the use of multiple data sources, not from any single measure or perspective.

Collectively, these considerations clarify what the implementation evaluation can most strongly support. The findings provide evidence about how the project was implemented, how implementation changed over time, how participants experienced the work, which supports were most useful, and what conditions appeared to support or limit implementation. They should be used to interpret the implementation of BTCSEI within its actual context and to inform future efforts to sustain or replicate CT and CS equity initiatives in other settings.

Recommendations and Lessons for Future Implementation

The following recommendations are intended to inform future efforts to implement, sustain, or replicate CT and CS equity initiatives in secondary schools.

Define the implementation infrastructure needed to support the work. A strong intervention model still has to be translated into district and school routines. Before implementation begins, project teams should clarify who will manage district coordination, school communication, purchasing, stipends, substitute coverage, data-sharing, student tracking, and participant follow-up. These operational structures directly affect whether administrators, teachers, and students can participate fully and whether project activities can be implemented consistently. For similar projects, implementation planning should include clear roles, timelines, decision points, and communication routines before professional learning or student-facing activities begin.

Provide discipline-specific models that show what CT looks like in practice. General definitions of CT are useful, but they are not enough to support classroom implementation. Teachers need examples that show how CT fits within their own courses, standards, pacing, and instructional goals. Future implementation should include model units, annotated lessons, student work samples, and examples across math, science, computer science, and other relevant content areas. These resources should show not only the final lesson or unit, but also the design decisions behind the work: what was adapted, why it counted as CT, how students were expected to engage, and how teachers made CT practices explicit.

Treat structured collaboration as part of the intervention. CT integration requires teachers to translate broad practices into content-area instruction, and that work is difficult to do in isolation. Future efforts should protect collaboration time and ensure that teachers have opportunities to review examples, adapt units, examine student work, and discuss implementation challenges. Collaboration may occur through release days, summer planning, school-based planning time, cross-site Communities of Practice, or other structures. The format may vary, but the implementation model should make clear that collaboration is part of the work, not an optional support added around it.

Define administrator roles through concrete leadership behaviors. Administrator support is more useful when leaders have clear ways to reinforce the work. Future projects should define what administrator support looks like in practice. This may include attending key professional learning sessions, reviewing CT unit plans, observing CT instruction, supporting teacher collaboration, connecting CT to school improvement priorities, and communicating with counselors or pathway staff. Administrators do not need to lead every part of implementation, but they need routines for keeping CT visible and connected to school priorities after grant-funded supports end.

Help students recognize CT in the work they are already doing. Future implementation should support teachers in making CT more explicit during instruction without turning it into a disconnected vocabulary exercise. This may include using common CT language, asking students to reflect on the strategies they used to solve a problem, and connecting classroom tasks to broader CT practices. Students need opportunities to understand that breaking problems into steps, identifying patterns, testing ideas, and refining solutions are not just class activities; they are transferable problem-solving strategies connected to CS, other disciplines, and future opportunities.

Integrate career exploration into required classroom and school routines. Pathful implementation illustrates a common challenge with student-facing tools: access to a platform does not ensure consistent use. Career exploration activities should be built into course assignments, grade-level routines, advising structures, or schoolwide events. Future projects should specify when students will engage in career exploration, who will facilitate the activity, how it connects to CT instruction, and how students will reflect on what they learned. Career exploration is more likely to support student understanding when it is connected to classroom learning and future decision-making rather than treated as a separate activity.

Connect CT instruction to advising, counseling, and course pathways. CT exposure can help expand access to CS only if students understand how classroom experiences connect to future opportunities. Future efforts should involve counselors, pathway coordinators, and administrators more intentionally. Students need clear information about available CS and ICT courses, what those courses involve, how CT connects to them, and how course choices relate to future college and career options. These connections are especially important in high school, when many students already have developing interests, identities, and course plans.

Focus sustainability planning on roles, routines, and resources. BTCSEI developed teacher capacity, CT units, administrator awareness, and implementation tools that could support continued work. Sustainability will depend on whether those assets become part of regular school and district practice. Future efforts should identify teacher leaders, maintain shared repositories of CT units, embed CT into professional learning plans, clarify administrator roles, and connect CT to school improvement and pathway goals. Sustainability should not be treated as a final grant activity; it should shape implementation decisions throughout the project.

Design evaluation systems around implementation realities. Future evaluations should account for changing cohorts, student mobility, incomplete survey participation, differences in exposure, and shifts in implementation design. Student tracking procedures should be

developed early, especially when projects aim to follow students across multiple years or examine pathway outcomes. Measurement tools should also be piloted and reviewed for reliability before they are used to support major conclusions. These methodological considerations affect how well project teams can understand what was implemented, who was reached, and what changed over time.

Conclusion

The BTCSEI project demonstrates that computational thinking can be integrated into core academic instruction in ways that are feasible for teachers and meaningful for students. The strongest implementation evidence was at the teacher and classroom levels. Across the grant period, teachers developed greater capacity to understand, plan for, and implement CT, and students had opportunities to engage with CT through regular coursework. This created an instructional foundation for expanding access to CS by giving students earlier opportunities to build problem-solving skills, develop confidence, and encounter CT before making decisions about future CS coursework. However, the implementation findings show that CT integration alone is not enough to create a full ecosystem of supports for equitable CS participation. The broader goals of strengthening CS identity, career awareness, and future pathway participation require stronger connections across classroom instruction, school leadership, student reflection, career exploration, advising, and course-taking structures. Students need opportunities to use CT, recognize it, connect it to CS, and understand how it relates to their own interests and future plans. Similarly, teachers and administrators need routines, resources, and shared expectations that keep CT visible beyond individual classrooms or grant-funded activities.

As the implementation evaluation concludes, BTCSEI offers a useful model for how schools can begin building a foundation for CT integration and CS equity. The project made meaningful progress through teacher professional learning, CT-focused unit development, administrator engagement, and continuous improvement. Future efforts should build from these strengths while continuing the work of connecting CT instruction to student reflection, career exploration, advising, and pathway participation. In this way, CT can become not only a classroom practice, but part of a more coherent system of supports that helps students see CS as accessible, relevant, and connected to their futures.

Outcomes Evaluation: Examining Progress Towards Computer Science Equity



Silvana McCorkmick, PhD

David Mendelsohn, PhD

Project Outcomes Results

The Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports (BTCSEI) project is a five-year initiative funded through the U.S. Department of Education's Education Innovation and Research (EIR) program. The project is led by the Orange County Department of Education (OCDE) in partnership with Inflexion and seeks to address inequities in computer science (CS) education, with a particular focus on increasing enrollment and retention of female and Latinx students in CS courses. The initiative aims to strengthen students' computational thinking (CT) skills, build student and schoolwide CS identity, and establish an ecosystem of supports to facilitate more equitable access to and success in CS coursework and information and communications technology (ICT) pathways.

Redwood Consulting Collective, Inc. (RCC) served as the independent external evaluator for the project's impact evaluation. RCC is not affiliated with OCDE or Inflexion and played no role in the development of the BTCSEI intervention. In accordance with U.S. Department of Education evaluation requirements for independence of the evaluator, RCC independently conducted the impact analyses and reporting of study findings. RCC's findings related to the impact evaluation were not subject to approval by the project director or by staff involved in conceptualizing or implementing the BTCSEI intervention.

This report complements the project's separately prepared implementation evaluation. The implementation evaluation documents the BTCSEI intervention model, the activities conducted across project years, and the fidelity with which key intervention components were implemented. In addition, the implementation evaluation examines changes within intervention schools in the mediators and intermediate outcomes specified in the project's theory of action. These include changes in educator participation in professional learning and instructional practices related to computational thinking, as well as changes in student attitudes and beliefs associated with computer science participation. As part of this effort, Inflexion administered annual student surveys during Years 1 through 3 of the intervention measuring students' computational thinking confidence and computer science identity. The computer science identity scale included subscales assessing confidence in learning computer science skills, interest in learning computer science, perceptions of belonging in computer science, beliefs about the usefulness of learning computer science, and perceptions of encouragement to study computer science.

The present report focuses specifically on the impact evaluation and the outcomes examined through the study's analytic models. Consistent with the evaluation design plan and the final analytic approach, the report examines whether participation in BTCSEI was associated with differences in student outcomes between intervention schools and business-as-usual schools, whether outcomes differed within intervention schools based on student characteristics, and whether variation across intervention schools was associated with patterns of access, participation, retention, and performance in computer science classes and information and communications technology pathways for girls and Latinx students.

To address these questions, the evaluation draws primarily on district-provided administrative data and matched analytic samples. These data include student demographic characteristics, course enrollment records identifying whether students were taught by BTCSEI-trained teachers, Grade 8 baseline assessment scores from the Smarter Balanced Assessment Consortium (SBAC) mathematics assessment, Grade 11 mathematics SBAC scores, Grade 11 scores from the California Science Test (CAST), and school-level data on computer science and information and communications technology course offerings, enrollment patterns, and successful course completion.

The impact evaluation addresses three primary research questions:

1. Does the intervention result in differential outcomes for students between intervention and comparison schools?
2. Are there differential outcomes for students in intervention schools based on characteristics of the students or schools?
3. Across intervention schools, do levels of implementation fidelity of intervention components increase access, participation, retention, and performance in computer science classes and information and communications technology pathways for girls and Latinx student groups?

Together, the implementation evaluation and the impact evaluation provide complementary evidence about the BTCSEI initiative. The implementation evaluation documents how the project was implemented and examines changes in key mediators and intermediate outcomes within intervention schools, while the present report examines whether the initiative was associated with measurable differences in student achievement and participation in computer science and information and communications technology coursework.

The remainder of this report is organized as follows. The [Methods](#) section describes the study design, participating schools, analytic sample, and data sources used in the impact evaluation. The [Findings](#) section presents results aligned with each of the study's research questions, including comparisons between intervention and business-as-usual schools, analyses of differential outcomes among students within intervention schools, and analyses examining relationships between implementation fidelity and student participation and performance in computer science and information and communications technology coursework.

Outcomes Design and Methodology

Participants

Six schools in the Anaheim Unified High School District (AUHSD) participated in the evaluation. Three high schools (Anaheim High School (“Anaheim”, Cypress High School (“Cypress”), and Loara High School (“Loara”)) took part in the BTCSEI intervention (i.e., treatment), and three schools (Katella, Kennedy, and Western) served as the business-as-usual (i.e., control) condition. Table 30 provides school-level demographic information for Year 1 of the intervention, including enrollment, and percent of students who are female, Latinx, and eligible for free or reduced lunch (FRL).

Table 30. School-level demographics for BTCSEI and business-as-usual schools in Year 1 of the BTCSEI intervention.

School	Enrollment	% Female	% Latinx	% FRL Eligible
BTCSEI				
Anaheim	2,757	48.9	94.2	92.3
Cypress	2,777	50.2	31.1	50.9
Loara	1,596	48.9	81.7	88.7
Business-as-usual				
Katella	2,499	48.7	90.4	88.8
Kenedy	2,037	48.1	44.9	59.5
Western	1,684	48.3	74.9	88.7

Although the condition assignment occurred at the school level, the BTCSEI intervention involved math, science, and computer science (CS) teachers at participating schools and most analyses were performed at the student level. Across the three intervention years, multiple teachers from each participating school took part in the BTCSEI training (see Table 31).

Table 31. Teacher participation for BTCSEI schools in Years 1 through 3 of the intervention.

Year/Course	Anaheim	Cypress	Loara	Total
Year 1	6	3	4	13
Math	6	3	4	13
Year 2	9	9	6	24
Math	6	2	0	8
Science	2	6	5	13
CS	1	1	1	3

Year/Course	Anaheim	Cypress	Loara	Total
Year 3	9	8	5	22
Math	4	2	2	8
Science	4	5	2	11
CS	1	1	1	3

For each year of the intervention, student enrollment in participating teachers' courses was tracked to determine the overall reach of the BTCSEI intervention. Table 32 presents the number of students reached by participating BTCSEI teachers for each year of the intervention.

Table 32. Number of students reached by participating BTCSEI teachers by school in Years 1 through 3 of the intervention.

Year/Course	Anaheim	Cypress	Loara	Total
Year 1	431	157	379	967
Math	431	157	379	967
Year 2	464	603	312	1,379
Math	361	201	7	569
Science	224	602	312	1,138
Year 3	404	399	209	1,012
Math	178	185	96	459
Science	203	205	93	501
CS	188	187	119	494

Note: In years 2 and 3, it was possible for students to be in multiple classes with participating BTCSEI teachers. As such, the total students for each subject do not sum to the total students for the year.

Data were collected for students who entered Grade 9 in Year 1 of the BTCSEI intervention and were subsequently followed annually through Grade 11. These students were tracked longitudinally, with the final analytic sample being determined at the conclusion of the intervention.

Data were initially provided for 3,643 students (Treatment N = 1,923; Control N = 1,723) in Year 1 of the BTCSEI intervention. The district provided data for 3,349 students in Year 2 (Treatment N = 1,777; Control N = 1,572), and for 3,138 students in Year 3 (Treatment N = 1,682; Control N = 1,456).

Students were excluded from the analytic sample if they (a) no longer had data in Year 2 or 3 (e.g., moved out of district), (b) switched between treatment and control schools to avoid cross-condition contamination, or (c) did not have standardized test scores in both Grade 8 (baseline) and Grade 11. Students with only Grade 8 data were therefore excluded.

The final analytic sample pool included 2,268 students (Treatment N = 1,211; Control N = 1,057). Table 33 provides student-level demographic information for the analytic sample.

Table 33. Student-level demographic and baseline information for the analytic sample (N = 2268).

Condition	N	% Female	% Latinx	% FRL	Grade 8 Math M (SD)	Grade 8 Science M (SD)
Treatment	1,211	46.5	72.3	60.4	2497.69 (130.89)	399.81 (21.61)
Control	1,057	49.2	67.3	55.3	2484.91 (114.48)	396.94 (19.98)

For the primary outcomes analyses in Research Question 1 (Grade 11 Mathematics SBAC and CAST scores), propensity score matching was used to create final matched samples for each outcome of interest. It should be noted that the matching process was atypical, as the pool of control students was smaller than the treatment pool. To maximize the likelihood of successful matching, best practice suggests that the control pool should be significantly larger than the treatment pool. As such, this inversion in the sample sizes represents a limitation for those analyses and thus, findings should be interpreted with some caution. For the Grade 11 Mathematics analyses, 1,011 treatment students were successfully matched with 1,011 control students, representing an 83% success rate. Appendix P describes the matching process in more detail. For the Grade 11 Science analyses, 987 treatment students (out of a slightly smaller pool of 1,201 students) successfully matched with 987 control students (out of a slightly smaller pool of N = 1,054 students), representing an 82% success rate.

Data Sources & Measures

Impact evaluation data were primarily collected through the two grant partners: Anaheim Unified High School District (AUHSD) and Inflexion.

District Data

AUHSD provided annual student- and school-level data. Student-level data included school enrollment, demographics (gender, ethnicity, free/reduced lunch eligibility, ELL status), and course enrollment (to determine whether courses were taken with a BTCSEI-trained teacher). In addition, the district provided baseline (Grade 8) standardized test data for both math and science, as well as outcome standardized test data for both Grade 11 math and science.

Standardized math test scores used the Smarter Balanced Assessment Consortium (SBAC) math test, which is based on Common Core standards, and is an end-of-year test for grades 3 through 8, as well as grade 11. The scale score ranges, as well as the achievement level score ranges (i.e., standard exceeded, standard met, standard nearly met, and standard not met) vary

across different grade levels. The grade 8 and grade 11 scale score ranges, as well as the achievement level scale score ranges, are provided in Table 34.

Table 34. Scale score ranges and achievement level scale score ranges for grade 8 and grade 11 SBAC math test.

	Grade 8	Grade 11
Overall Scale Score Range	2290 - 2850	2300 - 2900
Achievement Level Scale Score Range		
Standard Exceeded	2668 – 2850	2682 - 2900
Standard Met	2567 – 2667	2583 – 2681
Standard Nearly Met	2487 – 2566	2493 – 2582
Standard Not Met	2290 - 2486	2300 - 2492

Standardized science test scores used the California Science Test (CAST), which measures proficiency in the California Next Generation Science Standards (CA NGSS), and is used in grades 5, 8, and once in high school (either grade 10, 11, or 12). AUHSD students take the high school CAST in grade 11. Similar to the SBAC, the scale score ranges, as well as the achievement level score ranges (i.e., standard exceeded, standard met, standard nearly met, and standard not met) vary across grade levels. The grade 8 and high school scale score ranges, as well as the achievement level scale score ranges, are provided in Table 35.

Table 35. Scale score ranges and achievement level scale score ranges for grade 8 and high school California Science Test.

	Grade 8	High School
Overall Scale Score Range	350 - 450	550 - 650
Achievement Level Scale Score Range		
Standard Exceeded	433 – 450	636 – 650
Standard Met	415 – 432	615 – 635
Standard Nearly Met	378 – 414	576 - 614
Standard Not Met	350 – 377	550 - 575

School-level data were also provided annually. These data included demographic data for the school (overall enrollment, percentage of student body who were female, percentage of student body who were Latinx, and percentage of student body who were FRL eligible), as well as

broader course-taking patterns and success rates (i.e., number of computer science or information and communication technologies (ICT) pathway courses offered, percentage of female and Latinx students who take computer science or ICT pathway courses, and percentage of female and Latinx students who successfully complete computer science or ICT pathway courses).

Inflexion Data

Inflexion provided additional data, primarily from a student survey, which they conducted annually in Years 1 through 3 of the BTCSEI intervention. Data for 212 students was received from Inflexion, however only 170 surveys could be matched to the student data provided by the district, so only those students were included in analyses. Two measures from the student survey were included in the impact evaluation: (1) a computational thinking confidence scale, which consisted of 12 items ($\alpha = .92$) and (2) a computer science identity scale, which consisted of 25 items ($\alpha = .86$). In addition to the overall scale, the computer science identity scale included 5 subscales (listed below), which were also explored in the analyses.

Computer Science Identity Subscales:

1. Confidence in ability to learn computer science skills and solve computer science problems (5 items; $\alpha = .85$)
2. Interest in learning computer science and solving problems (5 items; $\alpha = .88$)
3. Perceptions of belonging in computer science (5 items; $\alpha = .84$)
4. Belief in the usefulness of learning computer science (5 items; $\alpha = .86$)
5. Perceptions of being encouraged to study computer science (5 items; $\alpha = .86$)

Impact Analysis

RESEARCH QUESTION #1



Does the intervention result in differential outcomes for students between treatment and comparison schools?

Main Findings: Students at BTCSEI schools and business-as-usual schools did not significantly differ in mean Grade 11 SBAC scores. In addition, mean Grade 11 CAST scores for students at BTCSEI were significantly lower than those for students at business-as-usual schools. However, the difference may not be large enough to be considered meaningful or practical.

Impact on Student Outcomes

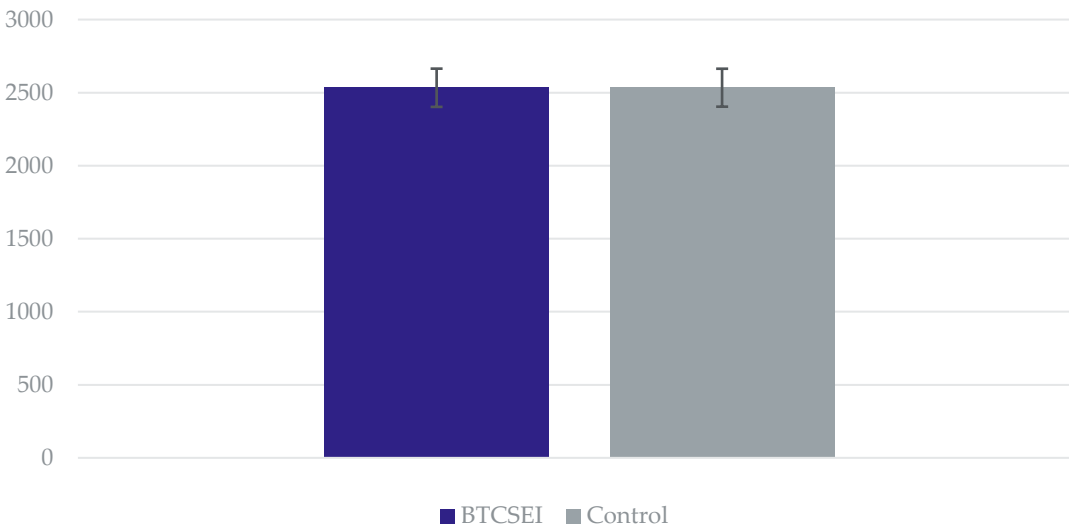
Research Question 1 set out to explore the effect of the BTCSEI intervention on students' Grade 11 standardized math test scores, based on the Smarter Balanced Assessment Consortium (SBAC) math test. Additionally, given that there was significant participation from science teachers across the intervention years, the evaluation increased its scope to examine the effect of the BTCSEI intervention on students' Grade 11 standardized science test scores as well, using the California Science Test (CAST). Propensity score matching was used to ensure that students in both conditions were balanced across a number of characteristics.

Standardize Math Test Scores

A multiple linear regression model was conducted to determine whether students in the treatment condition scored significantly higher on the Grade 11 standardized math exam than students in the comparison group. The model assessed Grade 11 mean mathematics SBAC scores and included all matching variables as covariates (see Appendix P for a detailed description of the matching procedure). Results demonstrated that condition was not a significant predictor of Grade 11 mathematics SBAC scores (see Appendix Q for full model). **In other words, Grade 11 mathematics SBAC scores did not significantly differ for students at schools where the BTCSEI intervention was conducted ($M = 2533.13$) as compared to**

Grade 11 standardized math test scores did not significantly differ between students at BTCSEI schools and non-participating schools.

students at business-as-usual schools ($M = 2533.49$; see Figure 12)³. It should be noted that, for students at both BTCSEI intervention schools and business-as-usual schools, the average SBAC scores fall in the “Standard Nearly Met” achievement level.



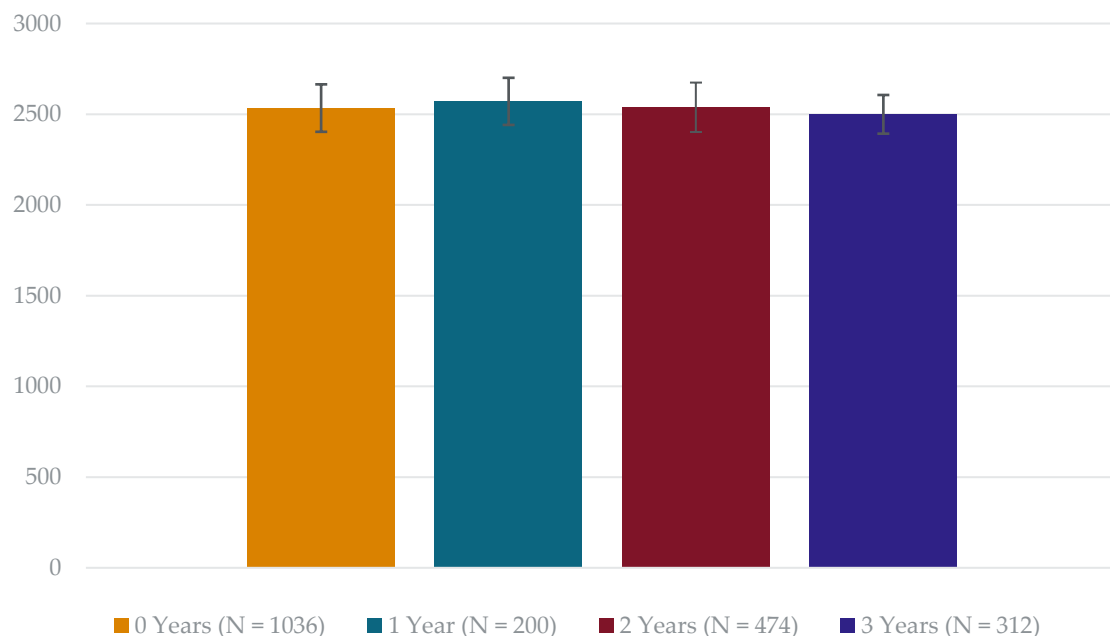
Note: Error bars represent standard deviation. BTCSEI $M = 2533.13$, $SD = 130.81$; Business-as-usual $M = 2533.49$, $SD = 129.87$.

Figure 12. Mean SBAC score comparison for students at BTCSEI and non-participating schools.

In addition, mean SBAC scores were compared based on the number of years students were exposed to the BTCSEI intervention (i.e., intervention dosage). A separate multiple linear regression model was assessed, controlling for student demographics and Grade 8 mathematics SBAC scores. For this analysis, all students at business-as-usual schools ($N = 1011$) received 0 years of exposure to the BTCSEI intervention, as well as 25 additional students who were enrolled at BTCSEI schools but did not receive instruction from anyone who received the intervention. Of the remaining students at BTCSEI intervention schools, 200 students received one year of exposure, 474 students received two years of exposure, and 312 students received three years of exposure. Overall, years of exposure to the BTCSEI intervention was not a significant predictor of Grade 11 mathematics SBAC scores. **In other words, Grade 11 mathematics SBAC scores did not significantly differ based on how many years of intervention students were exposed to. More specifically, students who were exposed to zero years ($M = 2533.99$), one year ($M = 2570.96$), two years ($M = 2538.18$), or three years ($M = 2499.52$) of instruction from a BTCSEI-trained teacher did not differ on their SBAC scores (see Figure 13)⁴.** It should also be noted that all these averages fall in the “Standard Nearly Met” achievement level for the SBAC.

³ $\beta = -.001$, $p = .92$

⁴ $\beta = -.01$, $p = .47$



Note: Error bars represent standard error. 0 years M = 2533.99, SD = 130.46; 1 year M = 2570.96, SD = 137.27; 2-year M = 2538.18, SD = 136.28; 3-year M = 2499.52, SD = 106.65).

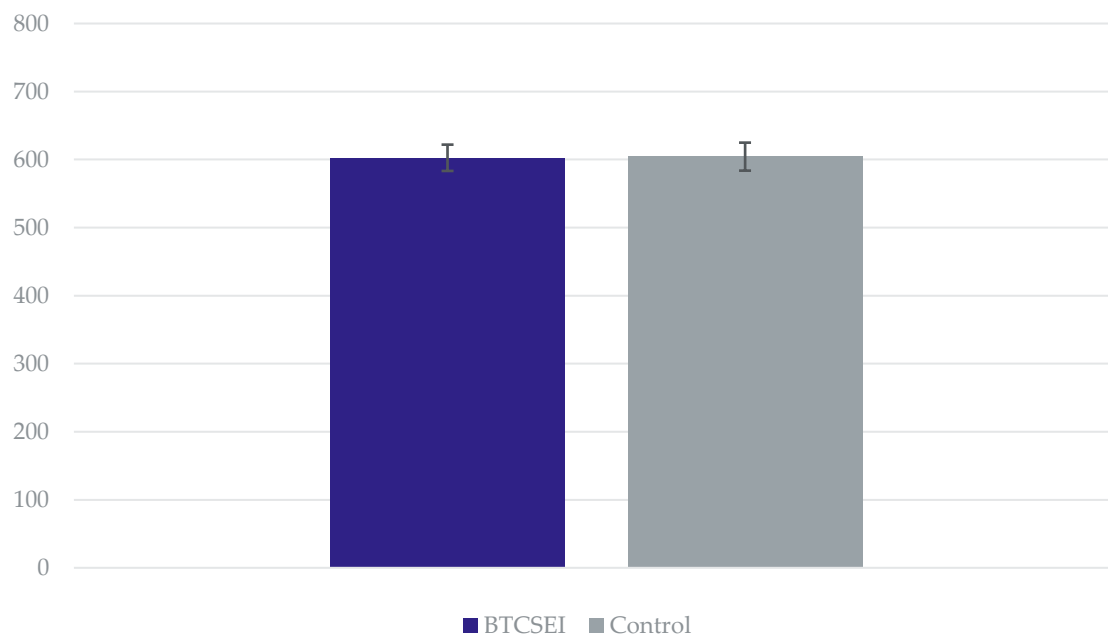
Figure 13. Mean SBAC score comparison for students based on years of exposure to BTCSEI.

Standardize Science Test Scores

Grade 11 CAST scores were examined to determine whether the BTCSEI intervention had an impact on Grade 11 standardized science exam scores. A multiple linear regression model was used for analysis, including all matching variables as covariates (except for Grade 8 CAST score, see Appendix P for a detailed description of the matching procedure). Results demonstrated that condition was a significant predictor of Grade 11 CAST scores, even beyond the other covariates in the model. However, this result was in the opposite direction of what was hypothesized (see Appendix Q for full model). **In other words, Grade 11 CAST scores were significantly lower for students at schools where the BTCSEI intervention was conducted ($M = 602.63$) as compared to students at business-as-usual schools ($M = 604.34$; see Figure 14)⁵.** It should be noted that the effect size for this result was very small, representing only a 2-point difference between the average scores between the two conditions, and the averages for both conditions fall in the “Standard Nearly Met” achievement level. As such, the difference is statistically significant but not practically significant and is likely due to the large sample sizes rather than meaningful differences between the two groups.

Grade 11 standardized science test scores were 2 points lower for students at BTCSEI schools compared to participating schools

⁵ $\beta = -.04$, $p = .003$



Note: Error bars represent standard deviation. BTCSEI M = 602.63, SD = 19.35; Business-as-usual M = 604.34, SD = 20.58.

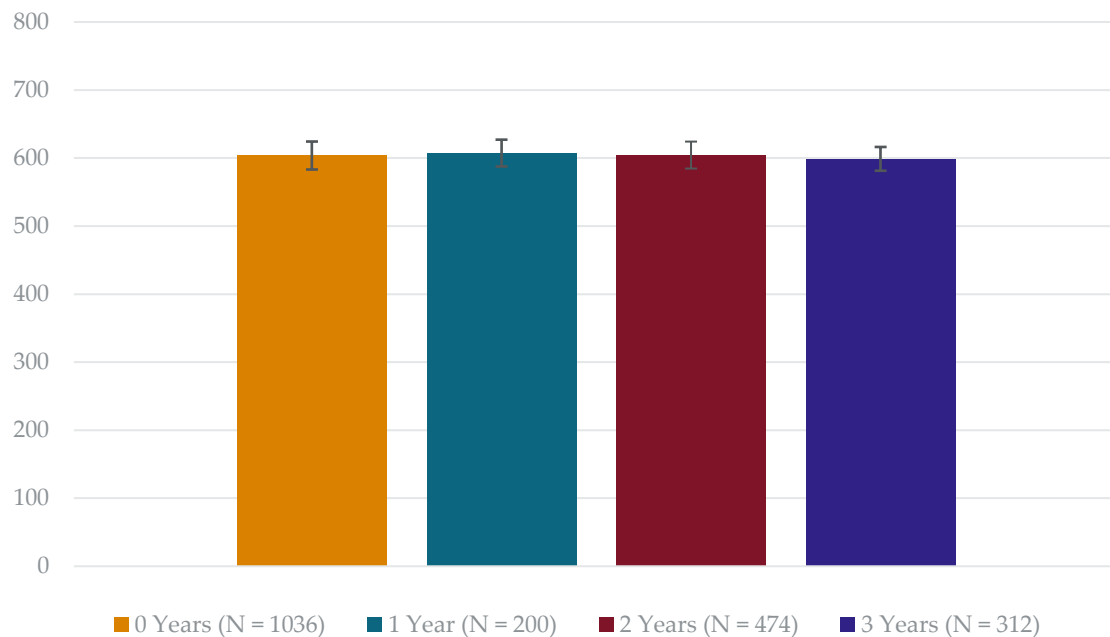
Figure 14. Mean CAST score comparison for students at BTCSEI and non-participating schools.

Mean CAST scores were also compared based on the number of years students were exposed to the BTCSEI intervention. A separate multiple linear regression model was assessed, controlling for student demographics and Grade 8 CAST scores. For this analysis, all students at business-as-usual schools (N = 987) were classified as having 0 years of exposure to the BTCSEI intervention. An additional 24 additional students enrolled at BTCSEI schools were also included as having 0 years of exposure because they did not receive instruction from any teacher who participated in the intervention. Among the remaining students at BTCSEI intervention schools, 197 students received one year of exposure, 464 received two years of exposure, and 302 received three years of exposure.

Overall, years of exposure to the BTCSEI intervention was a significant predictor of Grade 11 CAST scores. Similarly, however, this result was in the opposite direction of what was hypothesized. **Specifically, when examining pair-wise mean differences, Grade 11 CAST scores were significantly lower for students who were exposed to three years (M = 598.82) of instruction from a BTCSEI-trained teacher, than for students with zero years (M = 603.71), one year (M = 607.30), or two years (M = 604.41) of instruction (see Figure 15)⁶.** There were no significant differences across the other groups. As above, the effect size for this result was quite small, and likely due to the large sample sizes rather than meaningful differences between the two groups. It should also be noted that all of these averages fall in the “Standard Nearly Met” achievement level, and the actual differences

⁶ $\beta = -.04, p = .004$

between the means ranged from 5 points to 9 points. As such, although this difference is statistically significant, it does not represent practical significance.



Note: Error bars represent standard error. 0 years M = 603.71, SD = 20.57; 1 year M = 607.30, SD = 19.74; 2-year M = 604.41, SD = 19.80; 3-year M = 598.82, SD = 17.48).

Figure 15. Mean CAST score comparison for students based on years of exposure to BTCSEI.

RESEARCH QUESTION #2



Are there differential outcomes for students in treatment schools based on characteristics of the students or schools?

Main Findings: Although girls and boys did not differ in their Grade 11 mathematics SBAC scores, girls scored higher than boys on the Grade 11 CAST. Latinx students scored lower on the GRADE 11 mathematics SBAC (but not the CAST) than non-Latinx students. In addition, Latinx students showed larger gains from Grade 8 to Grade 11 on the CAST than non-Latinx students. CS identity only predicted SBAC scores and only in Year 2 of the intervention (Grade 10).

Differential Impact on Student Outcomes

Research Question 2 examined whether the BTCSEI intervention was particularly impactful for specific groups of students, with a focus on girls and Latinx students. In addition, dosage effects were assessed by comparing mean outcomes based on the number of years students received instruction from a BTCSEI-trained teacher (ranging from 0 – 3 years).

This analysis was conducted only within schools that received the BTCSEI intervention; therefore, no comparisons were made with business-as-usual schools. As such, only three schools were represented in these analyses. The relative proportions of students from each school can be seen in Figure 16. Within these schools, differences in standardized test scores were examined across student demographic groups and levels of computer science (CS) identity.

School Attended

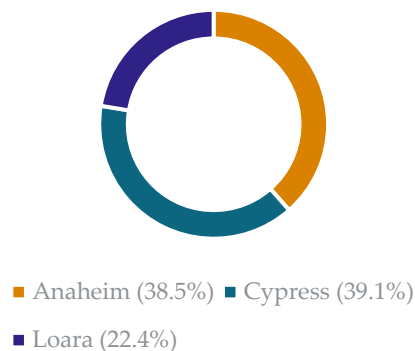


Figure 16. Proportion of students from each of three schools for demographic, CT confidence, and CS identity comparisons.

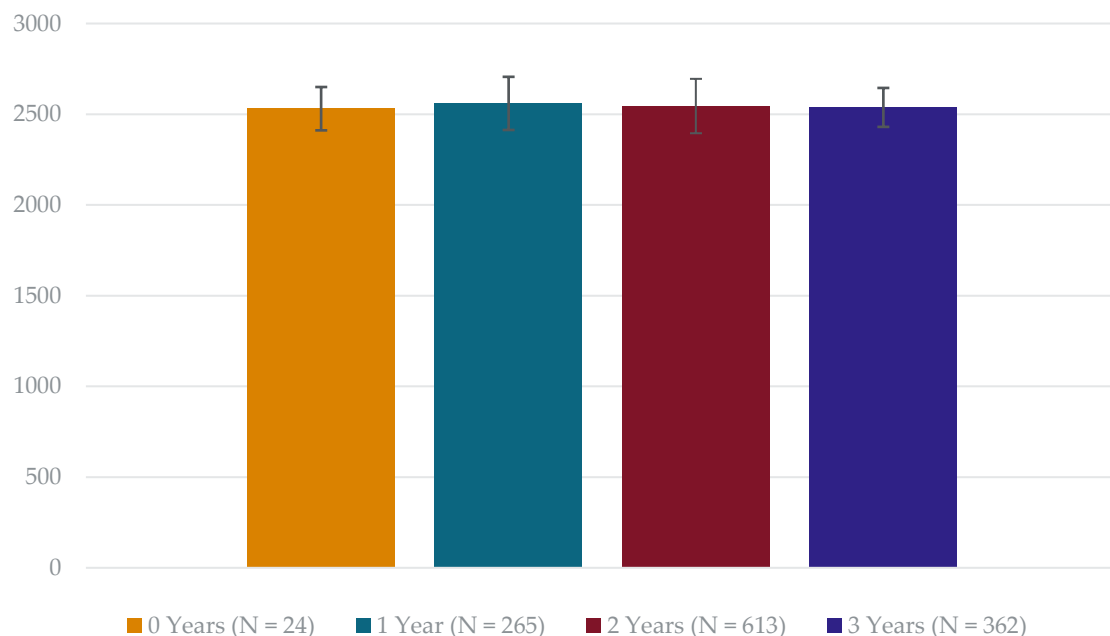
Grade 11 Standardize Math Scores

Grade 11 mean mathematics SBAC scores were examined, only for students within BTCSEI intervention schools, to determine whether there were differences based on: (1) years of exposure to BTCSEI-trained teachers, (2) student demographics, and (3) student self-reported CT confidence and CS identity. These analyses were modeled using one-way ANOVAs, and all analyses controlled for the baseline Grade 8 mathematics SBAC scores. Each predictor was examined separately.

Dosage

First, differences in Grade 11 mean mathematics SBAC scores were examined based on the number of years that students received instruction from BTCSEI-trained teachers. **When looking only at BTCSEI intervention schools, there was an overall significant difference in mean SBAC scores based on how many years of instruction students received from BTCSEI-trained teachers.⁷** Follow-up pairwise comparison analyses were then conducted (using Bonferroni adjustments) to determine where these differences were. **Results were in the opposite direction of what was hypothesized, revealing that students who were exposed to one year of instruction from BTCSEI-trained teachers had significantly higher SBAC scores (M = 2559.79) than those with either 2 years (M = 2545.08) or 3 years (M = 2537.63) of exposure (see Figure 17).** Because of these differences, exposure to BTCSEI instruction (i.e., 0 -3 years) was included as a control variable in all further analyses. It should be noted that, although statistically significance, this represents a small effect size. Moreover, all of the averages that were compared fall into the “Standard Nearly Met” achievement level of the SBAC.

⁷ $F(3, 1294) = 4.03, p = .007, \eta_p^2 = .01$



Note: Error bars represent standard error. 0 years M = 2533.99, SD = 130.46; 1 year M = 2559.79, SD = 4.98; 2-year M = 2545.08, SD = 3.26; 3-year M = 2537.63, SD = 4.30).

Figure 17. Mean SBAC score comparison for students at BTCSEI schools based on years of exposure to BTCSEI.

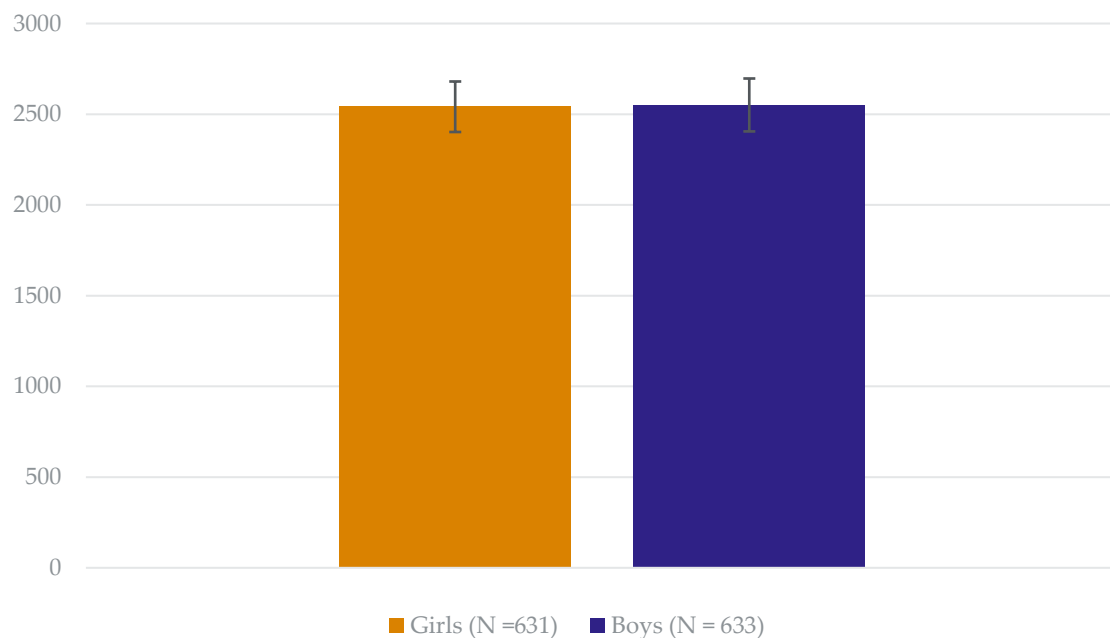
Gender

Differences in Grade 11 mean mathematics SBAC scores were examined based on gender. When looking only at BTCSEI intervention schools, there were no significant differences in SBAC scores between girls (M = 2541.35) and boys (M = 2550.15) (see Figure 18).⁸ It may be, however, that girls' SBAC scores increased more between 8th and 11th grade test administrations than boys' SBAC scores did. To test this, a mixed ANOVA was conducted, comparing mean differences in SBAC scores between girls and boys, and between 8th and 11th grade (years of exposure to BTCSEI instruction was included as a control variable). There was an overall increase in SBAC scores from 8th grade (M = 2500.83) to 11th grade (M = 2545.75).⁹ **However, when assessing gender differences over time at BTCSEI intervention schools, the difference was not statistically significant.¹⁰ Specifically, SBAC scores for girls increased by approximately 40 points between Grade 8 and Grade 11, and scores for boys increased by approximately 50 points during the same period, and this difference was not statistically significant (see Figure 19).**

⁸ $F(1, 1260) = 3.79, p = .06, \eta_p^2 = .003$

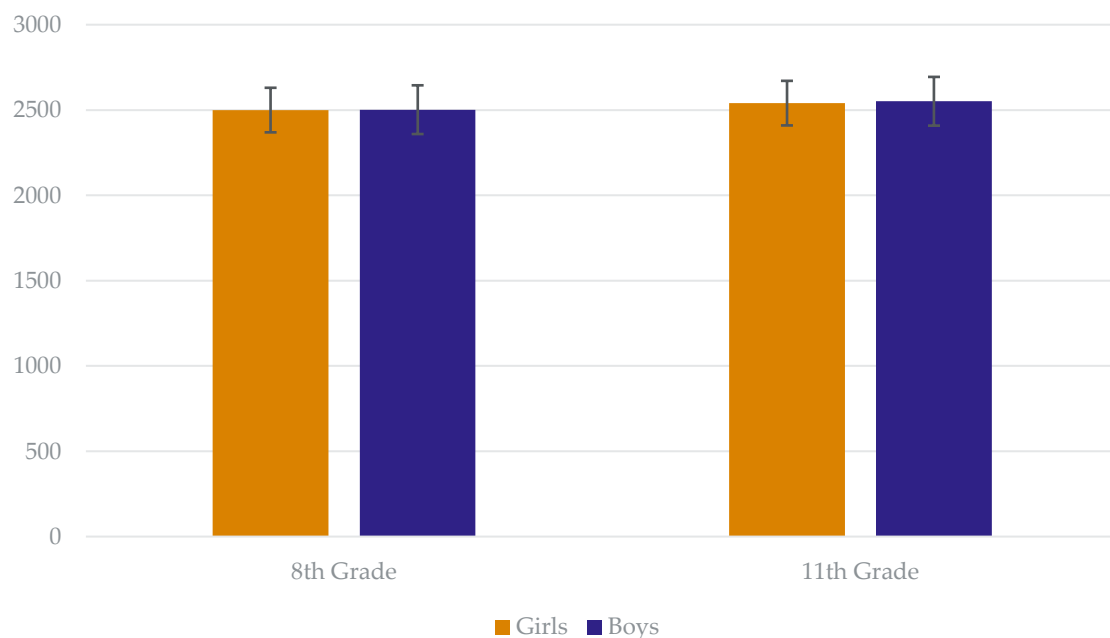
⁹ $F(1, 1261) = 68.92, p < .001, \eta_p^2 = .05$

¹⁰ $F(1, 1261) = 3.48, p = .06, \eta_p^2 = .003$



Note: Error bars represent standard deviation. Girls M = 2541.35, SD = 138.51; Boys M = 2550.15, SD = 145.86.

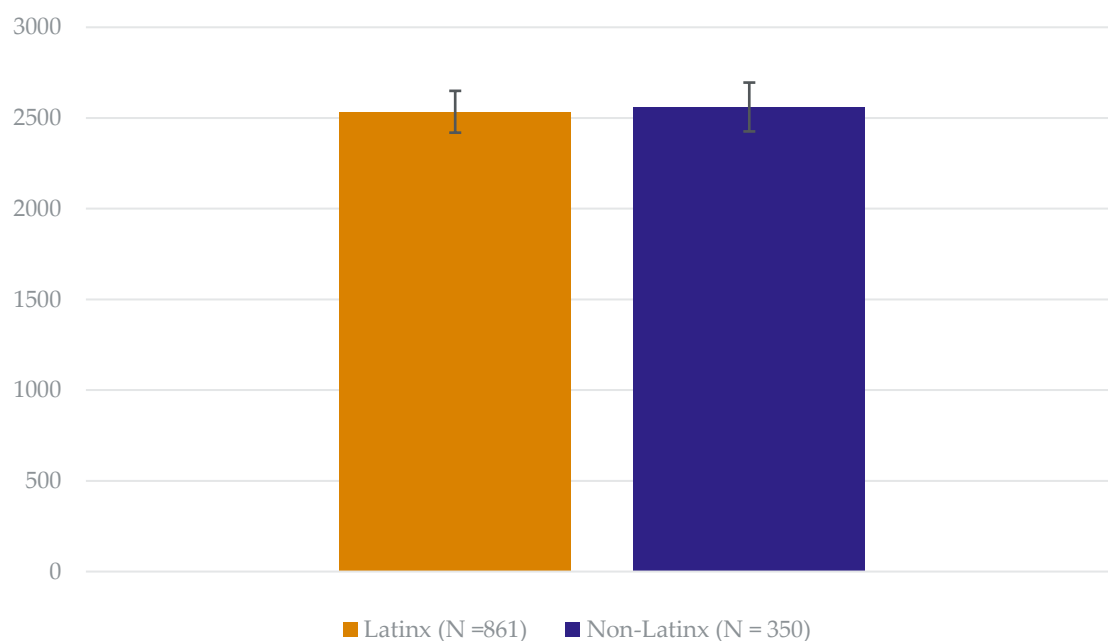
Figure 18. Mean Grade 11 SBAC score comparison for boys and girls at BTCSEI schools.



Note: Error bars represent standard deviation. Girls (Grade 8: M = 2499.70, SD = 130.34; Grade 11: M = 2540.34, SD = 138.51); Boys (Grade 8: M = 2501.96, SD = 130.51; Grade 11: M = 2551.16, SD = 145.86).

Figure 19. Change in mean SBAC scores from 8th grade to 11th grade for boys and girls at BTCSEI schools.

Differences in Grade 11 mean mathematics SBAC scores were examined based on ethnicity, specifically comparing scores for Latinx and non-Latinx students. **When looking only at BTCSEI intervention schools, Latinx students scored significantly lower on the SBAC (M = 2534.33) than non-Latinx students (M = 2560.61; see Figure 20).**¹¹ Although this 26-point mean difference is statistically significant, it must be noted that this difference represents a small effect. The average scores for both Latinx and non-Latinx students fall in the “Standard Nearly Met” achievement level of the SBAC. Not only that, but Grade 8 mathematics SBAC scores were a much stronger predictor of Grade 11 score than ethnicity, suggesting that this difference in Latinx and non-Latinx students’ scores was present before Grade 11. Indeed, **when assessing differences in Latinx and non-Latinx students over time at BTCSEI intervention schools, the difference was not statistically significant.**¹² Specifically, SBAC scores for both Latinx students and non-Latinx students increased by approximately 45 points between Grade 8 and Grade 11. Overall, this pattern suggests that the BTCSEI intervention did not significantly reduce the gap in Grade 11 mathematics SBAC performance between Latinx and non-Latinx students.

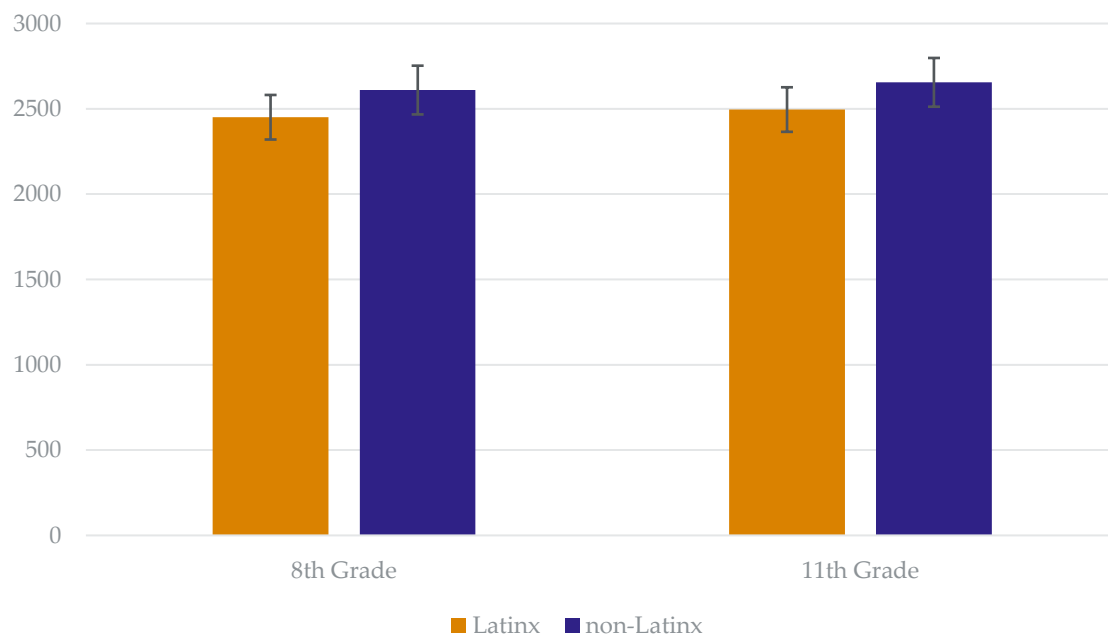


Note: Error bars represent standard deviation. Latinx M = 2534.33, SD = 114.43; Non-Latinx M = 2560.61, SD = 133.02.

Figure 20. Mean SBAC score comparison for Latinx and non-Latinx students at BTCSEI schools.

¹¹ $F(1, 1207) = 17.96, p < .001, \eta_p^2 = .02$

¹² $F(1, 1208) = 0.01, p = .97, \eta_p^2 < .001$



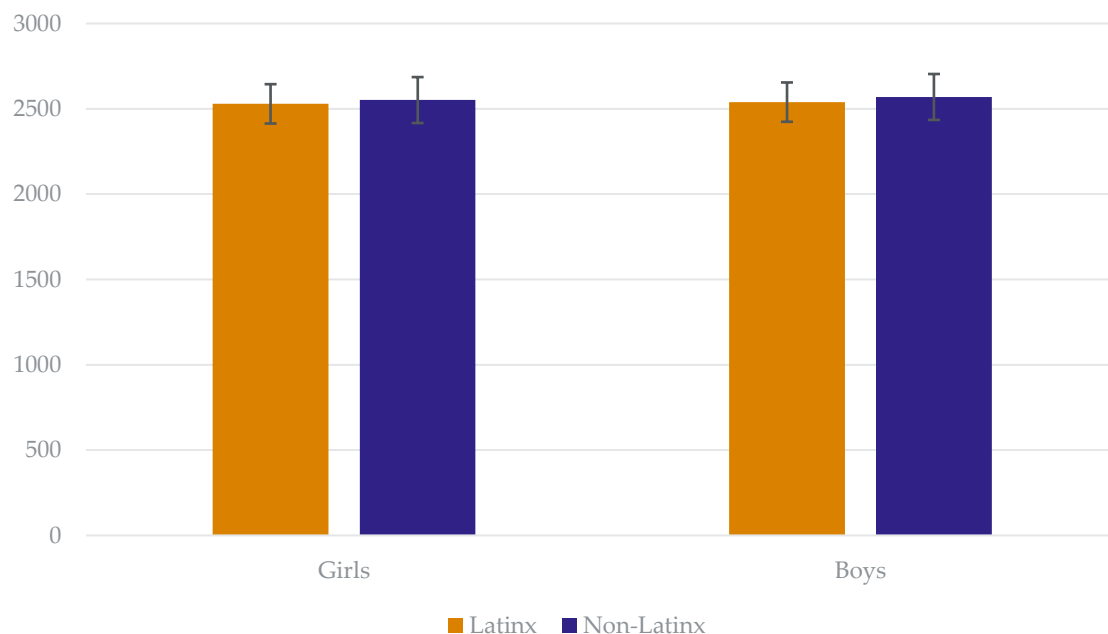
Note: Error bars represent standard deviation. Latinx (Grade 8: M = 2450.80, SD = 97.67; Grade 11: M = 2495.83, SD = 114.43); non-Latinx students (Grade 8: M = 2610.11, SD = 124.44; Grade 11: M = 2655.32, SD = 133.02).

Figure 21. Change in mean SBAC scores from 8th grade to 11th grade for Latinx and non-Latinx students at BTCSEI schools.

Gender & Ethnicity

A two-way ANOVA was conducted to examine whether there was an interaction of ethnicity and gender for the Grade 11 mathematics SBAC scores. Although the differences described above for both gender and ethnicity still remained in this model, the interaction was not significant.¹³ In other words, although Latinx students scored lower overall than non-Latinx students, this did not differ between Latinx boys and girls (see Figure 22).

¹³ $F(1, 1205) = 0.64, p = .43, \eta_p^2 = .001$



Note: Error bars represent standard deviation. Girls (Latinx M = 2529.28, SD = 3.98; non-Latinx M = 2551.42, SD = 5.49); Boys (Latinx M = 2539.37, SD = 3.89; non-Latinx M = 2569.52, SD = 6.51).

Figure 22. Mean SBAC score comparison by gender and ethnicity at BTCSEI schools.

Confident in Computation Thinking & CS Identity

Lastly, differences in Grade 11 mathematics SBAC scores were examined based on students' self-reported confidence in computational thinking, as well as their computer science (CS) identity. This relationship was examined for each year of the intervention (baseline, and years 1 through 3 of the intervention) using linear regression models that controlled for Grade 8 mathematics SBAC score and amount of exposure to BTCSEI instruction up to that point. Across these analyses, only **Year 2 CS identity score emerged as a predictor of Grade 11 mathematics SBAC scores, such that those who reported higher CS identity in Year 2 of the intervention (Grade 10), tended to have higher SBAC scores the following year (see Tables 36 & 37). It may be that Grade 10 is a particularly important time for the formation and impact of CS identity.** However, it should be noted that in no other year did this pattern emerge. As such, caution should be used when interpreting this result.

Table 36. CT confidence scores predicting Grade 11 mathematics SBAC scores by year of intervention.

Year	N	β	p
Baseline (Grade 8)	147	.08	.19
Year 1 (Grade 9)	147	.03	.68
Year 2 (Grade 10)	147	.10	.11
Year 3 (Grade 11)	147	.08	.22

Note: β represents standardized coefficients from the regression analysis.

Table 37. CS identity overall scores predicting Grade 11 mathematics SBAC scores by year of intervention.

Year	N	β	p
Baseline (Grade 8)	144	.10	.12
Year 1 (Grade 9)	145	.02	.80
Year 2 (Grade 10)	146	.14	.03
Year 3 (Grade 11)	147	.03	.68

Note: β represents standardized coefficients from the regression analysis.

It may be that certain elements of CS identity are stronger predictors than others. As such, the individual subscales of the CS identity measure were assessed in terms of whether they predicted scores on the Grade 11 mathematics SBAC test, and across the years of the intervention. These subscales include:

- Confidence in ability to learn computer science skills and solve computer science problems
- Interest in learning computer science and solving problems
- Perceptions of belonging in computer science
- Belief in the usefulness of learning computer science
- Perceptions of being encouraged to study computer science

When examining the subscales of the CS identity measure, no clear pattern emerged. **Only two of the subscales were significant predictors, and only in Year 2 of the intervention (i.e., Grade 10). Specifically, in Grade 10, both confidence in ability to learn CS skills and solve CS problems, and belief in the usefulness of learning CS were significant predictors of Grade 11 mathematics SBAC scores, meaning that students who reported stronger beliefs in these elements tended to receive higher SBAC scores (see Table 38).** As with the overall scales, it may be that there is something especially important about these particular beliefs in Grade 10, however, caution should be applied to avoid overstating these findings.

Table 38. CS identity elements predicting Grade 11 mathematics SBAC scores by year of intervention.

Subscale	Baseline (N = 144)		Year 1 (N = 145)		Year 2 (N = 146)		Year 3 (N = 147)	
	β	p	β	p	β	p	β	p
Confidence in ability to learn CS skills and solve CS problems	.08	.23	.05	.46	.13*	.04	-.01	.95
Interest in learning CS and solving problems	.07	.29	.02	.73	.12	.05	.01	.90
Perceptions of belonging in CS	.07	.25	<.001	.99	.11	.08	.04	.56
Belief in usefulness of learning CS	.11	.08	.02	.74	.13*	.04	.03	.61
Perceptions of being encouraged to study CS	.12	.07	-.01	.92	.12	.07	.05	.44

Note: β represents standardized coefficients from the regression analysis. *Represents a statistically significant predictor.

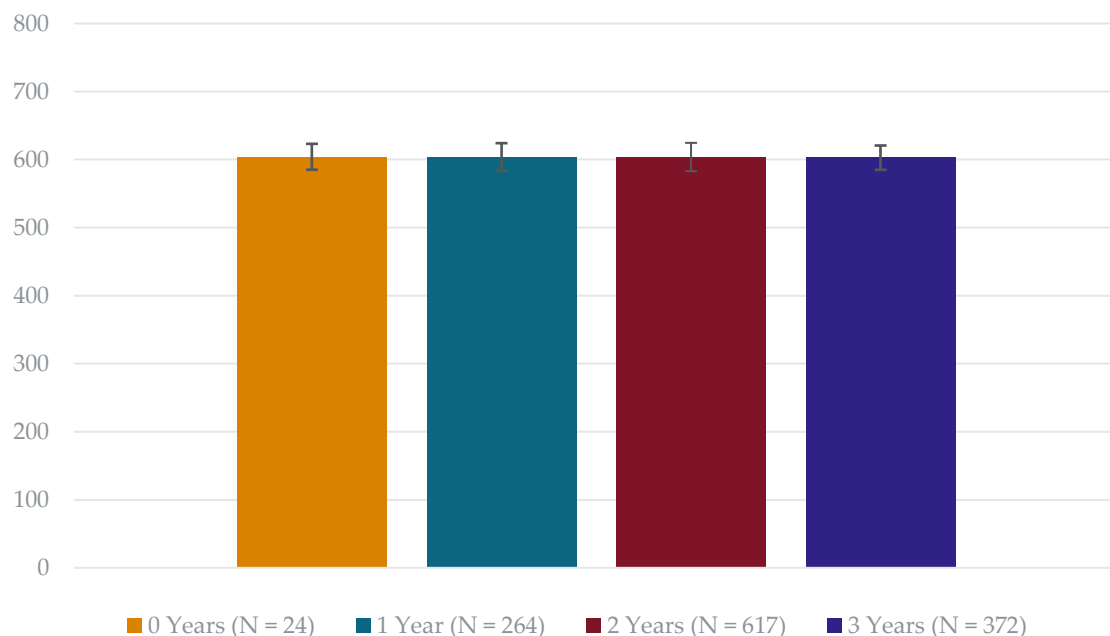
Grade 11 Standardize Science Test Scores

Grade 11 mean CAST scores were examined only for students within BTCSEI intervention schools, to determine whether there were differences based on: (1) years of exposure to BTCSEI-trained teachers, (2) student demographics, and (3) student self-reported CT confident and CS identity. These analyses were modeled using one-way ANOVAs, and all analyses controlled for Grade 8 CAST scores. Each predictor was examined separately.

Dosage

Differences in Grade 11 mean CAST scores were examined based on the number of years that students received instruction from BTCSEI-trained teachers. **When looking only at BTCSEI intervention schools, there was no significant difference in mean CAST scores based on how many years of instruction students received from BTCSEI-trained teachers.¹⁴ In other words, amount of exposure to BTCSEI-trained teachers did not have a significant impact on Grade 11 CAST scores (see Figure 23).** Exposure to BTCSEI instruction (i.e., 0 -3 years) was still included as a control variable in all further analyses.

¹⁴ $F(3, 1272) = 0.47, p = .70, \eta_p^2 = .001$



Note: Error bars represent standard error. 0 years M = 590.08, SD = 19.02; 1 year M = 608.08, SD = 20.32; 2-year M = 605.31, SD = 20.85; 3-year M = 598.10, SD = 17.85).

Figure 23. Mean CAST score comparison for students at BTCSEI schools based on years of exposure to BTCSEI.

Gender

Differences in Grade 11 mean CAST scores were examined based on gender. **When looking only at BTCSEI intervention schools, girls scored significantly higher on the CAST (M = 604.58) than boys (M = 602.42; see Figure 24).¹⁵ Although statistically significant, the difference in scores between boys and girls was only 2 points, so this does not represent practical significant. In addition, both means fall in the “Standard Nearly Met” achievement level for the CAST. As such, caution must be used to not overstate the finding.**

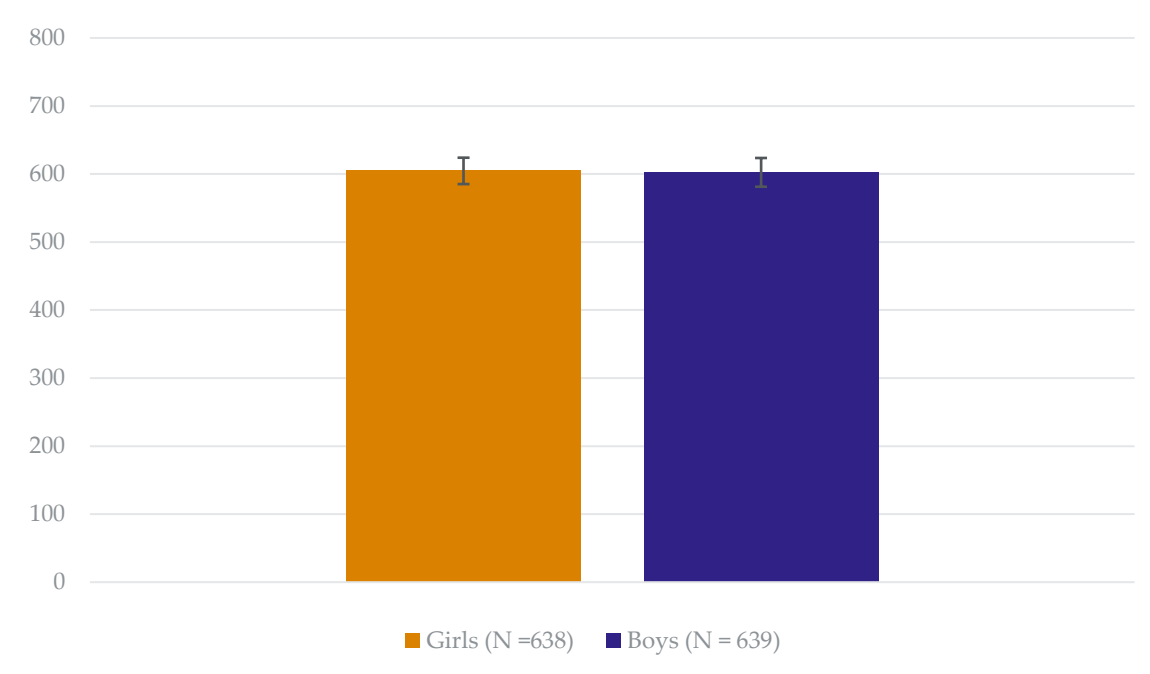
To further investigate gender differences, a mixed ANOVA was conducted, comparing mean differences in CAST scores between girls and boys, and between 8th and 11th grade (years of exposure to BTCSEI instruction was included as a control variable). For both girls and boys, there was an overall increase in CAST scores from 8th grade (M = 400.36, SD = 21.42) to 11th grade (M = 603.50, SD = 20.30).¹⁶ **When assessing gender differences over time at BTCSEI intervention schools, the difference was also statistically significant.¹⁷ Specifically, girls had a mean increase of approximately 205 points on the CAST between Grade 8 and**

¹⁵ $F(1, 1273) = 8.96, p = .003, \eta_p^2 = .01$

¹⁶ $F(1, 1274) = 31535.32, p < .001, \eta_p^2 = .96$

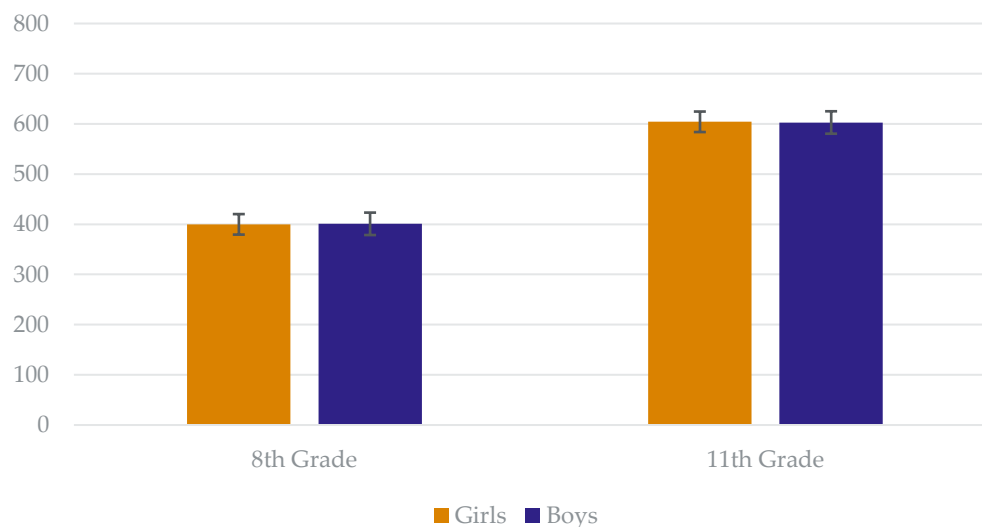
¹⁷ $F(1, 1274) = 9.63, p = .002, \eta_p^2 = .01$

Grade 11 test administrations, while boys had a mean increase of 202 points in the same time period. This difference in growth was statistically significant, but still only represents a difference of a 3-point increase. Moreover, the difference does not represent a meaningful increase in test achievement level such that, both these averages fall in the “Standard Nearly Met” achievement level of the CAST. As such, caution must be used to not overstate the finding.



Note: Error bars represent standard deviation. Girls M = 604.58, SD = 19.43; Boys M = 602.42, SD = 21.13.

Figure 24. Mean CAST score comparison for boys and girls at BTCSEI schools.



Note: Error bars represent standard deviation. Girls (Grade 8: M = 399.85, SD = 20.45; Grade 11: M = 604.19, SD = 19.43); Boys (Grade 8: M = 400.89, SD = 22.35; Grade 11: M = 602.81, SD = 21.13).

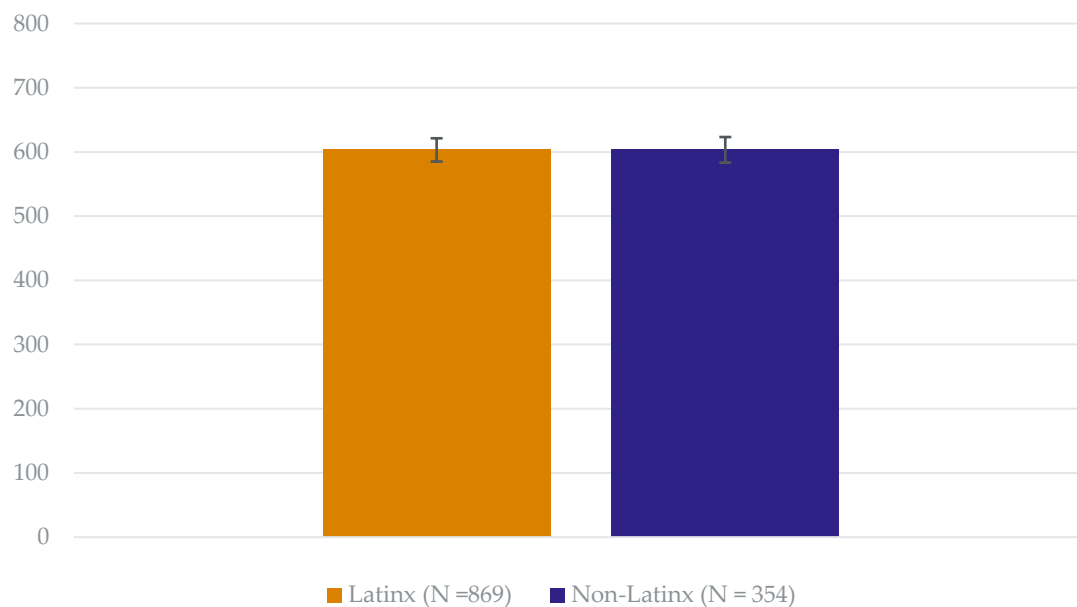
Figure 25. Change in mean CAST scores from 8th grade to 11th grade for boys and girls at BTCSEI schools.

Ethnicity

Differences in Grade 11 mean CAST scores were examined based on ethnicity, specifically comparing scores for Latinx and non-Latinx students. **When looking only at BTCSEI intervention schools, there was no significant difference in mean CAST scores between Latinx students (M = 603.13) and non-Latinx students (M = 603.24; see Figure 26).**¹⁸ The average scores for both Latinx and non-Latinx students fall in the “Standard Nearly Met” achievement level of the SBAC. Not only that, but Grade 8 mathematics SBAC scores were a much stronger predictor of Grade 11 score than ethnicity, suggesting that this difference in Latinx and non-Latinx students’ scores was present before Grade 11. **Again, when assessing differences in Latinx and non-Latinx students over time at BTCSEI intervention schools, the difference was statistically significant.**¹⁹ Specifically, Latinx students had a mean increase of approximately 205 points between the Grade 8 and Grade 11 administrations of the CAST, while non-Latinx students had a mean increase of only approximately 199 points. This difference in growth was statistically significant, but still only represents a difference of a 6-point increase. Not only that, but all these averages fall in the “Standard Nearly Met” achievement level of the CAST. Although caution must be used when interpreting these results, **this pattern suggests that the BTCSEI intervention may have had an impact in reducing the gap in CAST scores between Latinx and non-Latinx students over time.**

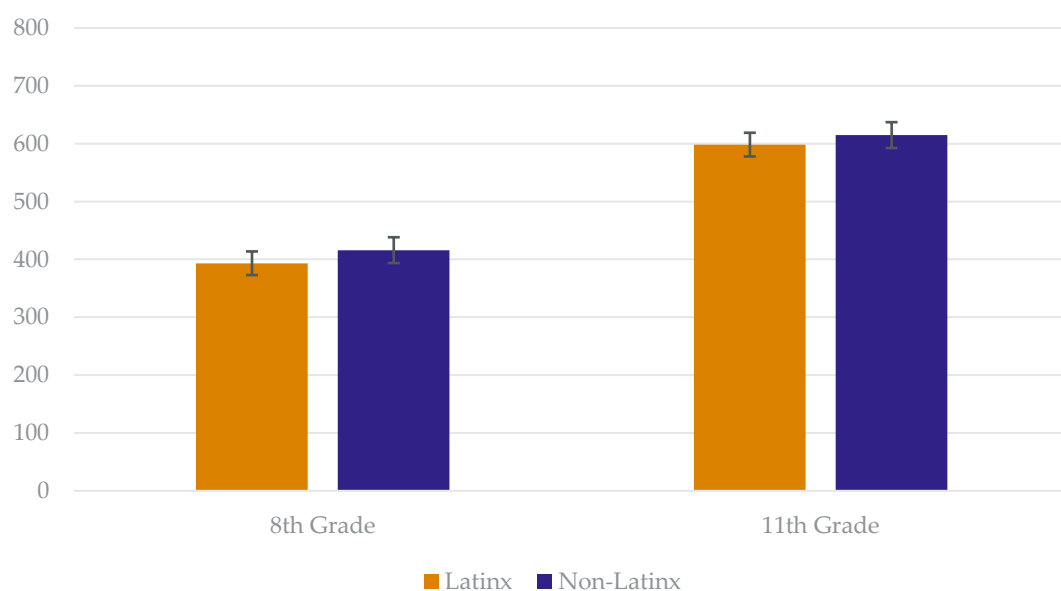
¹⁸ $F(1, 1219) = 0.01, p = .91, \eta_p^2 < .001$

¹⁹ $F(1, 1220) = 49.19, p < .001, \eta_p^2 = .04$



Note: Error bars represent standard deviation. Latinx M = 613.13, SD = 18.06; Non-Latinx M = 603.24, SD = 19.87.

Figure 26. Mean CAST score comparison for Latinx and non-Latinx students at BTCSEI schools.

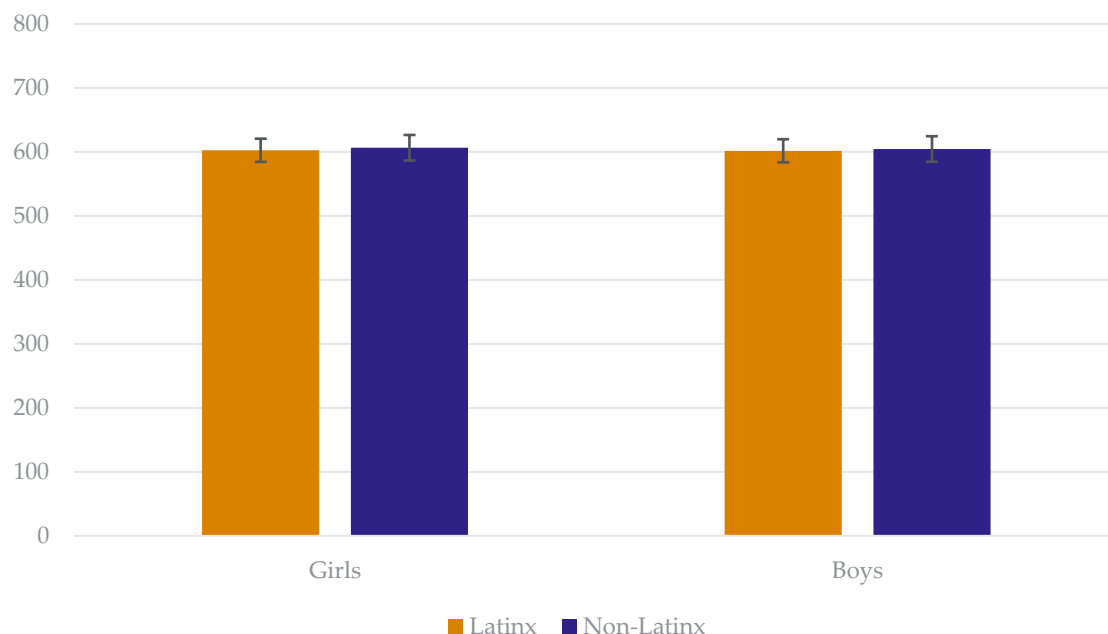


Note: Error bars represent standard deviation. Latinx (Grade 8: M = 393.31, SD = 18.68; Grade 11: M = 598.41, SD = 18.06); non-Latinx (Grade 8: M = 415.92, SD = 18.48; Grade 11: M = 614.83, SD = 19.98).

Figure 27. Change in mean CAST scores from 8th grade to 11th grade for Latinx and non-Latinx students at BTCSEI schools.

Gender & Ethnicity

A two-way ANOVA was conducted to examine whether there was an interaction of ethnicity and gender for the Grade 11 CAST scores. Although the differences described above for both gender and ethnicity were still similar in this model, the interaction was not significant.²⁰ In other words, although girls scored higher than boys overall, this did not differ between Latinx and non-Latinx students (see Figure 28).



Note: Error bars represent standard deviation. Girls (Latinx M = 602.61, SD = 0.70; non-Latinx M = 606.57, SD = 1.12); Boys (Latinx M = 601.75, SD = 0.69; non-Latinx M = 604.59, SD = 1.14).

Figure 28. Mean CAST score comparison by gender and ethnicity.

Computational Thinking and Computer Science Identity

Differences in Grade 11 CAST scores were examined based on students' self-reported confidence in computational thinking, as well as their computer science (CS) identity. This relationship was examined for each year of the intervention (baseline, and years 1 through 3 of the intervention) using linear regression models that controlled for Grade 8 CAST score and amount of exposure to BTCSEI instruction up to that point. **Across these analyses, neither confidence in computational thinking nor CS identity emerged as a significant predictor of CAST scores in any year (see Tables 39 & 40).**

²⁰ $F(1, 1217) = 0.07, p = .79, \eta_p^2 < .001$

Table 39. CT confidence scores predicting grade 11 CAST scores by year of intervention

Year	N	β	p
Baseline (Grade 8)	148	.08	.22
Year 1 (Grade 9)	148	.06	.37
Year 2 (Grade 10)	148	.12	.07
Year 3 (Grade 11)	148	.07	.30

Note: β represents standardized coefficients from the regression analysis.

Table 40. CS identity predicting grade 11 CAST scores by year of intervention.

Year	N	β	p
Baseline (Grade 8)	145	.05	.43
Year 1 (Grade 9)	146	.03	.68
Year 2 (Grade 10)	147	.04	.50
Year 3 (Grade 11)	148	.03	.60

Note: β represents standardized coefficients from the regression analysis.

Again, the subscale elements of CS identity were also examined individually. When examining the subscales of the CS identity measure, no clear pattern emerged. **None of the subscales emerged as a significant predictor across any year of the intervention (see Table 41).** Overall, this suggests that student confidence in computational thinking or computer science identity did not impact their Grade 11 CAST scores.

Table 41. CS identity elements predicting Grade 11 CAST scores by year of intervention.

Subscale	Baseline (N = 145)		Year 1 (N = 146)		Year 2 (N = 147)		Year 3 (N = 148)	
	β	p	β	p	β	p	β	p
Confidence in ability to learn CS skills and solve CS problems	.07	.27	.05	.41	.03	.64	.02	.70
Interest in learning CS and solving problems	.07	.30	.01	.91	.04	.57	-.02	.81
Perceptions of belonging in CS	.01	.94	-.01	.91	.03	.60	.05	.42
Belief in usefulness of learning CS	.07	.28	.12	.06	.08	.22	.10	.12
Perceptions of being encouraged to study CS	.02	.82	-.03	.61	.02	.71	.01	.93

Note: β represents standardized coefficients from the regression analysis. *Represents a statistically significant predictor.

RESEARCH QUESTION #3



Across treatment schools, do levels of implementation fidelity of intervention components increase access, participation, retention, and performance in CS classes and ICT pathways for girls and Latinx student groups?

Main Findings: There was not enough variability in implementation fidelity, course offerings, and enrollment to draw any meaningful conclusions, largely because only three schools participated in the BTCSEI intervention. CS course offerings were consistent at the three schools across the baseline year and three intervention years. This was also true for course enrollment, including enrollment for girls and Latinx students.

Impact on Course-Taking Patterns

Research Question 3 set out to explore the effect of implementation fidelity of the BTCSEI intervention on patterns of course offerings and CS and ICT pathway enrollment at BTCSEI schools. However, as the number of schools engaged in the intervention was much smaller than originally anticipated and only three schools are available for comparison, this question is examined in a purely descriptive fashion. In addition, as there was very little variability in the implementation fidelity scores for each school across the years of the intervention, only the ICT pathway and CS courses offered, as well as patterns of enrollment in these courses, is presented.

When examining the number of ICT Pathway and CS courses offered across the three schools, there was no real change across the years of the intervention. One school increased its course offerings by one in the first year of the intervention, but that did not continue to increase. As such, access to ICT Pathway and CS courses remained mostly consistent across the three years of the intervention (see Table 42).

Table 42. ICT Pathway & CS courses offered at BTCSEI schools across baseline and intervention years.

School	Baseline	Year 1	Year 2	Year 3
Anaheim	2	2	2	2
Cypress	3	4	4	4
Loara	2	2	2	2

The proportion of students enrolled in ICT Pathway and CS courses was first examined across baseline and the three years of the intervention. Overall, there were only a small number of students enrolled in ICT Pathway and CS courses over the years of the intervention (ranging from 2.0% to 4.5% depending on the year and school, see Figure 29). Cypress had the largest proportion of students enrolled in ICT Pathway and CS courses across all years of the intervention. Rates of ICT Pathway and CS course enrollment was lower for female students (0.5% to 2.5%, see Figure 30) and Latinx students (1.5% to 3.3%, see Figure 31). Although Cypress had the largest proportion of female students enrolled in ICT Pathway and CS courses, it also had the smallest proportion of Latinx students enrolled in these courses. Cypress also had the smallest proportion of Latinx students overall.

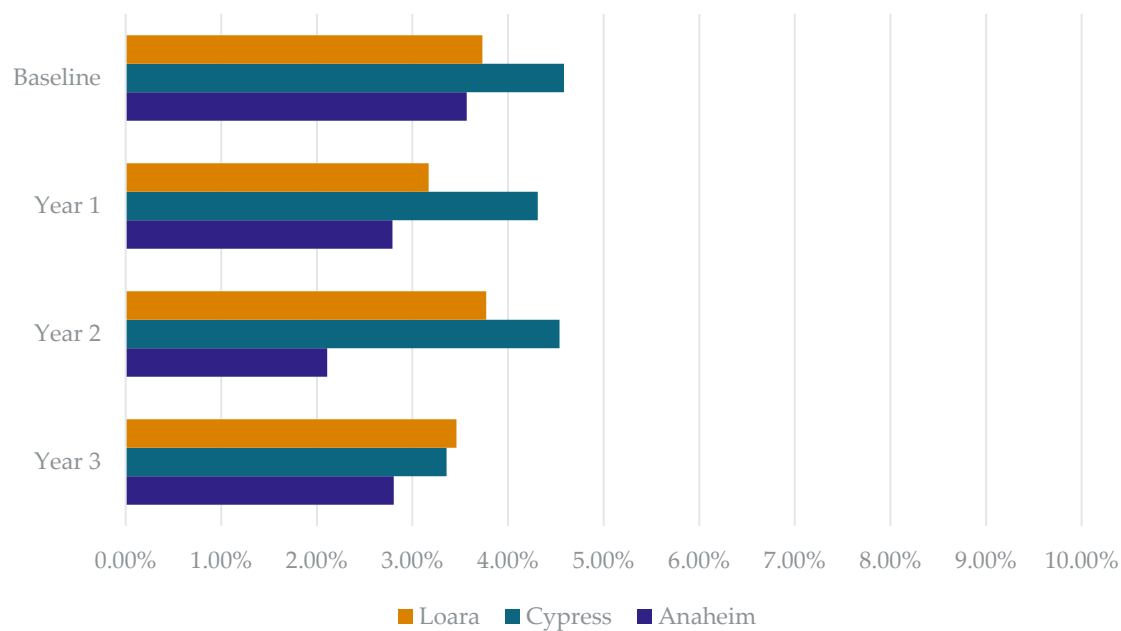


Figure 29. Proportion of students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.

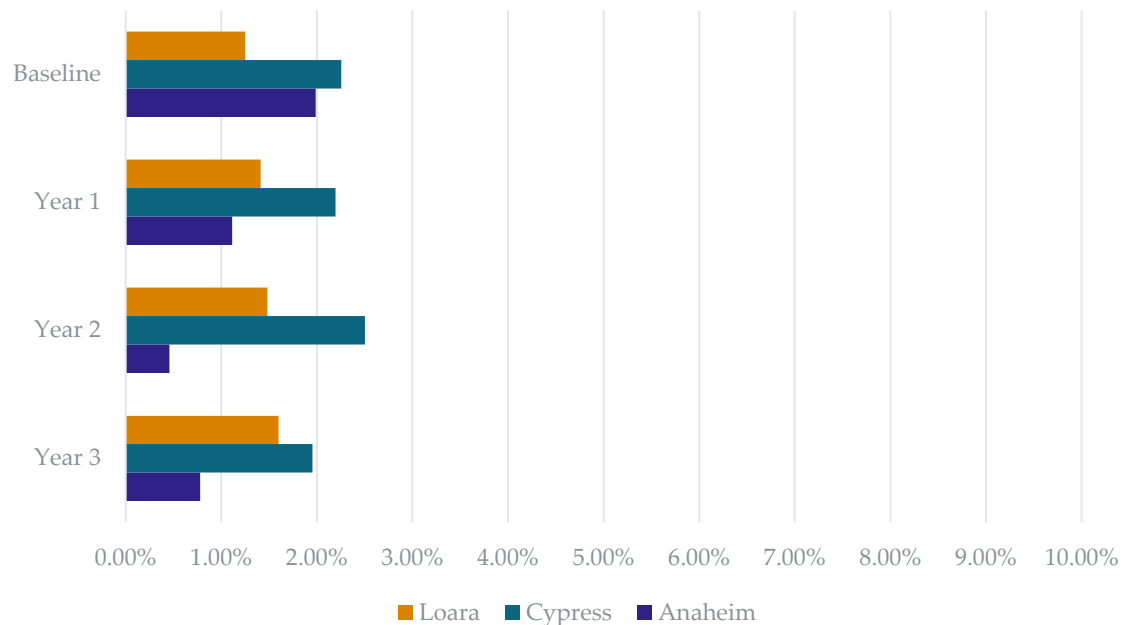


Figure 30. Proportion of female students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.

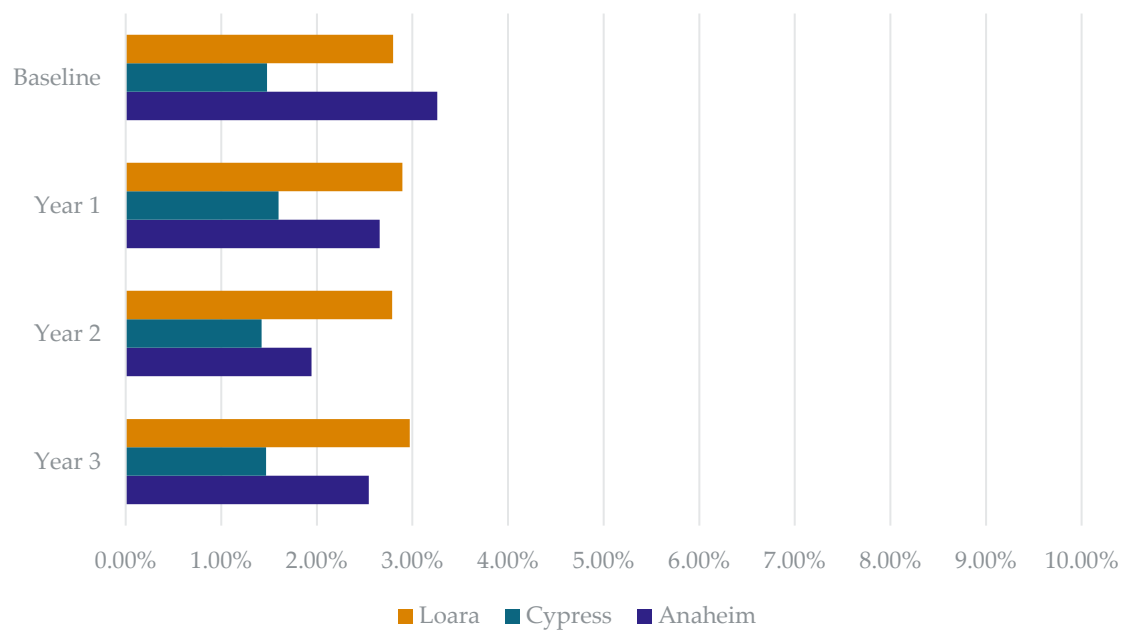


Figure 31. Proportion of Latinx students enrolled in ICT Pathway & CS courses at BTCSEI schools across baseline and intervention years.

Finally, the proportion of female or Latinx students who successfully completed the ICT Pathway and CS courses they enrolled in was examined. These data were provided for Years 1 through 3 of the BTCSEI intervention, but not for the baseline year. The results here varied by school. The results from Anaheim were promising, showing an increase in female and Latinx student success rates over the three years (increasing from 68% to 91% over time). This pattern did not replicate at the other two schools, however. Cypress saw much smaller increases over the three years (increasing from 75% to 80% over time), and Loara saw a large decrease in success rates in Year 3 (dropping from 80% in Year 2 to 50% in Year 3, see Figure 32). Overall, these represent mixed results for the impact of the BTCSEI intervention on the success rates of female and Latinx students in CS and ICT Pathway courses. It should be noted that, as only three schools took part in the intervention, the generalizability of these findings is very limited.

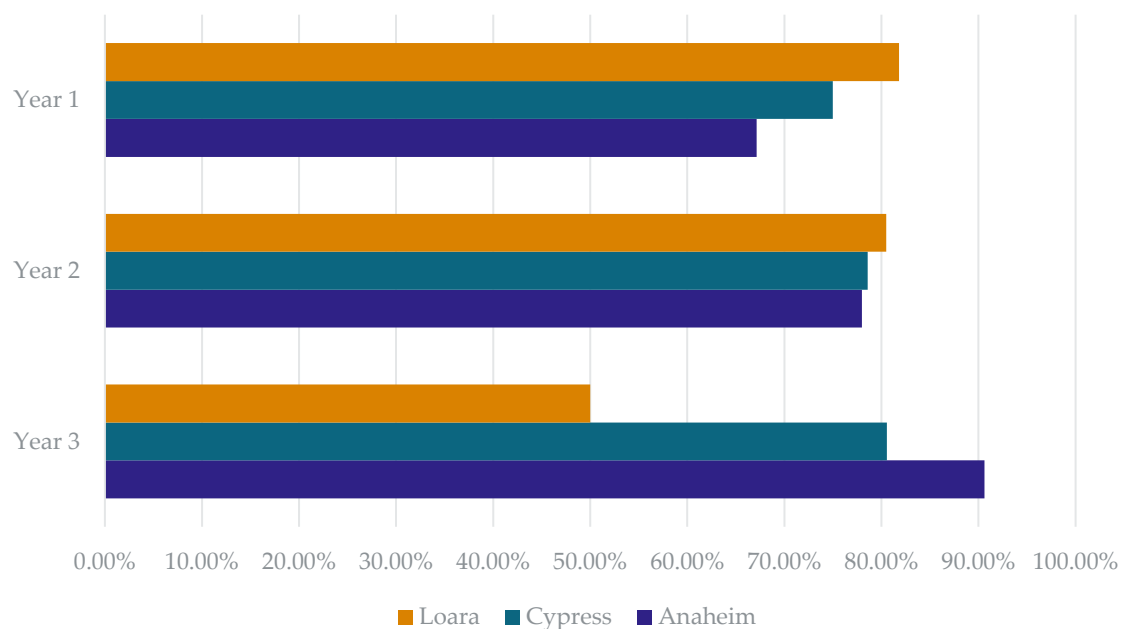


Figure 32. Success rates of female or Latinx students in ICT Pathway & CS courses at BTCSEI schools across intervention years.

References

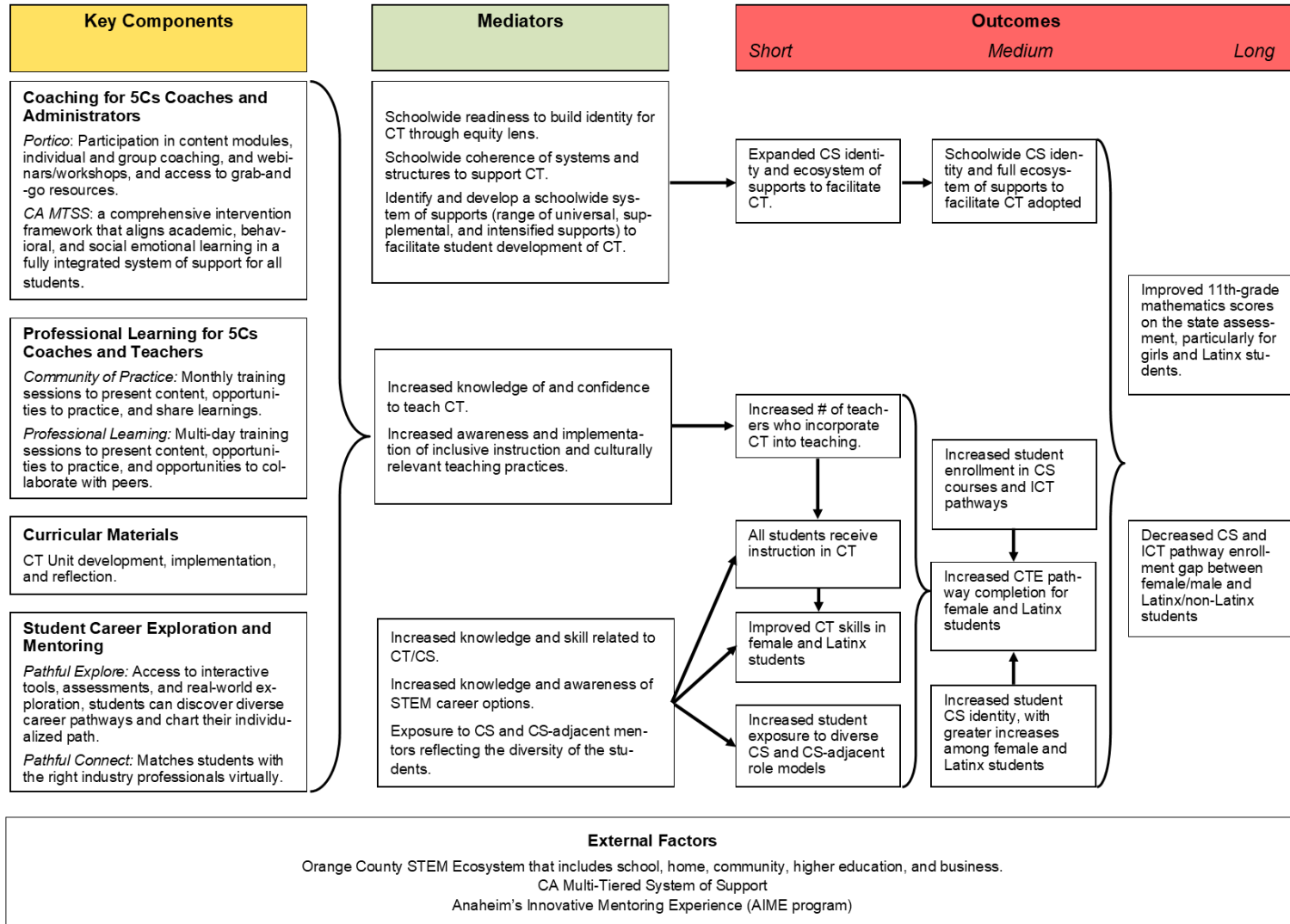
- Austin, P.C. (2010). The Performance of Different Propensity-Score Methods for Estimating Differences in proportions (Risk Differences or Absolute Risk Reductions) in Observational Studies. *Statistics in Medicine*, 29, 2137-2148. <https://doi.org/10.1002/sim.3854>.
- Breitenstein, S. M., Gross, D., Garvey, C. A., Hill, C., Fogg, L., & Resnick, B. (2010). Implementation fidelity in community-based interventions. *Research in Nursing & Health*, 33(2), 164–173.
- Brewer, J., & Hunter, A. (1989). *Multimethod research: A synthesis of styles*. Sage Publications.
- California Department of Education. (n.d.). *California Longitudinal Pupil Achievement Data System (CALPADS)*. <https://www.cde.ca.gov/ds/sp/cl/>
- California Department of Education. (n.d.). *California School Dashboard*. <https://www.caschooldashboard.org/>
- California Department of Education. (n.d.). *DataQuest*. <https://www.cde.ca.gov/ds/ad/dataquest.asp>
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Sage Publications.
- Ho D, Imai K, King G, Stuart E (2011). "Matchit: Nonparametric Preprocessing for Parametric Causal Inference." *Journal of Statistical Software*, 42(8), 1–28. doi:10.18637/iss.v042.i08.
- Rosenbaum, P.R., & Rubin, D. B. (1985). Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score. *The American Statistician*, 39, 33-38. <https://doi.org/10.1080/00031305.1985.10479383>



Appendices

Appendix A: Logic Model

Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Logic Model



Appendix B: School Selection and Participating School Characteristics

To determine the candidate pool for the intervention, OCDE project staff examined data from the 15 Orange County school districts that reported five-year CS course and/or ICT track enrollment data for 64 high schools. For each district, they compared CS/ICT enrollment rates of female students and students of color in high schools within the district with the overall percentage of female students and students of color in the district. An initial review showed that Latinx students, in addition to female students, were the only student group with large discrepancies in these schools. As such, OCDE set the following criteria for inclusion:

- Schools with a 15% or greater discrepancy between the five-year aggregate proportion of female students enrolled in CS/ICT and the district proportion of female students; and/or
- Schools with a 15% or greater discrepancy between the five-year aggregate proportion of Latinx students enrolled in CS/ICT and the district proportion of Latinx students.

A total of 49 high schools from across 11 school districts met the threshold for inclusion as potential sites for the intervention. Districts with three or more eligible high schools were prioritized for intervention site selection. An additional five school sites that met the criteria were included in the pool of candidates for selection into the comparison group. Table B1 shows CS/ICT pathway enrollment inequities by school district.

Table B-1. CS/ICT Pathway Enrollment Inequities in Districts for Potential Selection

District (Unified School District=USD; Union High School District=UHSD)	# High Schools in Selection Pool	% Discrepancy District vs. CS/ICT Enrollment <i>Female Students</i>	% Discrepancy District vs. CS/ICT Enrollment <i>Latinx Students</i>
Capistrano USD	6	19.7%	7.4%
Fullerton Joint UHSD	6	12.1%	40.1%
Garden Grove USD	5	16.9%	0.8%
Huntington Beach UHSD	7	18.1%	10.7%
Irvine USD	4	20.5%	6.0%
Newport Mesa USD	3	26.3%	22.6%
Orange USD	4	23.8%	5.2%
Placentia-Yorba Linda USD	4	25.6%	21.8%
Santa Ana USD	3	20.7%	6.8%

District (Unified School District=USD; Union High School District=UHSD)	# High Schools in Selection Pool	% Discrepancy District vs. CS/ICT Enrollment <i>Female Students</i>	% Discrepancy District vs. CS/ICT Enrollment <i>Latinx Students</i>
Saddleback Valley USD	4	25.6%	3.7%
Tustin USD	3	31.7%	17.5%
<i>Additional School Sites Eligible for Selection into Comparison Group</i>			
<i>Anaheim UHSD</i>	<i>2</i>	<i>17.3%</i>	<i>10.8%</i>
<i>Brea Olinda USD</i>	<i>1</i>	<i>26.4%</i>	<i>22.3%</i>
<i>Laguna Beach USD</i>	<i>1</i>	<i>17.4%</i>	<i>2.5%</i>
<i>Los Alamitos USD</i>	<i>1</i>	<i>25.6%</i>	<i>11.4%</i>

Although multiple schools met the eligibility criteria, school and district capacity shaped final participation. Ongoing challenges related to the COVID-19 pandemic and substitute teacher availability limited schools' ability to take on additional grant activities beyond existing commitments. Ultimately, the project was implemented in three AUHSD schools: Anaheim High School, Cypress High School, and Loara High School. Table B2 describes key demographic and performance characteristics of the participating schools.

Table B-2. Demographic and Performance Data for Participating Schools

	Anaheim HS	Cypress HS	Loara HS
Socioeconomically Disadvantaged	90.7%	42.8%	85.8%
Historically Underserved	95.0%	36.0%	83.7%
4-Year ACGR	94.7%	95.1%	88.2%
ELA Proficiency	Low	High	Very Low
Math Proficiency	Very Low	Medium	Very Low
Science Proficiency	18.8%	51.33%	20.5%

Note. Sources include the California School Dashboard and California Department of Education, DataQuest 2021/22 academic year; Socioeconomically disadvantaged = Students who are eligible for free or reduced-priced meals; or have parents/guardians who did not receive a high school diploma; Historically Underserved = The combined percentage of Black/African American, American Indian or Alaska Native, Hispanic, and Pacific Islander students; 4-Year ACGR = Adjusted 4-Year Cohort Graduation Rate; ELA and Math Proficiency = For the 2021/22 year only, performance levels will be reported using one of five Status levels (ranging from Very High, High, Medium, Low, and Very Low) for state measures on the Smarter Balanced Summative Assessment; Science Proficiency = The percentage of students in Grades 11 and 12 who met or exceeded on the California Science Test (CAST).

Appendix C: OCDE Project Staff Interview Protocol

OCDE EIR Computational Thinking Project Interview Protocol: Educator (OCDE Staff)

Thank you for your willingness to participate in this interview and to share your insights about the implementation of the OCDE EIR Computational Thinking project in AUHSD. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and AUHSD to explore how improving computational thinking skills, developing schoolwide and student-targeted computer science identity, and creating an ecosystem of supports to facilitate equity and inclusion in computer science can help all students, and in particular to increase enrollment and retention of female students and Latinx students in computer science courses.

As such, I will be asking you a series of questions to hear your thoughts on (a) the successes and challenges of the implementation of the CT project in Year 3 of the project; (b) your attitudes and perceptions related to computational thinking and the intended outcomes of the project; and (c) which key conditions, supports, and facilitators used by schools, the district, and OCDE will allow for continued success and sustainability of the aims of the CT project in the years to come. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we are interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this interview with interviews with other project staff and other EIR project schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE, AUHSD, and the U.S. Department of Education about project implementation, and the results will be used to support sustainability moving forward and, ultimately, in better understanding how improving students' computational thinking skills can help to facilitate equity and inclusion in computer science.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondents' questions]*

Thank you. I will begin recording now. Once I start the recorder, I will ask you for your consent to be recorded for this interview. [Start recorder]

This is [RESEARCHER'S NAME] speaking with [Name] from OCDE on [DAY, MONTH, DATE]. Can you please state your full name and that you consent to being recorded today? [Wait for response]. Thank you again for speaking with me today.

Thematic Interview Framework (OCDE Staff)

Warm Up

- Tell us a little bit about your involvement in the project? What is your role and responsibilities?

Project Planning and Implementation Journey: *First, we want to learn more about the efforts that went into planning for and implementing this project.*

- Thinking back over the last year of the project, describe the implementation journey from the start of the project to present. [Probe for milestones]
 - How has the project changed from what was originally planned?
- How is the grant team structured? Who is on the grant team? What are their roles and responsibilities? Tell us a little bit about how the grant team interacts. PROBE about staff transitions and hiring and onboarding new staff.
- Describe for us the process used to recruit teachers for Year 3 of the project.
 - What challenges did you experience when recruiting schools/teachers?
 - What successes did you experience?
- Tell us more about the relationship with AUHSD. How did that partnership start? How has it developed throughout the last year? [PROBE about the MOU]
- Communication is an important part of any project. Describe for us the ways in which you communicate with the district, schools, and teachers involved in the project.
 - Tell us more about the office hours that OCDE offered. How often did people use office hours? What types of questions did you get?
 - Did you meet with some teachers/project members more than others? If so, why?
 - eKadence was used to facilitate community building among teachers. Tell us more about that. How did it go? Are you planning to continue with eKadence in Year 3?
- Continuous improvement is a keystone of the EIR grant program. How are you using continuous improvement to make ongoing modifications to the project?
 - [PROBE for use of data] What data are you using? How are you using it? How are you monitoring whether those changes had a positive effect?

Overall Implementation: *Now I have some questions about general implementation of the project this past year.*

- What successes did your team (OCDE) experience during project implementation? What factors contributed to these successes?
- What barriers or challenges did your team (OCDE) experience during project implementation? How did you overcome these barriers to project implementation? What barriers still exist and how are you addressing them?
- Can you describe your perception of the level of communication and support the OCDE team received from grant partners (e.g., AUHSD, U.S. Department of Education program officer, Inflexion, Redwood Consulting Collaborative)

- In your opinion, what factors have facilitated **schools'** participation in the project? What factors have hindered **schools'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
 - What role has Portico played in the project?
 - To the best of your knowledge, how is Portico working for participating schools?
 - What do you see as the benefits of Portico participation as it related to the project's goals?
 - As a long-term goal of the project, Portico should help schools develop or refine a continuum of supports for students to support computer science and computational thinking practices schoolwide. How can Portico best support the overall goals of the project?
- In your opinion, what factors have facilitated **teachers'** participation in the project? What factors have hindered **teachers'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
 - What project activities do you believe were most helpful to teachers? What was it about those activities that made them the most helpful for implementation?
 - What project activities were least helpful to teachers? What was it about those activities that made them the least helpful?
 - Tell us about the release days that were offered to teacher participants to develop and reflect on the CT units. How did that planning process play out [Probe: what was the expectation/goal of the release days]? What is your perception of the outcomes of the release days? Will you change anything about the release days for the next cohort of teachers? [Probe: How useful was the time offered?]
- Were there any new community partners OCDE worked with as part of this year of implementation of the EIR project?

Benefits of Project Implementation: *I know it's early in the project, but I'd like to get a sense of whether you're experiencing personally or witnessing in your school any benefits from participation in the project.*

- What would you say have been the key initial benefits of implementing the computational thinking project? [PROBE for school-level, teacher-level, and student-level benefits]
- Looking forward, what benefits do you think the implementation of this project will have on the project's target populations, girls and Latinx students, in terms of computer science enrollment and career pathways?

Wrap-Up

- What is the biggest lesson learned from this project?
- As of now, thinking back to the way in which the first of this project rolled out, what plans do you have for supporting Cohort 3?

- What are the current plans for recruitment of classroom teachers for Year 3 of implementation? Have you had any difficulties in conducting the recruitment process so far? If yes, what are they?
- What aspects of Year 1 & 2 activities will you keep the same?
- What aspects of Year 1 & 2 activities will you change? [Probe to determine source of change, e.g., providing relevant examples]
- What plans, if any, does OCDE have to mature and sustain the Computational Thinking Project over time (e.g., beyond the grant cycle)?
- Is there anything else you would like to share to help us understand the implementation of this project?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our interview. Thank you again for taking the time to talk with me today.

[Stop recorder]

Appendix D: AUHSD Project Staff Interview Protocol

OCDE EIR Computational Thinking Project Interview Protocol: Educator (AUHSD Staff)

Thank you for your willingness to participate in this interview and to share your insights about the implementation of the OCDE EIR Computational Thinking project in AUHSD. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and AUHSD to explore how improving computational thinking skills, developing schoolwide and student-targeted computer science identity, and creating an ecosystem of supports to facilitate equity and inclusion in computer science can help all students, and in particular to increase enrollment and retention of female students and Latinx students in computer science courses.

As such, I will be asking you a series of questions to hear your thoughts on (a) the successes and challenges of the implementation of the CT project in Year 3 of the project; (b) your attitudes and perceptions related to computational thinking and the intended outcomes of the project; and (c) which key conditions, supports, and facilitators used by schools, the district, and OCDE will allow for continued success and sustainability of the aims of the CT project in the years to come. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we are interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this interview with interviews with other project staff and other EIR project schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE, AUHSD, and the U.S. Department of Education about project implementation, and the results will be used to support sustainability moving forward and, ultimately, in better understanding how improving students' computational thinking skills can help to facilitate equity and inclusion in computer science.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondents' questions]*

Thank you. I will begin recording now. Once I start the recorder, I will ask you for your consent to be recorded for this interview. [Start recorder]

This is [RESEARCHER'S NAME] speaking with [Name] from AUHSD on [DAY, MONTH, DATE]. Can you please state your full name and that you consent to being recorded today? [Wait for response]. Thank you again for speaking with me today.

Thematic Interview Framework (AUHSD Staff)

Warm Up

- Tell us about your involvement in the project. What is your role and responsibilities?

Project Planning and Implementation Journey: **First, we want to learn more about the efforts that went into planning for and implementing this project.**

- Tell me more about your role and the district's role as part of the OCDE grant planning team. [Clarify - do they participate in the PD/planning activities or is that OCDE only - this may change some of the following questions]
 - Communication is an important part of any project. Describe for us the ways in which you communicate and interact with OCDE, schools, and teachers involved in the project.
- Thinking back to the beginning of the project, describe the implementation journey from the start of the project to present. [Probe for milestones]
- Describe for us the process used to recruit teachers for Year 3 of the project.
 - What challenges did you experience when recruiting schools/teachers?
 - What successes did you experience?
 - Can you describe the process used to negotiate the MOU for the project? How has that changed in the second year of implementation?
 - Can you describe the process used to negotiate the stipends offered for project participation? How has that changed in the second year of implementation?
- Tell us more about the relationship with OCDE. How did that partnership for the grant start? How has it developed throughout the last year?

Overall Implementation: ***Now I have some questions about general implementation of the project this past year.***

- What successes did AUHSD experience during project implementation? What factors contributed to these successes?
- What barriers or challenges did AUHSD experience during project implementation? How did you overcome these barriers to project implementation? What barriers still exist and how are you addressing them?
- Can you describe your perception of the level of communication and support the AUHSD received from grant partners (e.g., OCDE, U.S. Department of Education program officer, Inflexion, Redwood Consulting Collaborative)
- In your opinion, what factors have facilitated **schools'** participation in the project? What factors have hindered **schools'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
 - What role has Portico played in the project?
 - To the best of your knowledge, how is Portico working for participating schools?
 - What do you see as the benefits of Portico participation as it related to the project's goals?

- As a long-term goal of the project, Portico should help schools develop or refine a continuum of supports for students to support computer science and computational thinking practices schoolwide. How can Portico best support the overall goals of the project?
- In your opinion, what factors have facilitated **teachers'** participation in the project? What factors have hindered **teachers'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
 - What project activities do you believe were most helpful to teachers? What was it about those activities that made them the most helpful for implementation?
 - What project activities were least helpful to teachers? What was it about those activities that made them the least helpful?
 - Tell us about the release days that were offered to teacher participants to develop and reflect on the CT units. How did that planning process play out [Probe: what was the expectation/goal of the release days]? What is your perception of the outcomes of the release days? Will you change anything about the release days for the next cohort of teachers? [Probe: How useful was the time offered?]
- Each school received funds for substitutes and resources for project implementation. What can you tell us about that process and how schools used the money? [Probe for use of funds, AUHSD involvement, etc.]
- One part of the project implemented this year is the use of the Pathful Connect platform. Can you tell me about the district is currently rolling out and/or implementing this platform in AUHSD schools? Can you tell me about how this will/might be used in the future in the district in order to support the goals of the CT project and/or the overarching district goals?
- Were there any new community partners AUHSD worked with as part of this year of implementation of the EIR project?
- How would you describe the level of awareness of the computational thinking project districtwide?
- Tell me about how the computational thinking project goals align with the district's vision. [Probe: CPSF, student success/skills, computer science career pathways, increased engagement with girls/Latinx students]

Project Support: Now I'm going to ask you a few questions about implementation support from other entities.

- How supported did you feel in your role as the lead district connection for the project at AUHSD? What other supports would have been helpful? [PROBE: from OCDE, AUHSD, Inflexion]
- What resources could OCDE offer to project schools to help them achieve the goals of the grant? What resources could AUHSD offer to project schools to help them achieve the goals of the grant?

Benefits of Project Implementation: *I know it's early in the project, but I'd like to get a sense of whether you're experiencing personally or witnessing in your district any benefits from participation in the project.*

- What would you say have been the key initial benefits of implementing the computational thinking project program? [PROBE for district-level, school-level, teacher-level, and student-level benefits]
- Looking forward, what benefits do you think the implementation of this project in AUHSD will have on the project's target populations, girls and Latinx students, in terms of computer science enrollment and career pathways?

Wrap-Up

- What lessons have you learned from this project or what is something you would change about this project, if you could, that would help another district/school looking to implement a program like this?
- What plans, if any, does your district have to mature and sustain the Computational Thinking Project over time? Do you have any concerns about the sustainability of the project after the completion of the grant period?
- Is there anything else you would like to share to help us understand the implementation of the EIR project in AUHSD, or in any of the individual participating schools?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our interview. Thank you again for taking the time to talk with me today.

[Stop recorder]

Appendix E: Administrator Interview Protocol

OCDE EIR Computational Thinking Project Interview Protocol: Educator (Administrators)

Thank you for your willingness to participate in this interview and to share your insights about the implementation of the OCDE EIR Computational Thinking project at [NAME OF SCHOOL]. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and AUHSD to explore how improving computational thinking skills, developing schoolwide and student-targeted computer science identity, and creating an ecosystem of supports to facilitate equity and inclusion in computer science can help all students, and in particular increase enrollment and retention of female students and Latinx students in computer science courses.

As such, I will be asking you a series of questions to hear your thoughts on (a) the successes and challenges of the implementation of the CT project in your school in Year 2 of the project; (b) your attitudes and perceptions related to computational thinking and the intended outcomes of the project; and (c) which key conditions, supports, and facilitators used by your school and district will allow for continued success and sustainability of the aims of the CT project in the years to come. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we are interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this interview with others at [NAME OF SCHOOL] and other EIR project schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE, AUHSD, and the U.S. Department of Education about project implementation, and the results will be used to support implementation moving forward in the next years of the project and, ultimately, in better understanding how improving students' computational thinking skills can help to facilitate equity and inclusion in computer science.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondents' questions]*

Thank you. I will begin recording now. Once I start the recorder, I will ask you for your consent to be recorded for this interview. [Start recorder]

This is [RESEARCHER'S NAME] speaking with [Name] from [NAME OF SCHOOL] on [DAY, MONTH, DATE]. Can you please state your full name and that you consent to being recorded today? [Wait for response] Thank you again for speaking with me today.

Thematic Interview Framework

Warm Up

- How were you recruited for the project? What did you know going in? What was your understanding about your school's participation?
- What did you believe were your roles and responsibilities? How did that compare to what your roles and responsibilities ended up being?

Portico: *A primary component of administrator participation was Portico, which included the monthly Counterpart and Copilot sessions.*

- In this second year, the project transitioned from 5Cs Coaches being the primary participant in Portico to the assistant principals. How did that work for you and your school? In what ways was that successful? In what ways was it challenging?
- What were the most useful Portico tools or activities that assisted you in supporting the implementation of the CT project at your school?
- What, if any, would you say have been the benefits of participating in Portico?
- How do you think Portico can best support administrators in project implementation in the final year of the project?
- As a long-term goal of the project, Portico should help schools develop or refine a continuum of supports for students to support CS and CT practices schoolwide. How can Portico best support your school in these activities?

Overall implementation: *Thank you. Now I have some questions about the general implementation of the project at your school.*

- What successes did you/your teachers/your school experience during project implementation? What factors contributed to these successes?
- What barriers or challenges did you/your teachers/your school experience during project implementation? How did you overcome these barriers to project implementation? What barriers still exist and how are you addressing them?
- What have you heard from teachers regarding their participation in the project? Have you heard anything from students?
- In your opinion, what factors have facilitated **teachers'** participation in the project? What factors have hindered **teachers'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
- In your opinion, what factors have facilitated **students'** participation in the project? What factors have hindered **students'** participation in the project?
- Were there any new community partners your school/team worked with as part of this first year of implementation of the EIR project?

Project Support: *Now I'm going to ask you a few questions about implementation support from other entities.*

- Throughout this academic year, do you feel like you had the information and resources you needed to fulfill the role in this project you were asked to play as a lead administrator at your school? [Probe: Did you have the information needed to integrate across the project roles with Portico, teachers, and the OCDE team]
- How supported did you feel in your role as the lead administrator for the project at your school? What other supports would have been helpful? [PROBE: from Portico, OCDE, AUHSD, others at your school]
- What resources could OCDE offer to project schools to help them achieve the goals of the grant? What resources could AUHSD offer to project schools to help them achieve the goals of the grant?
- How do you perceive the level of communication you received from the OCDE team?

Benefits of Project Implementation: *I know it's early in the project, but I'd like to get a sense of whether you're experiencing personally or witnessing in your school any benefits from participation in the project.*

- What would you say have been the key initial benefits of implementing the CT project program? [PROBE for school-level, teacher-level, and student-level benefits]
- Looking forward, what benefits do you think the implementation of this project in your school will have on the project's target populations, girls and Latinx students, in terms of computer science enrollment and career pathways?
- To what extent do you agree that computational thinking in core content areas is important for addressing the representation gap of girls and Latinx students in CS courses and/or ICT pathways? [REQUIRED FOR APR]

Wrap-Up

- What lessons have you learned from this project or what is something you would change about this project, if you could, that would help another school looking to implement a program like this?
- What plans, if any, does your school have to mature and sustain the CT Project over time?
- Is there anything else you would like to share to help us understand the implementation of the EIR project at [NAME OF SCHOOL]?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our interview. Thank you again for taking the time to talk with me today.

[Stop recorder]

Appendix F: 5Cs Coach Interview Protocol

OCDE EIR Computational Thinking Project Interview Protocol: Educator (5Cs Coaches)

Thank you for your willingness to participate in this interview and to share your insights about the implementation of the OCDE EIR Computational Thinking project at [NAME OF SCHOOL]. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and AUHSD to explore how improving computational thinking skills, developing schoolwide and student-targeted computer science identity, and creating an ecosystem of supports to facilitate equity and inclusion in computer science can help all students, and in particular increase enrollment and retention of female students and Latinx students in computer science courses.

As such, I will be asking you a series of questions to hear your thoughts on (a) the successes and challenges of the implementation of the CT project in your school in Year 1 of the project; (b) your attitudes and perceptions related to computational thinking and the intended outcomes of the project; and (c) which key conditions, supports, and facilitators used by your school and district will allow for continued success and sustainability of the aims of the CT project in the years to come. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we are interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this interview with others at [NAME OF SCHOOL] and other EIR project schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE, AUHSD, and the U.S. Department of Education about project implementation, and the results will be used to support implementation moving forward in the next years of the project and, ultimately, in better understanding how improving students' computational thinking skills can help to facilitate equity and inclusion in computer science.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondents' questions]*

Thank you. I will begin recording now. Once I start the recorder, I will ask you for your consent to be recorded for this interview. [Start recorder]

This is [RESEARCHER'S NAME] speaking with [Name] from [NAME OF SCHOOL] on [DAY, MONTH, DATE]. Can you please state your full name and that you consent to being recorded today? [Wait for response]. Thank you again for speaking with me today.

Thematic Interview Framework

Warm Up

- How were you recruited for the project? What did you know going in? What was your understanding about your school's participation?
- What did you believe were your roles and responsibilities? How did that compare to what your roles and responsibilities ended up being?

Portico: A primary component of 5Cs Coach participation was Portico, which included the monthly Counterpart and Copilot sessions.

- In this first year, the project offered a unique approach to Portico, with the 5Cs Coaches working with the assistant principals. How did that work for you and your school? In what ways was that successful? In what ways was it challenging?
- Next year, the approach to Portico will differ, with the assistant principals serving as the Portico leads. How do you think that will be different?
- What were the most useful Portico tools or activities that assisted you in supporting the implementation of the CT project at your school?
- What, if any, would you say have been the benefits of participating in Portico?
- How do you think Portico can best support administrators in project implementation over the next 2 years of the project?
- As a long-term goal of the project, Portico should help schools develop or refine a continuum of supports for students to support CS and CT practices schoolwide. How can Portico best support your school in these activities?

Overall Implementation: Thank you. Now I have some questions about general implementation of the project at your school

- What successes did you/your teachers/your school experience during project implementation? What factors contributed to these successes?
- What barriers or challenges did you/your teachers/your school experience during project implementation? How did you overcome these barriers to project implementation? What barriers still exist and how are you addressing them?
- What have you heard from assistant principals regarding their participation in the project? What have you heard from teachers? Have you heard anything from students?
- In your opinion, what factors have facilitated **teachers'** participation in the project? What factors have hindered **teachers'** participation in the project? *[Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.]*
- In your opinion, what factors have facilitated **students'** participation in the project? What factors have hindered **students'** participation in the project?
- Were there any new community partners your school/team worked with as part of this first year of implementation of the EIR project?

Participation in Professional Development Activities: *In this next set of questions, I'd like you to think about the grant training activities that occurred during this year of the project, which include the Summer Training Institute(s) and the Community of Practice meetings.*

- What project activities were most helpful to you? What was it about those activities that made them the most helpful for implementation?
- What project activities were least helpful to you? What was it about those activities that made them the least helpful?
- What, if any, would you say have been the benefits of participating in these activities?

Teacher Support Role: *Now I have a few questions about your interactions with teachers as part of this project.*

- 5Cs Coaches ended up serving a key role by coordinating project activities at the school-level and providing support to teachers. How prepared did you feel to serve in that role? Did you have the information and support you needed to successfully support teachers?
- How frequently did you communicate with teachers regarding the project and/or specific project activities?
 - What methods did you use to provide teachers with reminders about project activities? How often did you provide reminders? How well do you think these communications worked?
- How often did you meet with teachers at your school for this project? Were these meetings mandatory or voluntary? [Probe for release day meetings - were 5Cs Coaches involved?]

Project Support: *Now I'm going to ask you a few questions about implementation support from other entities.*

- Throughout this academic year, do you feel like you had the information and resources you needed to fulfill the role in this project you were asked to play as a 5Cs Coach at your school? [Probe: Did you have the information needed to integrate across the project roles with Portico, the admin, teachers, and the OCDE team]
- How supported did you feel in your role as the lead administrator for the project at your school? What other supports would have been helpful? [PROBE: from Portico, OCDE, AUHSD, others at your school]
- What resources could OCDE offer to project schools to help them achieve the goals of the grant? What resources could AUHSD offer to project schools to help them achieve the goals of the grant?
- How do you perceive the level of communication you received from the OCDE team?
- Did you use the office hours provided by OCDE for support? Why/why not?

Benefits of Project Implementation: *I know it's early in the project, but I'd like to get a sense of whether you're experiencing personally or witnessing in your school any benefits from participation in the project.*

- What would you say have been the key initial benefits of implementing the CT project program? [PROBE for school-level, teacher-level, and student-level benefits]
- Looking forward, what benefits do you think the implementation of this project in your school will have on the project's target populations, girls and Latinx students, in terms of computer science enrollment and career pathways?

Wrap-Up

- What lessons have you learned from this project or what is something you would change about this project, if you could, that would help another school looking to implement a program like this?
- What plans, if any, does your school have to mature and sustain the CT Project over time?
- Is there anything else you would like to share to help us understand the implementation of the EIR project at [NAME OF SCHOOL]?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our interview. Thank you again for taking the time to talk with me today.

[Stop recorder]

Appendix G: Coherence Review

OCDE EIR Project Implementation Coherence Review

Overview and Purpose

Inflexion is partnering with the Orange County Department of Education (OCDE) and Anaheim Union High School District (AUHSD) on the Education Innovation and Research (EIR) Computational Thinking Project, funded by the U.S. Department of Education. As part of this grant, Inflexion will be asking leaders at each school to complete a self-assessment of implementation progress for the EIR Computational Thinking Project at **three** time points throughout the grant. It is important to note that this review is **not** designed to evaluate you or your school. Rather, we aim to collect evidence of implementation progress over time. We fully expect that in the early years of the project, implementation will be at the beginning stages and will progress throughout the project.

This review will focus on the schoolwide systems and structures in place to support grant activities. Specifically, this review will ask you about your school vision, values, and beliefs; schoolwide computational thinking leadership and management practices; teacher mindset and beliefs; structures in place to support teachers; and schoolwide computational thinking instruction and practices. These topics are rooted in the Inflexion Approach, which addresses deep-seated challenges and barriers to systemic change. The Inflexion Approach stresses that systemic change fails when schools do not address the vision, values and beliefs, and student learning outcomes that define their school identity. Another barrier to schoolwide implementation efforts is misaligned organizational structures (i.e., systems, structures, and processes). A school's identity should inform the structures that dictate how schools are organized and operated. These two pillars form the foundation for pursuing school change. Finally, a school's organizational structure should support a learning approach that empowers college, career, and life readiness and success for all students.

This review is designed specifically to support school leaders as they implement the schoolwide practices from the EIR Computational Thinking Project. We acknowledge that no two schools are exactly alike. As such, their implementation journey and the support they need to be successful in their implementation journey will differ. This review is designed to allow for different paths to implementation. The Inflexion team will use your responses over time to track implementation of schoolwide practices for reporting purposes. More importantly, Portico coaching will leverage your responses to provide tailored guidance and resources to support your school in their implementation of the EIR Computational Thinking Project. Further, the advantages of this coherence review extend beyond supporting implementation of schoolwide computational thinking instruction and practices. It will provide each school with an opportunity for professional growth by helping school leaders:

- promote a systems-thinking mentality,
- build a shared language among school leaders,

- set specific implementation goals,
- reflect on implementation progress,
- create a "living record" of implementation that minimizes the effects of administrator and teacher turnover, and
- plan professional development.

Directions

To complete this self-assessment, we are asking assistant principals and 5Cs Coaches to read each statement and select the corresponding implementation level that is most appropriate for where the school is **at this point in time**.

It is possible individuals may feel that multiple levels capture their school's current implementation efforts. The goal is for the assistant principals and the 5Cs Coaches working on the EIR Computational Thinking Project to discuss implementation efforts with each other and reach **consensus** on their school's current implementation level within each component.

If meeting to complete this coherence review together is not possible, please consider what you know about the group's goals, efforts, and understandings and select the implementation level that you believe is **most accurate for your school right now** and complete this survey **separately**. The Inflexion team will review responses and reach out to team members to facilitate a consensus-reaching process in the case of items where team members differ in their implementation ratings.

Implementation Levels

Undeveloped (0) - Our school does not have in place all the components of this item and no actions are planned or in progress at this time. However, our school may have discussed our current status and the need for implementation, including discussions to identify existing strengths and opportunities, and the degree to which the item description meets the needs of our school, and exploration of options to meet the needs.

Launching (1) - Our school has identified a plan and is actively working to put in place the components of this item. Our school leaders have defined clear plans to develop the feature and personnel are assigned responsibility for carrying out the planned tasks.

Advancing (2) - Our school has in place all the implementation components and is now refining and improving upon them. Our transformation efforts are starting to make systemic changes.

Fully Implemented (3) - Our school has in place all components and continues to make efforts to ensure they are fully integrated, well-functioning, and has support systems in place. Our school maintains and improves skills through the system. Overall effectiveness is being monitored and components for ongoing implementation are revised to improve contextual fit when necessary.

Implementation Coherence Review

School Vision, Values, and Beliefs: For each item, please select the implementation level (0-3) that best represents your school's current reality.

1. Our school has a **vision** that reflects a comprehensive view of college, career, and life readiness.
2. Our school **values** the following:
 - social-emotional learning
 - student voice and choice/agency
 - computational thinking instruction and practices
 - support for historically marginalized groups of students in STEM
3. Our school vision, values, and beliefs consistently **serve as a guide** for school leadership team decision-making.
4. Our school **has a plan and system/strategies in place** to actively encourage social-emotional learning.
5. Our school **has a plan and system/strategies in place** to actively encourage student voice and choice/agency.
6. Our school **has a plan and system/strategies in place** to actively support students in developing their computational thinking skills.
7. Our school **has a plan in place** to actively support historically marginalized groups of students in STEM.
8. Our school **has a system of supports in place** to actively support historically marginalized groups of students in STEM.
9. Our school **has a plan in place** to increase inclusivity for girls and Latinx students in computer science courses.
10. Our school **has a system of supports in place** to increase inclusivity for girls and Latinx students in computer science courses.
11. Our school **has a plan and structures/strategies in place** to review and ensure every student has at least one support person on campus.
12. Our school **has a plan and structures/strategies in place** to ensure all students are known, potential needed supports are identified, and needed supports are implemented.

Schoolwide Computational Thinking Leadership and Management: For each item, please select the implementation level (0-3) that best represents your school's current reality.

13. Our school has **a plan and system/strategies in place** to distribute roles and responsibilities for ensuring computational thinking use and implementation.

14. Our school has **a plan and system/strategies in place** to improve the implementation of computational thinking instruction and needed supports.
15. Our school has **a plan and system/strategies in place** to disseminate and update faculty on a regular basis on the implementation of computational thinking instruction and practices.
16. Someone at our school is responsible for maintaining consistent documentation of the key structures that support computational thinking instruction and practices for the purposes of improving implementation.
17. Our school has **a plan and system/strategies in place** to use data to ensure all students have consistent opportunities to receive computational thinking instruction.
18. Our school has **a plan and system/strategies in place** for administrators, teachers, and students to have ongoing opportunities to provide and be provided with feedback regarding computational thinking instruction and practices.

Teacher Mindsets and Beliefs: For each item, please select the implementation level (0-3) that best represents your school's current reality.

19. All math, science, and computer science teachers at this school verbally acknowledge and act on the belief that teaching **social-emotional learning** is a vital part of their role.
20. All math, science, and computer science teachers at this school verbally acknowledge and act on the belief that students should have **voice and choice/agency** in their learning.
21. All math, science, and computer science teachers at this school verbally acknowledge and act on the belief that **computational thinking** is important.
22. All math, science, and computer science teachers at this school verbally acknowledge and act on the belief that **all students** have the **ability to learn** computational thinking.
23. All math, science, and computer science teachers at this school verbally acknowledge and act on the belief that **all students** can be **successful in STEM courses**.

Supporting Teachers: For each item, please select the implementation level (0-3) that best represents your school's current reality.

24. All math, science, and computer science teachers at our school are trained on recognizing their own beliefs about students and the implicit biases they may hold related to students' computational thinking interests and abilities.
25. All math, science, and computer science teachers are trained on using equitable practices and Universal Design for Learning (UDL) in their teaching.
26. All math, science, and computer science teachers training and instructional mentoring promotes the importance of computational thinking instruction and practices.

27. The school prioritizes funds to provide teachers with consistent opportunities to engage in professional learning related to computational thinking instruction and practices.
28. All math, science, and computer science teachers are trained on how their curriculum and instruction develops the skills associated with the school's computational thinking student learning outcomes.
29. All math, science, and computer science teachers are trained on how to align computational thinking instruction and practices to specific knowledge as well as the skills associated with the school's student learning outcomes.
30. All math, science, and computer science teachers are trained on how to consistently incorporate computational thinking instruction into, and reflect on, their practice.
31. All math, science, and computer science teachers have the time and space to review and create curriculum/lesson plans that embed computational thinking instruction strategies and practices in student assignments and reflection on individual students.
32. The master schedule allows for teachers to routinely collaborate in team meetings and teachers routinely engage in the review of computational thinking instruction and practice as a group.

Computational Thinking Instruction and Practices: For each item, please select the implementation level (0-3) that best represents your school's current reality.

33. Our school has **student learning outcomes** that emphasize computational thinking instruction and practices.
34. Computational thinking instruction strategies and practices are embedded in math, science, and computer science department's curricular scope and sequence.
35. Computational thinking instruction and practice takes place in every math, science, and computer science course.
36. Math, science, and computer science incorporate computational thinking instruction and practices aligned to student learning outcomes into their weekly routines and lesson plans.
37. All students are provided with opportunities to use computational thinking skills in a variety of courses (e.g., math, science, computer science).
38. Computational thinking instruction strategies and practices are consistently scaffolded across grades and across subjects (e.g., math, science, computer science).
39. All students in math, science, and computer science classes are provided with opportunities to access activities that include computational thinking practices/skills with adults outside of school (e.g., higher education, business and industry, and community).

40. All math, science, and computer science classes use computational thinking strategies and practices as one component of assessing progress on the student learning outcomes.
41. All math, science, and computer science teachers routinely communicate and reflect with parents/guardians in informal ways about students' progress and growth as learners.

Appendix H: Teacher Perceptions and Practices Survey

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Thank you for participating in this survey. The purpose of this survey is to better understand your current teaching practices and your perspectives on instruction. The information from this survey will contribute to OCDE's understanding of the progress and eventual impact of the *Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports* project. This survey should take approximately 25 minutes to complete. Thank you for taking the time to share your experience!

By clicking on "Next" you are agreeing to participate in this survey.

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Demographic and Experience

* 1. Please enter your name.

First Name

Last Name

* 2. Please select the school at which you work.

☐ Anaheim High School

☐ Cypress High School

☐ Loara High School

☐ Other (please specify)

3. Which of the following best represents your gender?

- ☐ Female
- ☐ Male
- ☐ Nonbinary
- ☐ I choose not to respond
- ☐ Other (please specify)

4. Select your race(s)/ethnicity (please select all that apply):

- ☐ American Indian or Alaska Native
- ☐ Asian or Asian American
- ☐ Black or African American
- ☐ Hispanic or Latinx
- ☐ Middle Eastern or Northern African
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ I choose not to respond
- ☐ Other (please specify)

5. What subject do you teach (select all that apply)?

- ☐ Mathematics
- ☐ Science
- ☐ Computer Science
- ☐ Other (please specify)

6. Including this academic year, how many years of experience do you have as an educator?

- ☐ Less than 2 years
- ☐ 2-5 years
- ☐ 6-9 years
- ☐ 10 years or longer
- ☐ I choose not to respond

7. Including this academic year, how long have you been at your current school?

- ☐ Less than 2 years
- ☐ 2-5 years
- ☐ 6-9 years
- ☐ 10 years or longer
- ☐ I choose not to respond

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Teacher Perceptions and Practices Survey Spring 2025

Knowledge Related to Computational Thinking

Computational thinking is a *cognitive process* by which humans identify and/or define real world problems (i.e., ambiguous and complex) to formulate solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination, while understanding the capabilities and limitations of computers and ensuring that the solution is fit for its intended purpose.

8. How knowledgeable are you related to each of the following?

	Not at all knowledgeable	Somewhat knowledgeable	Moderately knowledgeable	Extremely knowledgeable
How computational thinking applied to your subject area.	☐	☐	☐	☐
Identifying and/or defining real world problems. (i.e., ambiguous and complex).	☐	☐	☐	☐
Formulating solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination.	☐	☐	☐	☐
Understanding the capabilities and limitations of computers.	☐	☐	☐	☐
Evaluating that a solution is fit for its intended purpose.	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Preparedness

Computational thinking is a *cognitive process* by which humans identify and/or define real world problems (i.e., ambiguous and complex) to formulate solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination, while understanding the capabilities and limitations of computers and ensuring that the solution is fit for its intended purpose.

9. How well prepared are you to do each of the following?

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
Embed computational thinking into your subject area.	☐	☐	☐	☐
Instruct students on how to identify and/or define real world problems. (i.e., ambiguous and complex).	☐	☐	☐	☐
Instruct students on how to formulate solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination.	☐	☐	☐	☐
Instruct students on the capabilities and limitations of computers.	☐	☐	☐	☐
Instruct students on how to evaluate that a solution is fit for its intended purpose.	☐	☐	☐	☐
Use inclusive teaching practices in your instruction.	☐	☐	☐	☐
Use culturally responsive pedagogy in your classroom.	☐	☐	☐	☐
Use Universal Design for Learning (UDL) in your classroom.	☐	☐	☐	☐
Meet the needs of diverse learners.	☐	☐	☐	☐
Tie student learnings into the context of culture.	☐	☐	☐	☐
Address inequities in STEM education and/or careers.	☐	☐	☐	☐
Emphasize and model a growth mindset.	☐	☐	☐	☐
Act as a facilitator, allowing students agency in their learning.	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Self-Efficacy

Computational thinking is a *cognitive process* by which humans identify and/or define real world problems (i.e., ambiguous and complex) to formulate solutions that can be represented as sequential steps or rules to be executed by a human, computer, or combination, while understanding the capabilities and limitations of computers and ensuring that the solution is fit for its intended purpose.

10. How strongly do you agree or disagree with the following statements about integrating computational thinking into your teaching?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
When using computational thinking strategies, I welcome student questions.	☐	☐	☐	☐	☐
At this time, I feel I have the necessary skills to teach computational thinking in my discipline.	☐	☐	☐	☐	☐
I am typically able to answer students' questions during computational thinking activities.	☐	☐	☐	☐	☐
At this time, I would feel comfortable inviting my administrator to evaluate my use of computational thinking in my discipline.	☐	☐	☐	☐	☐
I feel comfortable improvising during computational thinking activities.	☐	☐	☐	☐	☐
I teach computational thinking concepts as well as I teach most other concepts in my content area.	☐	☐	☐	☐	☐
After I have taught using a computational thinking concept once, I feel confident using it again.	☐	☐	☐	☐	☐
I know the steps necessary to teach effectively using computational thinking concepts.	☐	☐	☐	☐	☐
I explain to students how computational thinking activities relate to the content of the course.	☐	☐	☐	☐	☐
I am continually finding better ways to integrate computational thinking in my subject area.	☐	☐	☐	☐	☐
I generally apply computational thinking strategies effectively.	☐	☐	☐	☐	☐
I understand computational thinking concepts well enough to integrate them into my content area effectively.	☐	☐	☐	☐	☐
I know how to make students interested in my content area using computational thinking.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Instructional Practices

Never	Yearly	Monthly	Weekly	Daily
I do not use this strategy.	I use this strategy at least once a year.	I use this strategy at least once a month.	I use this strategy at least once a week.	I use this strategy at least once a day.

11. How often does your teacher provide you the opportunity to do the following?

	Never	Yearly	Monthly	Weekly	Daily
Ask students to set their own goals for learning.	☐	☐	☐	☐	☐
Allow students voice and choice on projects and assignments.	☐	☐	☐	☐	☐
Allow students to manage the work on their own projects without telling them what they should be doing.	☐	☐	☐	☐	☐
Allow students to manage their own work time.	☐	☐	☐	☐	☐
Ask students to engage in data practice such as collecting or creating data, manipulating data, and analyzing and visualizing data.	☐	☐	☐	☐	☐
Ask students to use computational models to understand a concept.	☐	☐	☐	☐	☐
Ask students to design, construct, and/or assess computational models.	☐	☐	☐	☐	☐
Ask students to use computational models to find and test solutions.	☐	☐	☐	☐	☐
Encourage students to prepare problems for computational solutions.	☐	☐	☐	☐	☐
Engage students in activities related to and/or including programming.	☐	☐	☐	☐	☐
Assist students in selecting effective computational tools.	☐	☐	☐	☐	☐
Encourage students to assess different approaches/solutions to a problem.	☐	☐	☐	☐	☐

Ask students to develop modular computational solutions.	☐	☐	☐	☐	☐
Ask students to create computational abstractions.	☐	☐	☐	☐	☐
Encourage students to problem solve (e.g., troubleshooting, debugging) when something didn't work the way they wanted it to work.	☐	☐	☐	☐	☐
Help students engage in systems-level thinking, including investigating a complex system as a whole, understanding the relationships within the system, thinking in levels, communicating information about the system and/or defining systems and managing complexity.	☐	☐	☐	☐	☐
Help students connect what they are learning in a lesson or classroom activity to their own life.	☐	☐	☐	☐	☐
Help students to connect what they are learning in a lesson to other disciplines.	☐	☐	☐	☐	☐
Emphasize social and emotional learning such as social awareness, relationship skills, self-awareness, and self-management.	☐	☐	☐	☐	☐
Provide students with multiple means of engagement.	☐	☐	☐	☐	☐
Provide students with multiple means of representation.	☐	☐	☐	☐	☐
Provide students with multiple means of action and/or expression.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Teacher Perceptions and Practices Survey
Spring 2025

Perceptions of Students

12. How strongly do you agree or disagree with the following statements about the students in your class?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
My students are motivated to make things happen for themselves.	☐	☐	☐	☐	☐
My students understand how their interests relate to their future career pathways.	☐	☐	☐	☐	☐
My students are confident that they will reach their career goals.	☐	☐	☐	☐	☐
My students are aware of the career pathway opportunities that are available to them.	☐	☐	☐	☐	☐
My students can identify the specific resources or steps that they need to take to reach their career goals.	☐	☐	☐	☐	☐
Integrating computational thinking helped my students learn something new about possible career pathways.	☐	☐	☐	☐	☐
Integrating computational thinking contributed to a positive change in my students' engagement in their future.	☐	☐	☐	☐	☐
Integrating computational thinking contributed to a positive change in my students' attitudes about a possible future in STEM.	☐	☐	☐	☐	☐
Integrating computational thinking has helped my students feel more motivated to find a career that is rewarding.	☐	☐	☐	☐	☐
Integrating computational thinking helped my students learn something new about the possibilities of career paths in STEM.	☐	☐	☐	☐	☐
Integrating computational thinking helped my students believe it is possible for them to find a career in or related to STEM, if they choose.	☐	☐	☐	☐	☐
Integrating computational thinking allowed my students to see people like themselves in STEM career pathways.	☐	☐	☐	☐	☐
Integrating computational thinking resources helped me support meaningful exploration of career pathways in STEM.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Teacher Perceptions and Practices Survey Spring 2025

Professional Learning

13. How strongly do you agree with the following statements concerning your professional learning opportunities related to computational thinking?

My professional learning experiences related to computational thinking have...

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
been sustained and coherently focused, rather than short-term and unrelated.	☐	☐	☐	☐	☐
included time to think carefully about, try, and evaluate new ideas.	☐	☐	☐	☐	☐
been closely connected to my school's improvement plan.	☐	☐	☐	☐	☐
resulted in more collaboration with colleagues in my school.	☐	☐	☐	☐	☐
resulted in more collaboration with colleagues in other schools.	☐	☐	☐	☐	☐
included the support necessary to implement what I have learned.	☐	☐	☐	☐	☐
been valuable to my practice as a teacher.	☐	☐	☐	☐	☐

increased my
teaching
effectiveness.

☐☐☐☐☐

led to changes in
my teaching
methods.

☐☐☐☐☐

have included
follow-up support
as I implement
what I have
learned.

☐☐☐☐☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Teacher Perceptions and Practices Survey Spring 2025

Communities of Practice

14. How strongly do you agree with the following statements about your Community of Practice (CoP)?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Members of the CoP share a common goal to create inclusive classroom environments that sustain engagement from women and Latinx youth.	☒	☒	☒	☒	☒
Members of the CoP share a common goal to improve students' computational thinking.	☐	☐	☐	☐	☐
Members of the CoP share a common understanding of the terminology and concepts related to computational thinking.	☒	☒	☒	☒	☒
Members of my CoP have a variety of experiences and expertise.	☐	☐	☐	☐	☐
The CoP facilitated a knowledge exchange among members.	☒	☒	☒	☒	☒
The CoP fostered					

trust and respect among members through frequent interactions.

☐☐☐☐☐

My CoP provided the opportunity to develop multi-disciplinary relationships with other educators.

☐☐☐☐☐

My CoP provided the opportunity to establish lasting connections with educators from other schools.

☐☐☐☐☐

Participation in the CoP helped to alleviate my feelings of professional isolation.

☐☐☐☐☐

My CoP provided valuable professional learning opportunities that increased my effectiveness as an educator.

☐☐☐☐☐

The CoP provided me with an opportunity to discuss challenges in a non-judgmental environment.

☐☐☐☐☐

I feel supported by my CoP.

☐☐☐☐☐

The CoP improved my ability to support my female students.

☐☐☐☐☐

The CoP improved my ability to support my Latinx students.

☐☐☐☐☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Teacher Perceptions and Practices Survey Spring 2025

Obstacles to Implementing Computational Thinking

15. What obstacles, if any, have you encountered in fully integrating computational thinking in your classroom [check all that apply]:

- ☐ I have not encountered any obstacles
- ☐ Not enough knowledge/understanding of computational thinking
- ☐ Not enough time to plan and prepare lessons that incorporate computational thinking
- ☐ Not enough time to implement lessons that incorporate computational thinking
- ☐ Not enough guidance on how to incorporate computational thinking units into the curriculum
- ☐ Resources/materials/trainings are not high quality and/or easy to use
- ☐ Not enough examples and/or guidance on how to create computational thinking units or examples specific to computational thinking in my content area
- ☐ Not enough examples and/or guidance on how to connect computational thinking to computer science and computer science pathways
- ☐ Generally, too much information to easily digest and incorporate into teaching practices
- ☐ Not enough support from school leadership
- ☐ Not enough support from district leadership
- ☐ Not enough training or support from OCDE
- ☐ Student resistance to completing computational thinking units
- ☐ Unfinished student learning due to the COVID-19 pandemic
- ☐ I choose not to respond
- ☐ Other (please specify)

Thank you for your participation!

Appendix I: Teacher Focus Group Protocol

OCDE EIR Computational Thinking Project Focus Group Protocol: Educator (Teachers)

Thank you for your willingness to participate in this focus group and to share your insights about the implementation of the OCDE EIR Computational Thinking project at [NAME OF SCHOOL]. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and AUHSD to explore how improving computational thinking skills, developing schoolwide and student-targeted computer science identity, and creating an ecosystem of supports to facilitate equity and inclusion in computer science can help all students, and in particular increase enrollment and retention of female students and Latinx students in computer science courses.

As such, I will be asking you a series of questions to hear your thoughts on (a) the successes and challenges of the implementation of the CT project in your school in Year 2 of the project; (b) your attitudes and perceptions related to computational thinking and the intended outcomes of the project; and (c) which key conditions, supports, and facilitators used by your school and district will allow for continued success and sustainability of the aims of the CT project in the years to come. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we are interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this focus group with others at [NAME OF SCHOOL] and other EIR project schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE, AUHSD, and the U.S. Department of Education about project implementation, and the results will be used to support implementation moving forward in the next years of the project and, ultimately, in better understanding how improving students' computational thinking skills can help to facilitate equity and inclusion in computer science.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondent's questions]*

Thank you. I will begin recording now. Once I start the recorder, I will ask each of you for your name and your consent to be recorded for this focus group. [Start recorder]

This is [RESEARCHER'S NAME] speaking with [Group Name] from [NAME OF SCHOOL] on [DAY, MONTH, DATE]. Can you please state your full name and that you consent to being recorded today? [Wait for response]. Thank you again for speaking with me today.

Thematic Interview Framework

Warm Up

- How were you recruited for the project? What did you know going in? What was your understanding about your school's participation?
- What did you believe were your roles and responsibilities? How did that compare to what your roles and responsibilities ended up being?

Participation in Professional Development Activities: *We'd like to ask you about your own participation in the grant training activities that occurred during this year of the project, which include the Summer Training Institute(s) and the Community of Practice meetings.*

- What project activities were most helpful to you? What was it about those activities that made them the most helpful for implementation?
- What project activities were least helpful to you? What was it about those activities that made them the least helpful?

CT Units: *Now I'm going to ask some questions about the development and implementation of the computational thinking unit.*

- Tell me a little bit about your development of the CT units. How did teachers at your schoolwork together to develop the CT units?
- How did your team use the release days/development days provided by OCDE to work on your CT units? How useful were they in your overall development and implementation of the CT unit?
- Tell me about the implementation of the CT unit with your students. How do you think the computational thinking units were received by your students? What worked well? Is there anything that didn't work well?
- How did you reflect on the CT unit you developed and implemented with other members of your school team? What lessons did you take away from the reflections?
- Do you anticipate continuing to use the computational thinking units you developed following the conclusion of your participation in this project? Why or why not?

Pathful: *Another key component of the project was the Pathful platform.*

- Did you make use of the Pathful Connect or Pathful Explore online program? If so, how would you describe the usefulness of this tool in your classroom/CT unit?

Overall Implementation: *Now I have some questions about general implementation of the project at your school*

- What successes did you/your school experience during project implementation? What factors contributed to these successes?

- What barriers or challenges did you/your school experience during project implementation? How did you overcome these barriers to project implementation? What barriers still exist and how are you addressing them?
- What have you heard from your assistant principal regarding participation in the project? What have you heard from other teachers? Have you heard anything from students?
- In your opinion, what factors have facilitated **teachers'** participation in the project? What factors have hindered **teachers'** participation in the project? [*Probe for factors inherent in the school and factors from other project partners, such as the district, OCDE, community partners, families.*]
- In your opinion, what factors have facilitated **students'** participation in the project? What factors have hindered **students'** participation in the project?

Supports needed from school/district: *Now I am going to ask about the supports that may help teachers embed computational thinking in their instruction.*

- Throughout this academic year, do you feel like you had the information and resources you needed to fulfill your role in this project at your school? [Probe: Did you have the information needed to integrate across the project roles with the admin, other teachers, and the OCDE team]
- How supported did you feel in your role as a participating teacher for the project at your school? What other supports would have been helpful? [PROBE: from OCDE, AUHSD, others at your school]
- What resources could OCDE offer to project schools to help them achieve the goals of the grant? What resources could AUHSD offer to project schools to help them achieve the goals of the grant?
- How do you perceive the level of communication you received from the OCDE team?
- Did you use the office hours provided by OCDE for support? Why/why not?

Benefits of Project Implementation: *I know it's early in the project, but I'd like to get a sense of whether you're experiencing personally or witnessing in your school any benefits from participation in the project.*

- What would you say have been the key initial benefits of implementing the CT project program? [PROBE for school-level, teacher-level, and student-level benefits]
 - In what ways has this project affected your content knowledge of computational thinking?
 - How did participation in this project affect your preparedness or confidence in teaching computational thinking? How does this compare to your level of preparedness before participating in the project?
 - In what ways has this project affected your classroom practices for teaching computational thinking?
 - In what ways, if any, has this project influenced your awareness and implementation of inclusive instruction and culturally relevant teaching practices?

- Longer term, what benefits do you think the implementation of this project in your school will have on the project's target populations, girls and Latinx students, in terms of computer science enrollment and career pathways?

Wrap-Up

- Do you anticipate continuing to use the computational thinking instructional practices and strategies you learned following the conclusion of your participation in this project? Why or why not?
- What lessons have you learned from this project or what is something you would change about this project, if you could, that would help another school looking to implement a program like this?
- Is there anything else you would like to share to help us understand the implementation of the EIR project at [NAME OF SCHOOL]?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our focus group. Thank you again for taking the time to talk with me today.

[Stop recorder]

Appendix J: Classroom Observation Protocol

OCDE EIR Computational Thinking Project Classroom Observation Checklist

The purpose of this protocol is to document implementation progress. Complete the section below during the observation; also generate typed or written field notes during the observation describing what takes place in the classroom (last page of the protocol). After the observation is completed, fill out the remainder of the observation checklist by adding evidence text from the field notes and marking each appropriate indicator cell. No one classroom will exhibit characteristics of every category during a single observation. Aggregation across all observed classrooms and observation sessions will be required.

School: _____

Class/Subject: _____

Teacher: _____

Observer: _____

Date: _____

Start Time ____:____

End Time ____:____

Number of students present for most of the lesson: _____

Class attention (select one): What was the overall level of student attention?

_____ Low attention (less than 25% on task)

_____ Moderate attention (25%-75% on task)

_____ High attention (more than 75% on task)

Classroom organization (select all that apply): Which types of classroom organization were observed during the observation?

- ☐ Whole class
- ☐ Small groups
- ☐ Pairs
- ☐ Individual work

Was this one of the required computational thinking units (Y/N): _____

Short Description of Activity/Lesson Occurring in Classroom During Observation:

Item	False	Partially True	True	Not Applicable	<i>If partially true, what was missing or different from the expectation?</i>
Classroom Management					
The teacher clearly posted, presented, and/or discussed the learning targets for the lesson.					
The teacher demonstrated effective pedagogies for engaging students in the lesson (e.g., brainstorming, think-aloud sessions, question answering, or posing open-ended remarks, etc.).					
The teacher was responsive to student engagement and adjusted his/her/their strategies accordingly.					
The teacher acted as a resource person, working to support and enhance student learning (rather than directing it).					
The teacher infused the curriculum with technology to strengthen his/her/their instructional delivery.					
Students appeared to understand the lesson and task assignments. [Check via questions asked, engagement]					
Classroom Environment					
The teacher has established a warm and welcoming classroom environment (e.g., greets students by name, shows genuine interest in students).					
Student-teacher and student-student Interactions were positive, courteous, and respectful.					
The teacher seemed to value and attempted to build on the experiences, knowledge, and cultures students bring to the classroom.					
The teacher provided activities that nurtured a collaborative environment.					
The teacher encouraged active participation from all students.					

Item	False	Partially True	True	Not Applicable	<i>If partially true, what was missing or different from the expectation?</i>
Students freely shared their ideas and listened to each other's ideas.					
Teacher and/or student questions triggered divergent modes of thinking (higher level thinking).					
Student Agency					
Students were given the opportunity to make their own goals for learning and/or manage their own work time without being told what they should be doing.					
Students had a voice and choice in their projects and/or assignments.					
Students designed or implemented their own products during the class session.					
Students were encouraged and supported to reflect on and assess their own learning in an ongoing way.					
Students connected what they were learning in the lesson or classroom activity to other disciplines and/or their own life.					
Positioning and Teaching Computational Thinking					
The teacher used the term "computational thinking" in his/her/their delivery of content.					
The teacher and/or students used computational thinking vocabulary (e.g., identifying patterns, ordered steps/sequencing, troubleshooting, etc.).					
Computational thinking was embedded into the class rather than a separate add-on activity.					
The teacher clearly linked today's lesson to previous learning about computational thinking.					

Item	False	Partially True	True	Not Applicable	<i>If partially true, what was missing or different from the expectation?</i>
The teacher placed the current unit/lesson in a learning progression, connecting for students the unit and lesson to prior or future work in computational thinking and/or computer science.					
The teacher used relevant analogies and made cross-curricular connections explicit (e.g., comparing iterative product development to the writing process).					
The teacher encouraged and facilitated students to connect the concepts and skills in the lesson to real-world applications (this may be achieved through the content of the lesson itself and/or extensions and examples provided or solicited from students).					
The teacher modeled computational thinking strategies by working through a problem using a think-aloud strategy and physical representations/drawings.					
Opportunities to Develop Computational Thinking Mindsets and Skills					
CT Mindset: Students were comfortable dealing with open-ended problems and exhibited confidence dealing with complexity.					
Problem Identification: Students identified or were given complex, interdisciplinary, real-world problems that could be solved computationally, including evaluating whether it was appropriate and feasible to solve the problem computationally.					
Decomposition: Students identified or were given complex real-world problems that could be solved in many ways and were asked to break the problems into manageable smaller parts.					
Abstraction: Students assessed the information given to them about a problem and determined which facts were important and which were not in					

Item	False	Partially True	True	Not Applicable	<i>If partially true, what was missing or different from the expectation?</i>
solving the problem; students removed unnecessary detail to reduce complexity.					
Algorithmic Thinking: Students formulated solutions that could be represented as a set of ordered steps (sequencing) and then did them in a particular order to solve the problem or accomplish the task in a way that could be repeated by others (using the steps, or algorithm).					
Pattern Recognition: Students identified patterns and commonalities within a particular problem set, sequence, or data set (e.g., all use the Pythagorean Theorem).					
Brainstorming: Students worked systematically through each subproblem to develop a set of potential solutions. Students brainstorm alternative explanations/solutions with the result that most students came up with at least one alternative to their solutions or the class's solution to the lesson challenge.					
Testing: Students made predictions, estimates, and/or hypotheses related to their problem(s) and potential solutions. Students systematically tested their computational solutions by considering all scenarios and potential consequences.					
Troubleshooting: Students identified and fixed errors using a systematic process that included identifying likely causes of errors and testing/re-testing as needed.					
Interpretation: Students were encouraged to interpret data and explain relationships related to their problem(s) and potential solutions, with students taking most of the initiative and responsibility.					
Modeling: Students created visualizations (e.g., graphs, pictures, models, pseudo-code, etc.) that demonstrated their understanding of a problem and their solution(s).					

Item	False	Partially True	True	Not Applicable	<i>If partially true, what was missing or different from the expectation?</i>
Evaluation: Students analyzed and evaluated multiple potential solutions (their own and/or their classmates') to determine the best solution (most efficient and effective combination of steps and resources) while ensuring the solution is fit for its intended purpose.					
Refinement: Students worked to improve their solution(s) to increase efficacy, usability, and generalizability.					
Generalizability: Students generalized or transferred ideas, solutions, and/or the problem-solving process from one problem area to another.					
Human-Computer Interaction: Students discussed human-computer interactions and/or the capabilities and limitations of computers for problem solving.					

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Appendix K: Event Evaluation Form

Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Communities of Practice (CoP) Meeting Event Evaluation Form - Year 3

Thank you for completing this meeting evaluation form. The purpose of this form is to better understand your experiences with the communities of practice (CoP) meetings. The information from this form will assist OCDE in planning for future CoP meetings. This form should take about 5 minutes to complete. Thank you for taking the time to share your experience!

By clicking on “Next” you are agreeing to participate in this survey.

Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Communities of Practice (CoP) Meeting Event Evaluation Form - Year 3

* 1. School

- ☐ Anaheim High School
- ☐ Cypress High School
- ☐ Loara High School
- ☐ Other (please specify)

* 2. Role

- ☐ Classroom teacher
- ☐ 5Cs Coach
- ☐ Site administrator
- ☐ District administrator
- ☐ Counselor
- ☐ Higher education partner
- ☐ Business partner
- ☐ Student
- ☐ Parent
- ☐ Other (please specify)

3. Discipline Taught (select all that apply):

- ☐ Not Applicable
- ☐ Mathematics
- ☐ Science
- ☐ Computer Science
- ☐ Other (please specify)

Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Communities of Practice (CoP) Meeting Event Evaluation Form - Year 3

Objectives

4. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Objectives for the meeting were clear.	☐	☐	☐	☐	☐
The objectives were accomplished.	☐	☐	☐	☐	☐

Meeting Planning and Logistics

5. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
All necessary pre-materials (agenda or outline, readings) were sent in advance of the meeting.	☐	☐	☐	☐	☐
The day and time of the meeting was convenient.	☐	☐	☐	☐	☐
Pace of the meeting was adequate.	☐	☐	☐	☐	☐
Length of the meeting was adequate.	☐	☐	☐	☐	☐
The structure of the meeting supported and nurtured a collaborative environment.	☐	☐	☐	☐	☐
The meeting was conducted in a way that respected my time.	☐	☐	☐	☐	☐
I had adequate opportunities to express my views, thoughts, and/or ideas during the meeting.	☐	☐	☐	☐	☐
We used our meeting time effectively.	☐	☐	☐	☐	☐

Content

6. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
The content was well organized and easy to follow.	☐	☐	☐	☐	☐
The meeting covered the range of topics I expected it to cover.	☐	☐	☐	☐	☐
The meeting addressed the topics in sufficient detail.	☐	☐	☐	☐	☐
The meeting included time to think carefully about, practice, and evaluate the topics/new ideas being discussed.	☐	☐	☐	☐	☐
I felt encouraged to contribute to the discussion.	☐	☐	☐	☐	☐
The topics and materials were relevant to educators from my content area(s).	☐	☐	☐	☐	☐
I learned from my peers during the meeting.	☐	☐	☐	☐	☐

Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Communities of Practice (CoP) Meeting Event Evaluation Form - Year 3

Interactions with Colleagues

7. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
The CoP meetings have a warm and welcoming group environment (e.g., attendees greet each other, show genuine interest in each other).	☐	☐	☐	☐	☐
Attendee questions and discussions triggered creative/innovative ways of thinking.	☐	☐	☐	☐	☐
Attendee understandings and reflections frequently drove the direction of the meeting.	☐	☐	☐	☐	☐
Attendees connected material from the meeting to their discipline, class, and/or their own life.	☐	☐	☐	☐	☐
The CoP meeting resulted in collaboration with colleagues.	☐	☐	☐	☐	☐
I feel supported in my community of practice.	☐	☐	☐	☐	☐

Outcomes

8. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
The meeting increased my content knowledge relative to the topics presented or discussed.	☐	☐	☐	☐	☐
The meeting increased my skills relative to the topic presented or discussed.	☐	☐	☐	☐	☐
The meeting provided me with resources that I can access for future use.	☐	☐	☐	☐	☐
This CoP meeting was valuable to my teaching practices.	☐	☐	☐	☐	☐
The CoP meeting was beneficial for moving my thinking about computational thinking forward.	☐	☐	☐	☐	☐
This meeting was a good use of my time.	☐	☐	☐	☐	☐

Intent to Use

9. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
The CoP meeting met my expectations.	☐	☐	☐	☐	☐
The knowledge and skills that I gained from this meeting can be incorporated into my work.	☐	☐	☐	☐	☐
I feel supported to implement what I have learned in the CoP meeting.	☐	☐	☐	☐	☐
I will incorporate the new knowledge and/or skills into my teaching.	☐	☐	☐	☐	☐

Quality, Utility, & Relevance

10. Please select the choice that most closely represents the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
Overall, the information presented in the meeting was of high quality .	☐	☐	☐	☐	☐
Overall, the information provided was useful .	☐	☐	☐	☐	☐
Overall, the information and activities were relevant to my work.	☐	☐	☐	☐	☐

Please use the following space to offer additional comments about the event.

11. Most helpful aspect:

12. Least helpful aspect:

13. I learned:

14. Appreciations/Concerns/Suggestions

Thank you for your participation.

Appendix L: Student Perceptions Survey

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Introduction

Thank you for participating in this survey. The purpose of this survey is to better understand your current educational experiences and future education and career goals. This survey should take approximately 20 minutes to complete. Thank you for taking the time to share your experience!

By clicking on “Next” you are agreeing to participate in this survey.

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Demographic and Experience

* 1. Please enter your name.

First Name

Last Name

* 2. Please select the school you attend.

- ☐ Anaheim High School
- ☐ Cypress High School
- ☐ Loara High School
- ☐ Other (please specify)

3. Which of the following best represents your gender?

- ☐ Female
- ☐ Male
- ☐ Nonbinary
- ☐ I choose not to respond
- ☐ Other (please specify)

4. Select your race(s)/ethnicity (please select all that apply):

- ☐ American Indian or Alaska Native
- ☐ Asian or Asian American
- ☐ Black or African American
- ☐ Hispanic or Latinx
- ☐ Middle Eastern or Northern African
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ I choose not to respond
- ☐ Other (please specify)

5. What grade are you in this school year?

- ☐ 9th
- ☐ 10th
- ☐ 11th
- ☐ 12th

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Student Survey
Spring 2025

Student Confidence

6. How confident are you in your ability to do each of the following?

	Not at all confident 1	2	Somewhat Confident 3	4	Extremely Confident 5
Identify and define real world problems (i.e., ambiguous and complex).	☐	☐	☐	☐	☐
Identify patterns in problems.	☐	☐	☐	☐	☐
Create a list of steps to solve a problem.	☐	☐	☐	☐	☐
Brainstorm several solutions to a problem.	☐	☐	☐	☐	☐
Determine whether a solution will meet its intended goal.	☐	☐	☐	☐	☐
Consider possible intended and unintended outcomes of a solution.	☐	☐	☐	☐	☐
Identify the best solution from a set of solutions.	☐	☐	☐	☐	☐
Identify where your solution went wrong and brainstorm possible ways to fix it.	☐	☐	☐	☐	☐
Choose the best technology to assist with solving a problem.	☐	☐	☐	☐	☐
Use computers or other technology to help solve real-world problems.	☐	☐	☐	☐	☐
Create a computer program to solve a problem.	☐	☐	☐	☐	☐
Understand what computers can and cannot do.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Computer Science Identity (1)

7. How strongly do you **agree** or **disagree** with the following statements about computer science?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
I have self-confidence when it comes to computer science.	☐	☐	☐	☐	☐
I would take additional computer science courses if I were given the opportunity.	☐	☐	☐	☐	☐
I feel comfortable in computer science.	☐	☐	☐	☐	☐
Knowledge of computer science will help me earn a living.	☐	☐	☐	☐	☐
A friend or peer has encouraged me to study computer science.	☐	☐	☐	☐	☐
I am confident that I can solve problems by using computing.	☐	☐	☐	☐	☐
I hope that my future career will require the use of computer science.	☐	☐	☐	☐	☐
I feel I belong in computer science.	☐	☐	☐	☐	☐
Learning to use computing skills will help me achieve my career goals.	☐	☐	☐	☐	☐
Someone I know has given me the desire to study computer science.	☐	☐	☐	☐	☐
I can learn computer science without a teacher to explain it.	☐	☐	☐	☐	☐
I like to use computer science to solve problems.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Computer Science Identity (2)

8. How strongly do you **agree** or **disagree** with the following statements about computer science?

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
I feel accepted by my peers in computer science.	☐	☐	☐	☐	☐
Computing skills used to understand computer science material can be helpful to me in understanding things in everyday life.	☐	☐	☐	☐	☐
Someone I know has praised my work in computer science.	☐	☐	☐	☐	☐
I am sure I could do advanced work in computer science.	☐	☐	☐	☐	☐
The challenge of solving problems using computer science appeals to me.	☐	☐	☐	☐	☐
I know someone like me who uses computer science in their work.	☐	☐	☐	☐	☐
I'll need a mastery of computer science for my future work.	☐	☐	☐	☐	☐
Someone I know has discussed with me the computer science field.	☐	☐	☐	☐	☐
I think I will do well in computer science.	☐	☐	☐	☐	☐
I like writing computer programs.	☐	☐	☐	☐	☐
I know a lot of students like me who are interested in computer science.	☐	☐	☐	☐	☐
Computer science is a worthwhile and necessary subject.	☐	☐	☐	☐	☐
Someone in my family has encouraged me to study computer science.	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Instructional Practices

Never	Yearly	Monthly	Weekly	Daily
I have not experienced this activity.	My teacher uses this activity at least once a year.	My teacher uses this activity at least once a month.	My teacher uses this activity at least once a week.	My teacher uses this activity at least once a day.

Please use this rating scale for the following items.

9. How often does your **Math, Science and/or Computer Science teacher** provide you the opportunity to do the following?

	Don't Know	Never	Yearly	Monthly	Weekly	Daily
Set your own goals for learning.	☐	☐	☐	☐	☐	☐
Offer choices regarding what you learn and/or the way in which you complete projects or assignments.	☐	☐	☐	☐	☐	☐
Manage the work on your projects without telling you what you should be doing.	☐	☐	☐	☐	☐	☐
Manage your own work time.	☐	☐	☐	☐	☐	☐
Connect what you are learning in a lesson or classroom activity to your own life.	☐	☐	☐	☐	☐	☐
Connect what you are learning in a lesson to other content areas (for example, things you're learning in other classes or that you already know).	☐	☐	☐	☐	☐	☐
Identify and define real world problems (i.e., ambiguous and complex).	☐	☐	☐	☐	☐	☐
Identify patterns in problems.	☐	☐	☐	☐	☐	☐
Create a list of steps to solve a problem.	☐	☐	☐	☐	☐	☐
Brainstorm several solutions to a problem.	☐	☐	☐	☐	☐	☐
Determine whether a solution will meet its intended goal.	☐	☐	☐	☐	☐	☐
Consider possible intended and unintended outcomes of a solution.	☐	☐	☐	☐	☐	☐
Identify the best solution from a set of solutions.	☐	☐	☐	☐	☐	☐
Identify where your solution went wrong and brainstorm possible ways to fix it.	☐	☐	☐	☐	☐	☐
Choose the best technology to assist with solving a problem.	☐	☐	☐	☐	☐	☐
Use computers or other technology to help solve real-world problems.	☐	☐	☐	☐	☐	☐
Create a computer program to solve a problem.	☐	☐	☐	☐	☐	☐
Understand what computers can and cannot do.	☐	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion:
Developing an Ecosystem of Supports
Student Survey
Spring 2025

Career Decision Self-Efficacy

10. How strongly do you **agree** or **disagree** with the following statements about your future career pathway?

	Don't Know	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
I am motivated to make things happen for myself.	☐	☐	☐	☐	☐	☐
I understand how my interests, skills, and talents relate to my future career pathways.	☐	☐	☐	☐	☐	☐
I am confident I can reach my career goals.	☐	☐	☐	☐	☐	☐
I have connected my interests to a career I might want to do someday.	☐	☐	☐	☐	☐	☐
I am aware of the career pathway opportunities that are available to me.	☐	☐	☐	☐	☐	☐
I know the specific resources or steps that I need to take to reach my career goals.	☐	☐	☐	☐	☐	☐
Even if I experience setbacks, I know I will achieve my career goals.	☐	☐	☐	☐	☐	☐
Studying computational thinking will help me learn something new about possible career pathways (including STEM careers).	☐	☐	☐	☐	☐	☐
Studying computational thinking will contribute to a positive change in my engagement in my future.	☐	☐	☐	☐	☐	☐
Studying computational thinking will contribute to a positive change in my attitudes about a future in STEM.	☐	☐	☐	☐	☐	☐
Studying computational thinking will help me feel more motivated to find a career that is rewarding.	☐	☐	☐	☐	☐	☐
Studying computational thinking helped me believe it is possible to find a career in or related to STEM, if I choose.	☐	☐	☐	☐	☐	☐
Studying computational thinking allowed me to see people like myself in STEM career pathways.	☐	☐	☐	☐	☐	☐
Studying computational thinking resources helped me engage in more meaningful exploration of career pathways in STEM.	☐	☐	☐	☐	☐	☐

OCDE Building Toward Computer Science Equity and Inclusion: Developing an Ecosystem of Supports Student Survey Spring 2025

Students' College Going Expectations

11. What are your **work** plans after graduating high school?

- ☐ I plan to work full time.
- ☐ I plan to work part-time.
- ☐ I do not know.
- ☐ Other (please specify)

12. What are your **education** plans after graduating high school?

- ☐ No more education
- ☐ Attend a 2-year college or university program
- ☐ Attend a 4-year college or university program
- ☐ Attend a technical school or specialty training program
- ☐ I do not know
- ☐ Other (please specify)

13. How important is getting an education beyond high school?

- ☐ Not important
- ☐ Somewhat important
- ☐ Very important
- ☐ Don't know
- ☐ Choose not to respond

14. Why might you discontinue your education after high school (select all that apply)?

- ☐ No reason, I will definitely go
- ☐ It costs too much/I can't afford it
- ☐ I don't need college for my planned job
- ☐ I'm just not interested
- ☐ I need or want to work
- ☐ I want to join the military
- ☐ I don't want to be away from home
- ☐ I just don't like school
- ☐ Choose not to respond
- ☐ Some other reason (please specify)

Thank you for your participation!

Appendix M: Computational Thinking Knowledge Assessment

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

Demographics

* 1. Please enter your name.

First name

Last name

* 2. Please select the school you attend.

☐ Anaheim High School

☐ Cypress High School

☐ Loara High School

☐ Other (please specify)

3. Which of the following best represents your gender?

☐ Female

☐ Male

☐ Nonbinary

☐ I choose not to respond

☐ Other (please specify)

4. Select your race(s)/ethnicity (please select all that apply).

☐ American Indian or Alaska Native

☐ Asian or Asian American

☐ Black or African American

☐ Hispanic or Latinx

☐ Native Hawaiian or other Pacific Islander

☐ Middle Eastern or Northern African

☐ White

☐ I choose not to respond

☐ Other (please specify)

5. What grade are you in this school year?

☐ 9th

☐ 10th

☐ 11th

☐ 12th

**Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025**

Please read each item and select the one best answer.

6. Jessica has a roll of tape. She cuts off two pieces of the tape and gets the following patterns.

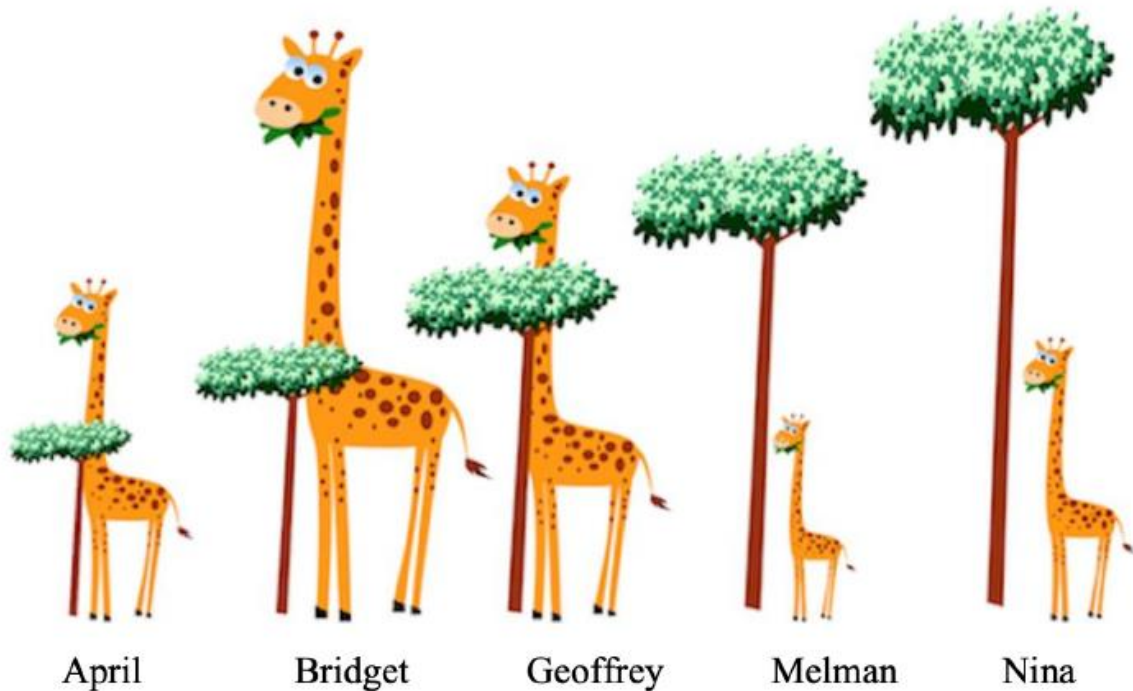


What kind of pattern will Jessica get when she cuts the next piece?

- ☐ A horizontal strip of yellow tape with black wavy edges containing four icons in sequence: a five-pointed star with a small diamond, a crescent moon with two small stars, a sun with rays, and another five-pointed star with a small diamond.
- ☐ A horizontal strip of yellow tape with black wavy edges containing four icons in sequence: a five-pointed star with a small diamond, a sun with rays, a crescent moon with two small stars, and another five-pointed star with a small diamond.
- ☐ A horizontal strip of yellow tape with black wavy edges containing four icons in sequence: a five-pointed star with a small diamond, a sun with rays, another five-pointed star with a small diamond, and a crescent moon with two small stars.
- ☐ A horizontal strip of yellow tape with black wavy edges containing four icons in sequence: a crescent moon with two small stars, a five-pointed star with a small diamond, a sun with rays, and another crescent moon with two small stars.

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

7. It's time for lunch, but the giraffes are in a mess. Every giraffe can't find the same height leaves for lunch (As shown in the figure).



"Nina and Bridget change your places!" Bob, the village mayor, comes out and says, "April and Geoffrey also change your places!" Now three giraffes can have a good lunch.

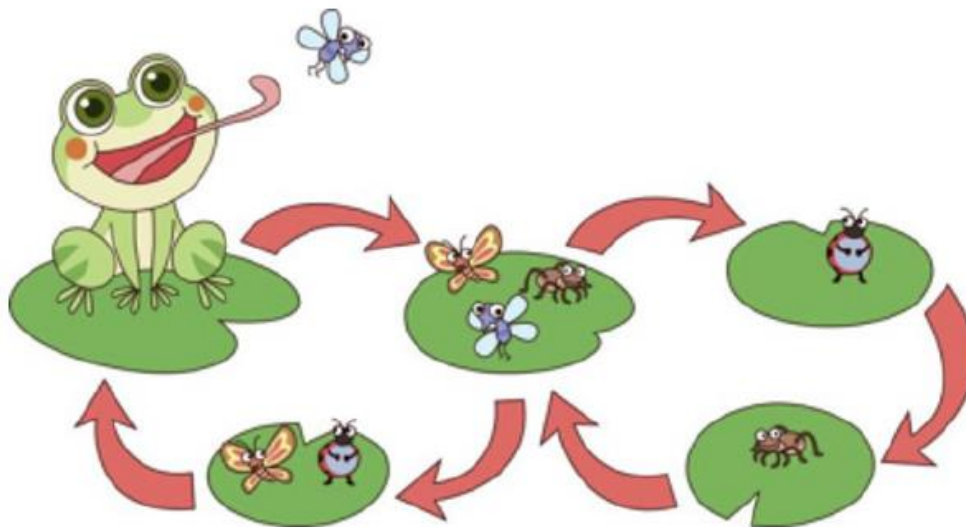
Which two giraffes should change their positions **next** so they all can have a good lunch?

- ☐ Bridget and Melman
- ☐ Geoffrey and Melman
- ☐ Melman and Nina
- ☐ April and Nina

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

8. The little robot frog can only jump between lotus leaves along the red arrow. Once it jumps, the little frog would eat a bug where it lands. The little frog can only eat one bug at a time.

To eat up all the bugs on the lotus leaves, how many times should the little frog jump at least?

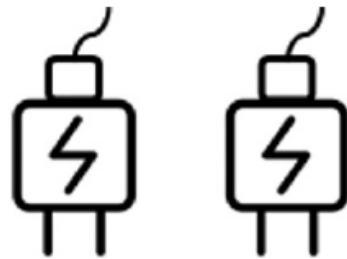
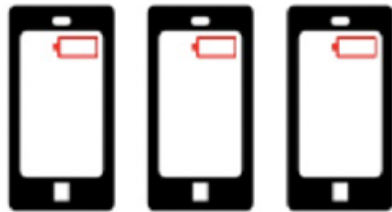


- ☐ 10
- ☐ 9
- ☐ 5
- ☐ 8

Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

9. Gabriella has three mobile phones and two chargers. The phones are all powered off. It takes two hours for each phone to be fully charged.

In order to fully charge all three mobile phones as soon as possible, how many hours does it take?



- ☐ 6 hours
- ☐ 4 hours
- ☐ 3 hours
- ☐ 2 hours

Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

10. The white and black kittens enjoy lining up according to rules. The white kittens prefer lining up in the odd rows, while the black kittens prefer lining up in the even rows. The number of kittens per row is twice as the number in the above row.

If there are 63 kittens in line, how many black kittens are there?



☐ 42

☐ 21

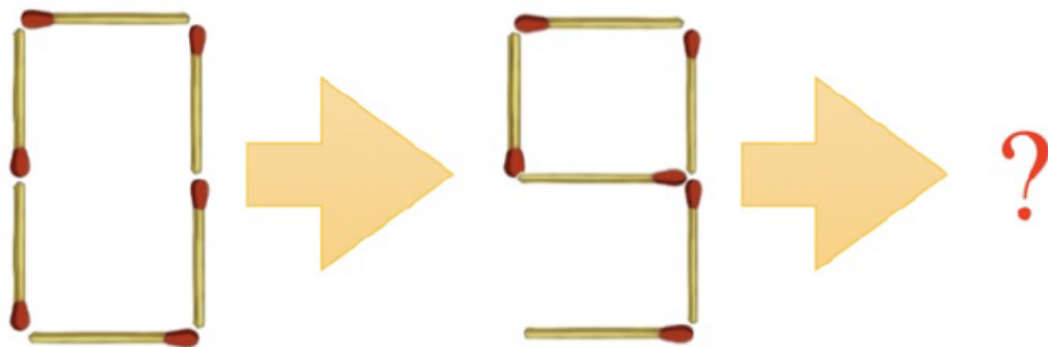
☐ 40

☐ 10

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

11. Matteo has six matches. He uses the six matches to create a 0. Keith comes and moves a match in it. He turns 0 into 9. Aiden moves another match.

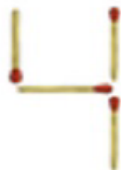
Which of the following numbers can he make?



☐



☐





Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

12. Sara tells the truth on Mondays, Wednesdays and Fridays, while she lies on other days. Today Sara says, " I will tell the truth tomorrow."

What's the day of the week?



Tuesday



Thursday



Saturday



Sunday

Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

13. Emma has a garden, where three new flowers will bloom and one will wither each night. Four flowers are blooming in the garden today.

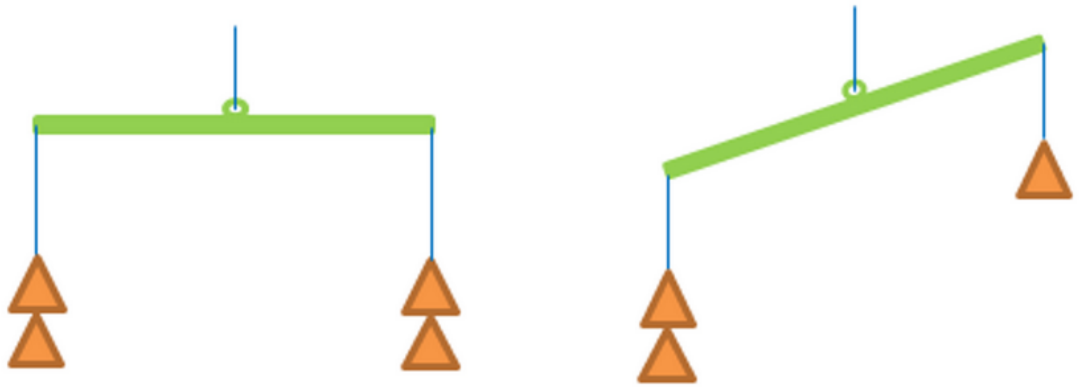
On which day can Emma collect 15 flowers in the garden at a time?



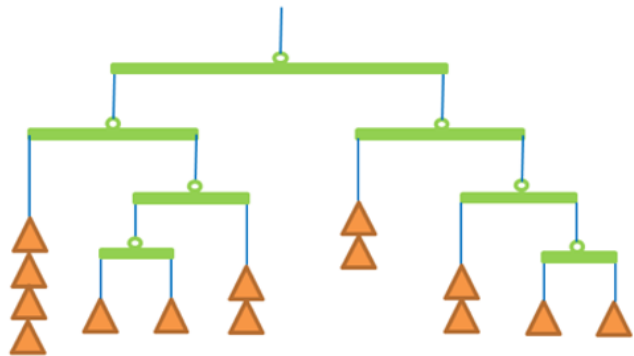
- ☐ After 4 days
- ☐ After 5 days
- ☐ After 6 days
- ☐ After 7 days

Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

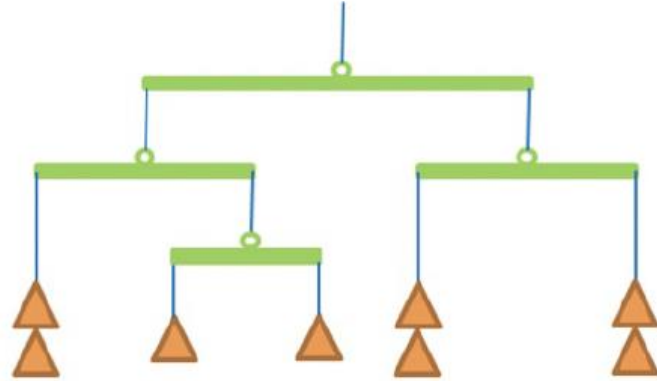
14. Padma is making festival decorations with ropes, sticks and colored balls. Padma finds that the whole decoration can be balanced only when there are equal numbers of colored balls on both sides of the stick, otherwise it will tilt left or right.



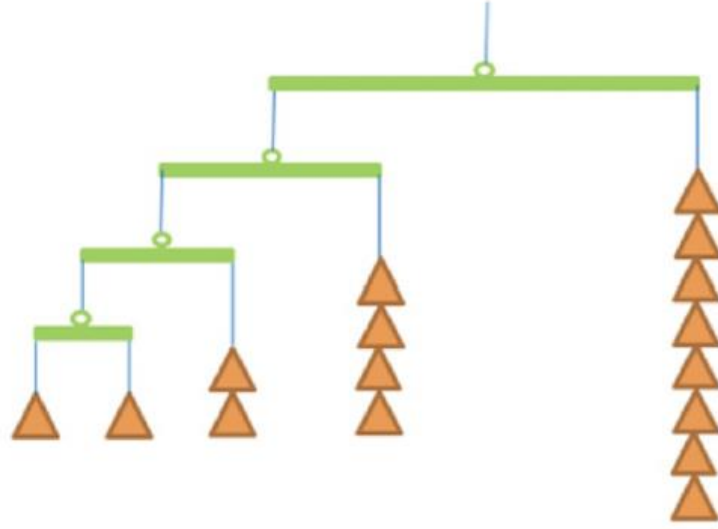
Which of the four options is **not** balanced?



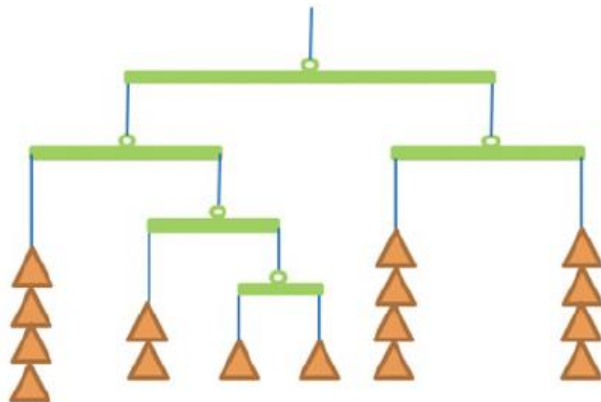
○



○



○



Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

15. The machine mouse likes to look for food along the pipes. It always follows the rules below:

Step 1: Keep going down until meeting an intersection.

Step 2: Walk from the intersection to another vertical pipe.

Step 3: Repeat step 1.



Entrance 1 Entrance 2 Entrance 3 Entrance 4 Entrance 5



According to rules, which entrance leads to the cake in the middle?

☐ Entrance 1

☐ Entrance 2

☐ Entrance 3

☐ Entrance 4

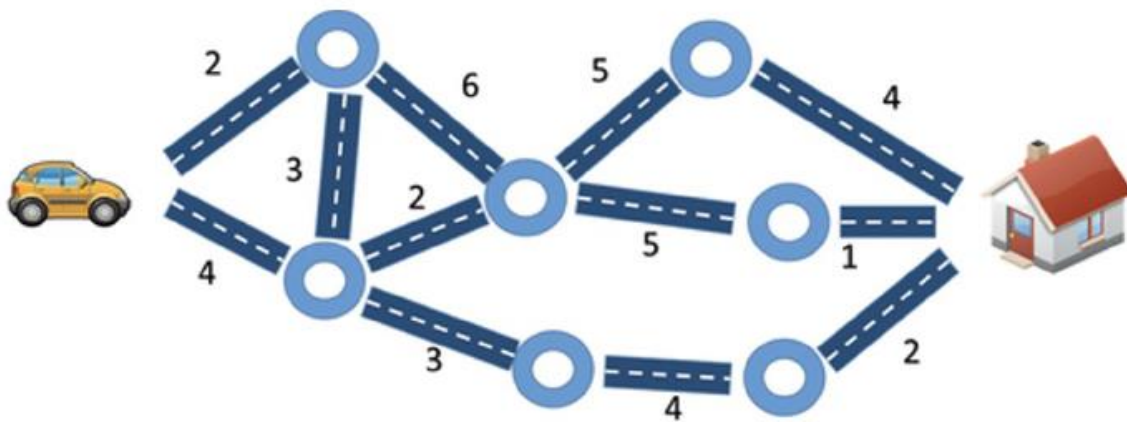
Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

16. Uncle Joe will drive home after work every day. He will pass some roads on the way. The time (minutes) spent on each road is marked.

Can you find the shortest route and figure out the time uncle Joe needs in going home?



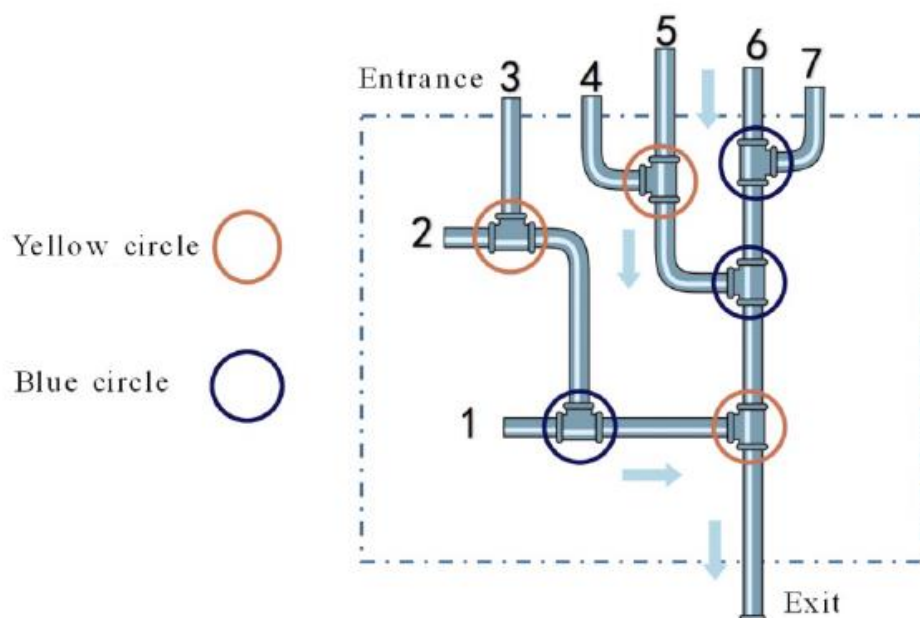
- ☐ 11 minutes
- ☐ 12 minutes
- ☐ 13 minutes
- ☐ 14 minutes

Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

17. Eva's water control system has seven inlet pipes and one outlet pipe. Water flows from the inlet pipes to the outlet pipe. There are two kinds of automatic switches in the system. Water flows down only when the switch is on. The automatic switches in the yellow circle are open when there is water in both inlet pipes, otherwise it will be closed. The automatic switches in the blue circle are always on.



Which of the following ways allows water to flow out of the outlet pipe?

- ☐ Water flows along inlet pipes 2, 3, 7
- ☐ Water flows along inlet pipes 2, 3, 5
- ☐ Water flows along inlet pipes 2, 4, 5
- ☐ Water flows along inlet pipes 3, 6, 7

Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

18. The little robot's work is to line up teddy bears, including putting the little bear on the left, and the big bear on the right.

- ① Robot can only pick up one bear at a time.
- ② Robot can put the bear in any position.

For example, the little robot can successfully line up the three bears below at one time.



There are seven bears below. How many times at least does it take for little robot to line up all the seven bears?



- ☐ 3 times
- ☐ 4 times
- ☐ 5 times
- ☐ 6 times

Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

19. Kristine has a long colorful strip with three colored squares arranged according to some rules. She wants to use this colorful strip, so she cuts several squares from the middle of the colorful strip.

So, how many squares does she most likely cut?



- ☐ 14
- ☐ 15
- ☐ 16
- ☐ 17

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

20. A digital program can randomly execute the following three statements at any position of a number.

Statement 1: Replace 1 in the original number with 11

Statement 2: Replace 2 in the original number with 3

Statement 3: Insert 3 at any position of the original number

For example, if you input 121, the program may output 1121, 11311, 13133333 and other random results.

If you input 12344321, which of the following results is **absolutely impossible**?

☐ 1133334433131

☐ 1123433343211

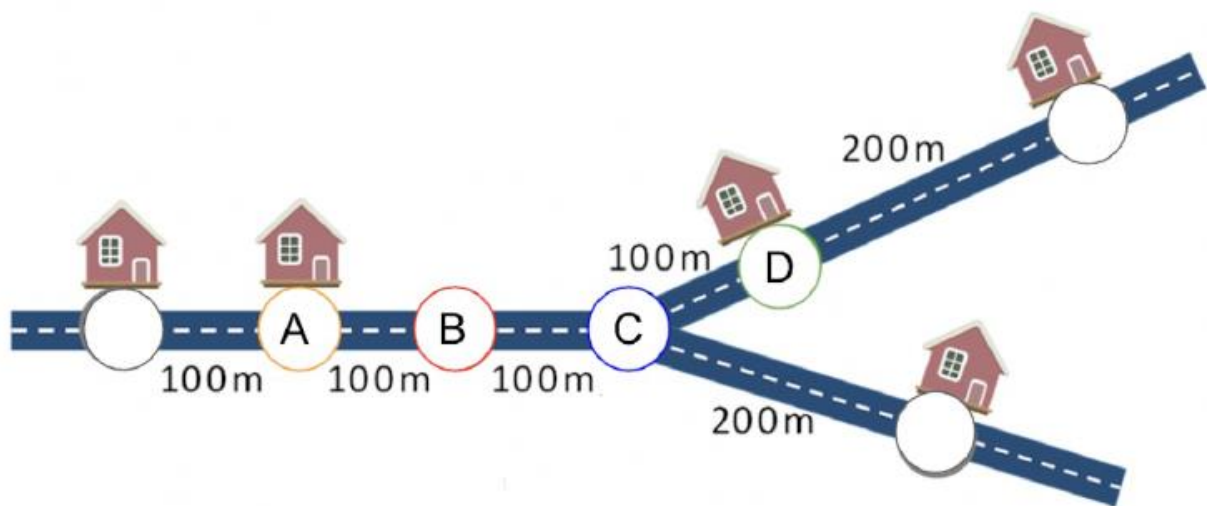
☐ 1123344332431

☐ 3131334433131

Building Toward Computer Science Equity and Inclusion Computational Thinking Student Assessment Spring 2025

21. Five children live in five houses on the following three streets. These five children will walk to one bus station in the morning and take the school bus together.

In order to shorten the sum of distances that five children walk, which of the following stations should the school bus stop at?



- ☐ A
- ☐ B
- ☐ C
- ☐ D

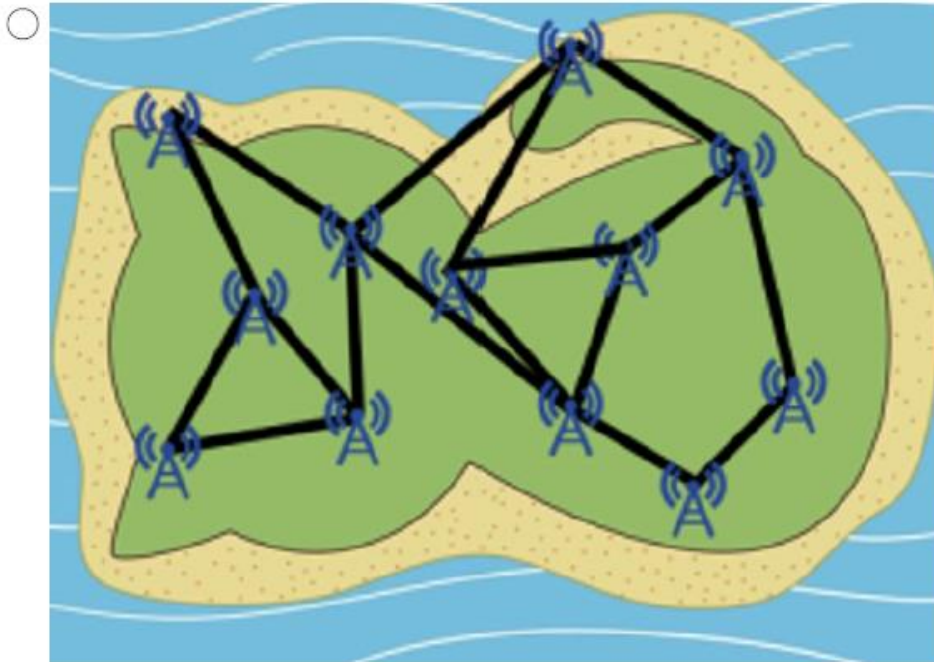
Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

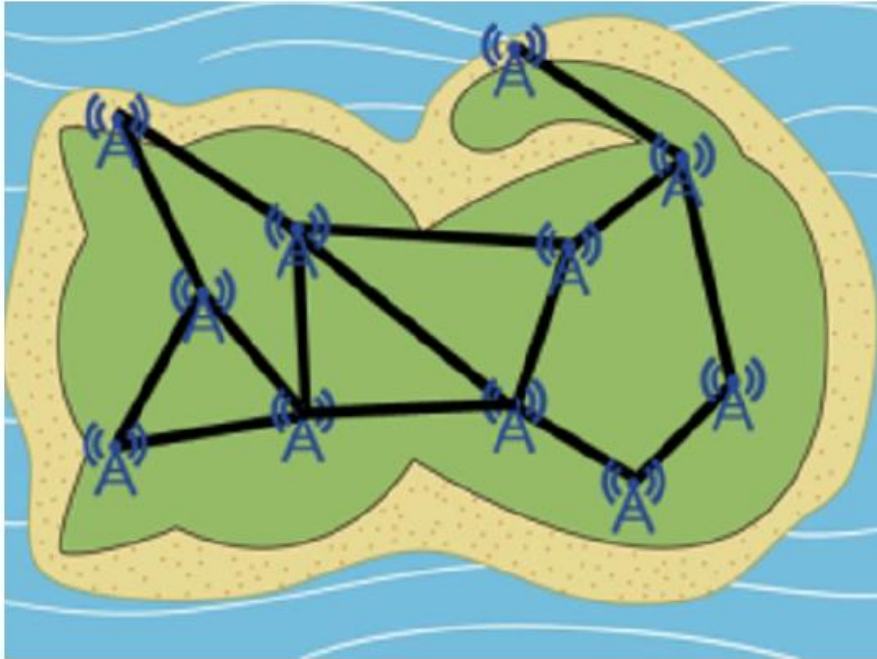
Spring 2025

22. A mobile phone company is going to build signal towers on Green Island. The signal towers can transmit the collected signals to each other through the connection between the towers. Sometimes the rats on the island destroy a signal tower. In order to ensure smooth communication, if any tower is broken, then any other two signal towers must be able to transmit the signal to each other instantly.

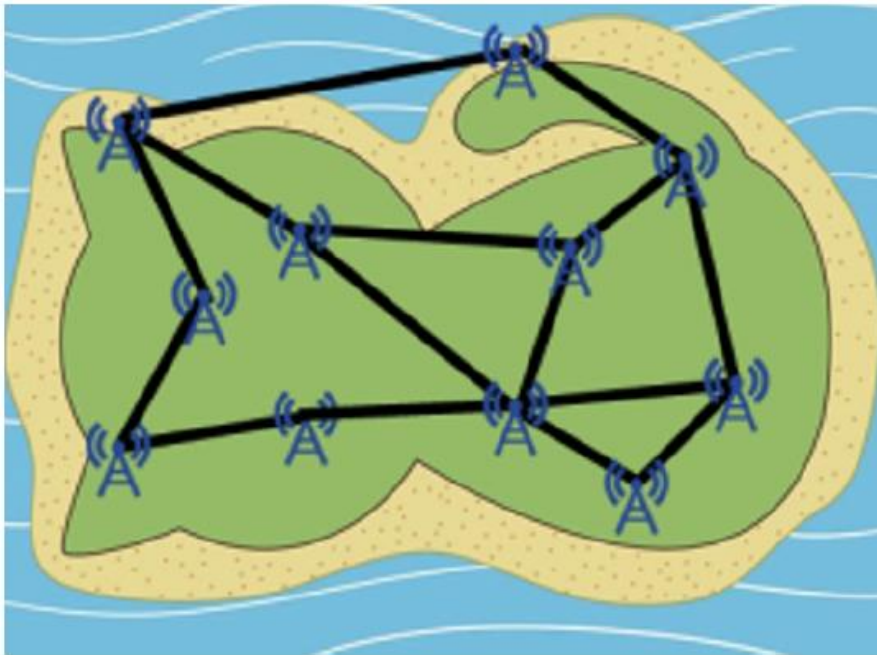
Which of the following can accomplish this task?



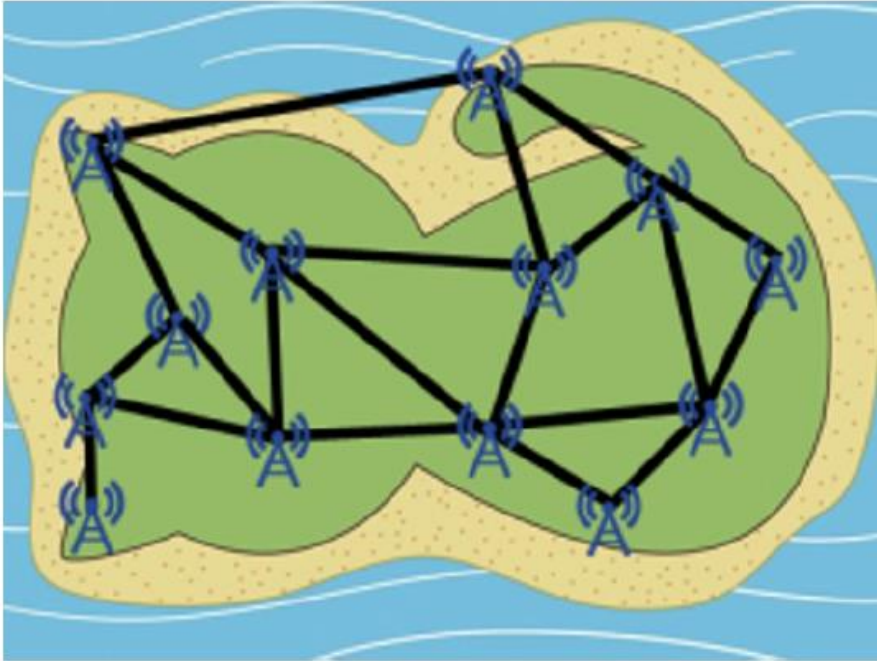
○



○



○

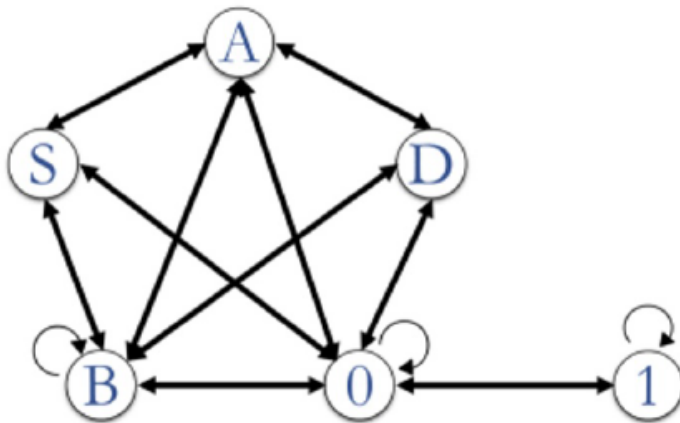


Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

23. Summer is the fishing season of the Blue River. Fishing boats on the Blue River must apply for a fishing license according to their own routes. The figure below is the schematic diagram of the navigable route of the Blue River, and the number is the place where the fishing boat can stop. The double arrow indicates that the fishing boat can go back and forth between two places, and the arc arrow indicates that the fishing boat can go around the place repeatedly. All licenses must begin with letter "B" and end with number "0" or "1".



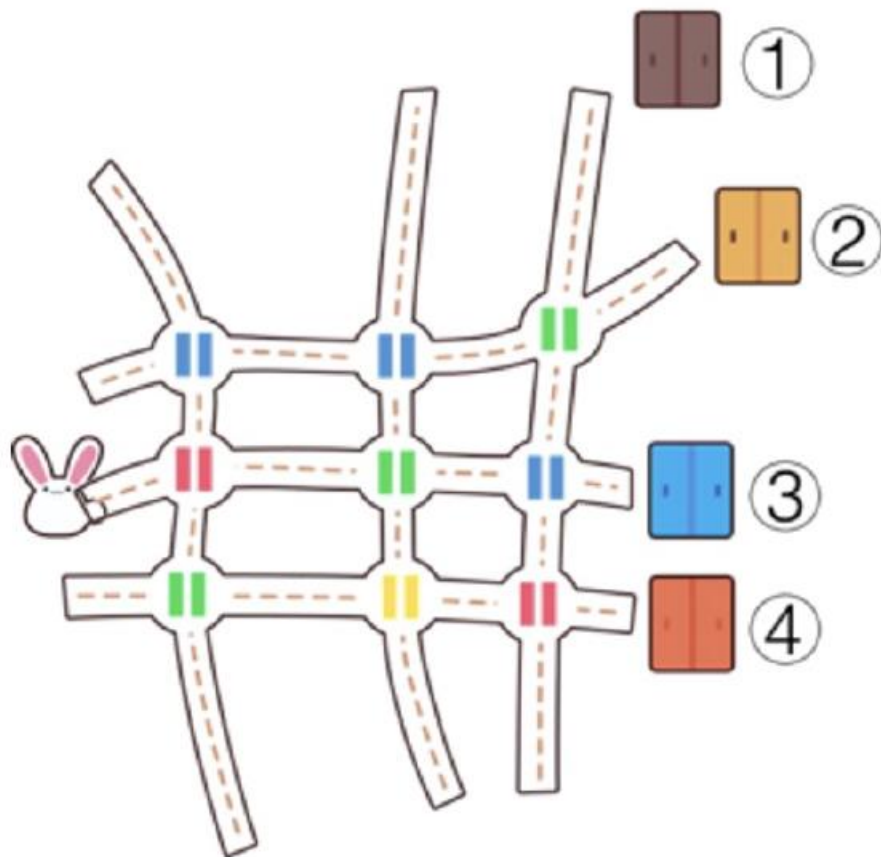
I

Which of the following licenses is fake?

- ☐ BA0S001
- ☐ BA0D001
- ☐ BSA0111
- ☐ BSD0011

24. Every animal living in Animal Kingdom must obey the traffic rules. The traffic rules of Animal Kingdom are:

- if you see a red road sign at the intersection of the road, go left
- if you see a blue road sign, go right
- if you see a yellow road sign, turn around and go back
- if you see the green road sign, go straight ahead.

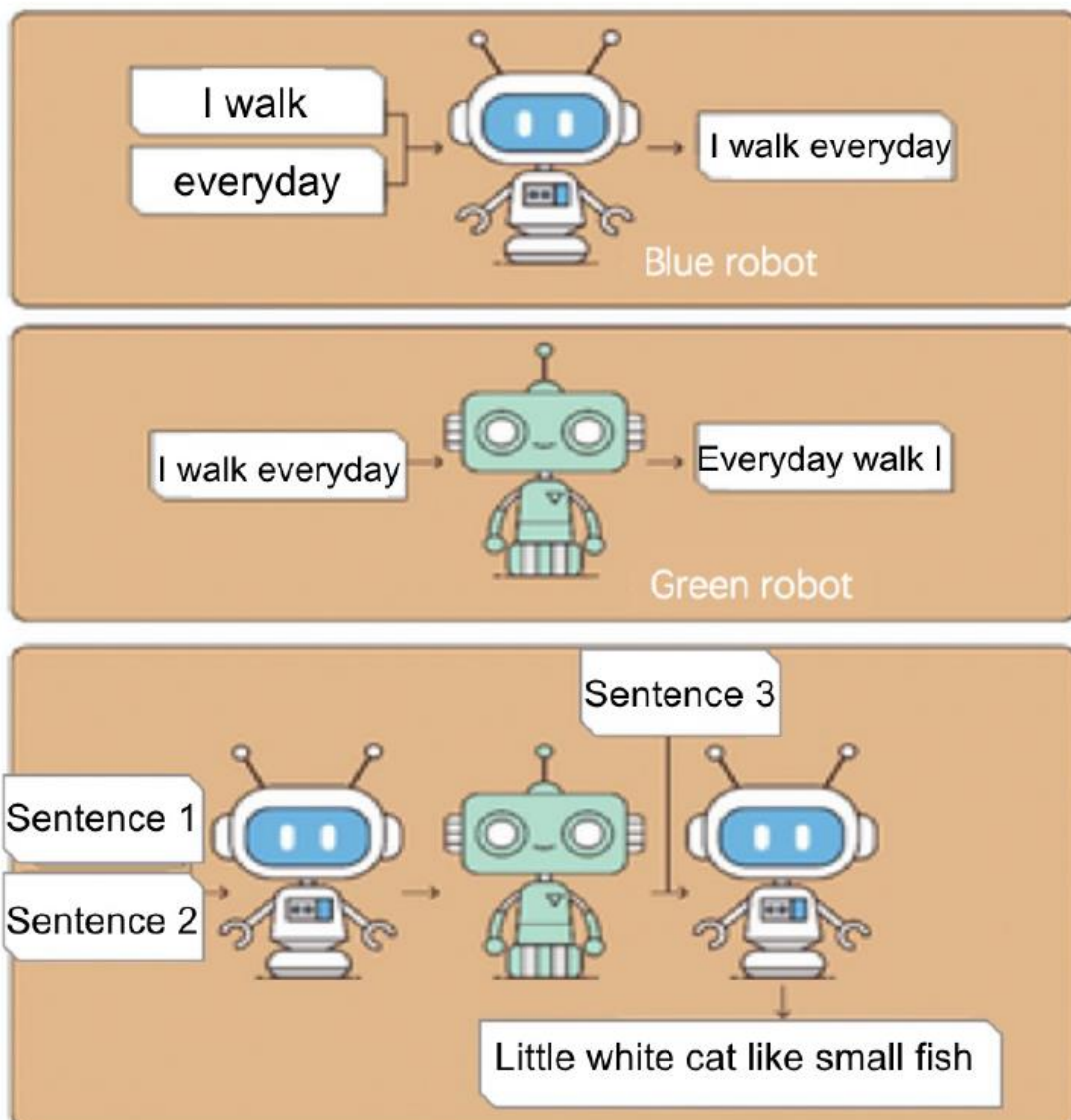


There is a little rabbit ready to go, so which gate will it go out from?

- ☐ Gate 1
- ☐ Gate 2
- ☐ Gate 3
- ☐ Gate 4

Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

25. Paloma has two robots that can change what people say. The blue robot can put the two sentences together. The green robot can reverse the sequence of words in the sentence.
example in boxes 1 and 2 below.



In the third box, the output sentence and sentence 3 go through a blue robot, which says: "Little white cat likes small fish". So, what are sentence 1, sentence 2, and sentence 3 respectively ?

- ☐ white cat, Little, likes small fish.
- ☐ white cat, Little, fish likes small.
- ☐ cat white, Little, likes small fish.
- ☐ cat white, Little, fish likes small.

Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

26. Before the game, boys and girls from two teams need to shake hands face to face. Generally, the two teams form a line and pass the other. Whenever they meet an opponent, they shake hands once, and the time of shaking hands is about one second. At first, only the first member of each team shakes hands. Next, the first two players shake hands at the same time (as shown below). The handshake lasts until the last players have shaken hands with every opponent.

If each team has 15 players, how many seconds does the handshake ceremony take?



- ☐ 15 seconds
- ☐ 29 seconds
- ☐ 30 seconds
- ☐ 42 seconds

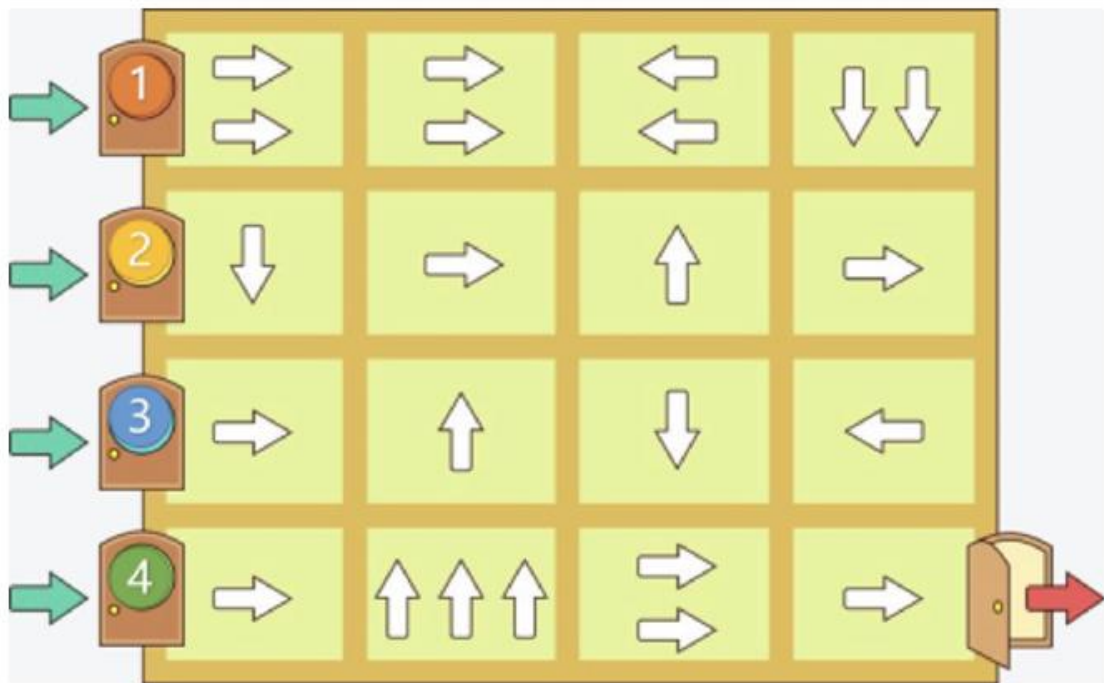
Building Toward Computer Science Equity and Inclusion

Computational Thinking Student Assessment

Spring 2025

27. Riley is going to explore the maze. In this maze, you have to follow the arrows on the grid. The rule is that you have to move in the direction of the arrow, and the number of squares you move is the same as the number of arrows. Each time you reach a grid, you follow its arrows to move on until you find the exit. the lower right corner.

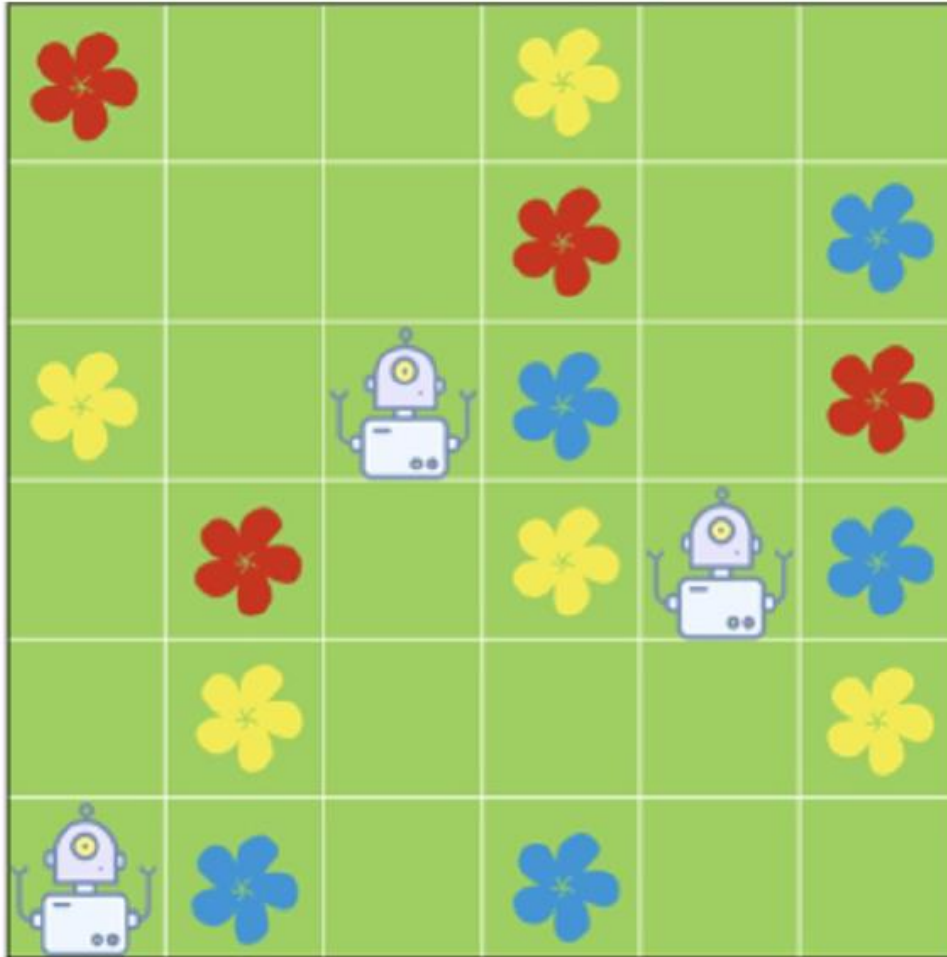
Can you help Riley find the entrance that leads to the exit in the lower right corner?



- ☐ Entrance 1
- ☐ Entrance 2
- ☐ Entrance 3
- ☐ Entrance 4

28. There are three robots on the lawn. You can move the robots at the same time through a set of commands. After all the commands are finished, the robots will pick up the flowers in the grid where they stay. For example, when we issue the "up, right, and down" commands, three robots can pick up three blue flowers in total.

So, if you want the robots to pick up a red flower, a blue flower and a yellow flower, which of the following commands should you issue?



- ☐ Top, right, down, left, left
- ☐ Up, right, down, up, up
- ☐ Right, up, up, up, left
- ☐ Right, up, up, left, up

Building Toward Computer Science Equity and Inclusion
Computational Thinking Student Assessment
Spring 2025

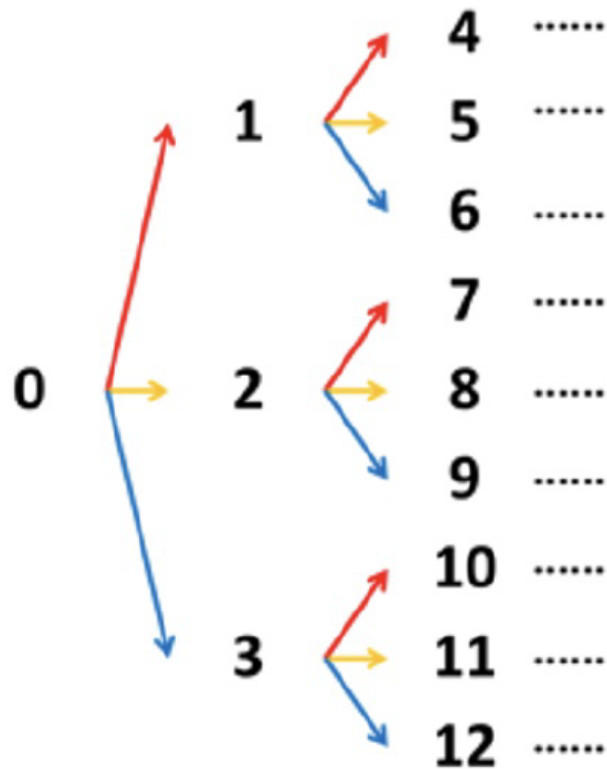
29. The figure below shows the skiing line of seven skiers in the **0th** minute. To save energy, the leading skier changes to the end of the team line each passing minute, and the sequence of other skiers moves forward.

So, which skiers will take the lead in the **9th** minute?



- ☐ s
- ☐ t
- ☐ u
- ☐ v

30. Kiva is playing the game of drawing the number tree. The number tree branches are filled with numbers (0-1000) according to the order of top to bottom and left to right (As shown in the Figure).



The rule is that each branch generates three branches on its right (for example, branch 2 generates 3 branches, namely up: branch 7, middle: branch 8, down: branch 9).

A monkey is at branch 0. It can climb the number tree, read the direction of the arrows (up, middle, or down), and reach a specific branch. For example, if the monkey followed arrows “middle-up”, he will get to branch 7.

Now, if the monkey wishes to get to branch 123, which of the following arrows can help him?

- ☐ down - up - middle - middle - down
- ☐ up - up - up - up - down
- ☐ middle - down - up - down - middle
- ☐ up - middle - down - down - up

Thank you for completing this assessment!

Appendix N: Student Focus Group Protocol

OCDE EIR Computational Thinking Project Focus Group Protocol: Students (Math, Science, and CS)

Thank you for your willingness to participate in this focus group and to share your insights about the computational thinking project you have been a part of in your math, science, and/or computer science class at [NAME OF SCHOOL]. As you may know, I am a researcher with Inflexion. Inflexion is partnering with OCDE and your school district to explore how improving student computational thinking skills can help more students feel prepared to take computer science courses. As such, we are visiting a number of schools to help us better understand what it's been like for you because teachers in the math, science, and computer science departments at your school are participants in this project.

In this focus group, I would like to ask you a series of questions to hear your thoughts on how the computational thinking project has been implemented in your math, science, and/or computer science classes. There are no right or wrong answers to these questions. Please share your honest point of view. Keep in mind that we're interested in constructive comments, whether positive or critical in nature.

Inflexion will combine information from this focus group with others at [NAME OF SCHOOL] and other area schools without identifying you by name or the name of your school. Ultimately, we will report back to OCDE about how schools are implementing computational thinking in classes, and the results will be used to support implementation of computational thinking instruction throughout the district.

I will be audio recording this discussion to ensure that I accurately capture the information you share with me today. Do you have any questions before we begin? *[Answer respondent's questions]*

Do I have your permission to record our conversation?

Thank you. I will begin recording now. *[Start recorder]*

This is [RESEARCHER'S NAME] speaking with students at [NAME OF SCHOOL] on [DAY, MONTH, DATE]. Thank you again for speaking with me today. We ask that before answering any question, you please state your name, so we know who is speaking when we review the recording later.

Thematic Interview Framework

Background

- First, let's just go around and you can introduce yourselves. Tell me your name, grade, and favorite subject. If you don't want to share your actual name, you can make one up.

Awareness of Computational Thinking: *As you may know, your math, science and/or computer science teachers are participating in a project to learn more about computational thinking and integrating computational thinking into their classes.*

- How would you describe what computational thinking is? [Probe for vocabulary, examples]
- How has your teacher introduced work around computational thinking in your math, science, or computer science class?
- What can you tell me about the computational thinking lessons from your math, science, or computer science class? [Probe about memories of the CT units.]
 - What did you like about the CT units?
 - What was challenging about the CT units?
- What can you tell me about what you learned about computational thinking in your math, science, or computer science class at your school?
- Did you use the Pathful Explore or Pathful Connect online program in your math, science, or computer science classes? If so, describe your use of the online tool Pathful. What was useful or interesting to you about using this program?

Impact of CT instruction on the student: *Now I'm going to ask a few questions about what you might have gained from the computational thinking unit.*

- In what ways has your involvement in this project influenced your knowledge and awareness related to computational thinking and computer science?
- How has your experience with computational thinking changed the way you solve problems or think about challenges?
- Have you or do you plan to enroll in computer science or ICT pathway courses?

Awareness of Computer Science/Computer Science Identity: *One of the goals of this project is to increase awareness of an interest in computer science as a career pathway.*

- In what ways has your involvement in this project influenced your **knowledge and awareness of STEM and computer science career options**?
- What do you think about **computer science as a career option**?
- To what extent has your involvement in this project influenced your future in computer science (**CS identity**)? Can you see yourself as a computer scientist? Why or why not? [Probe for clarity]

- To what extent has your involvement in this project increased your **exposure to a diverse group of computer science mentors and role models**?
- Do you see ways you might use CT or CS skills in your future—even if you don't become a computer scientist?

Wrap-Up

- What's one thing you'll take away from this experience?

That's all of my questions. Do you have any questions or comments for me?

Great. This concludes our focus group. Thank you again, [STUDENTS' NAMES], for taking the time to talk with me today.

[Stop recorder]

Appendix O: Implementation Fidelity Checklist

OCDE EIR Computational Thinking Fidelity Matrix and Reporting

Key Component 1 (of 4) – Coaching for School Administrators (APs) and 5Cs Coaches. Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
Portico CoPilot Sessions	9 hours of personalized one-on-one coaching each academic year	5Cs Coaches	Portico attendance records	Portico coaches; provided to evaluator each semester	0 = participates in < 80% of possible coaching hours 1 = participates in at least 80% of hours	1	N/A	N/A	N/A	3 5Cs Coaches	2022–23
Portico CoPilot Sessions	9 hours of personalized one-on-one coaching each academic year	Administrator (AP)	Portico attendance records	Portico coaches; provided to evaluator each semester	0 = participates in < 80% of possible coaching hours 1 = participates in at least 80% of hours	1	N/A	N/A	N/A	3 APs	2022–23 2023–24 2024–25

**Key Component 1 (of 4) – Coaching for School Administrators (APs) and 5Cs Coaches.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
Portico Counterpart Sessions	9 hours of small group (EIR cohort) coaching each academic year	5Cs Coaches	Portico attendance records	Portico coaches; provided to evaluator each semester	0 = participates in < 80% of possible coaching hours 1 = participates in at least 80% of hours	1	N/A	N/A	N/A	3 5Cs Coaches	2022–23
Portico Counterpart Sessions	9 hours of small group (EIR cohort) coaching each academic year	Administrator (AP)	Portico attendance records	Portico coaches; provided to evaluator each semester	0 = participates in < 80% of possible coaching hours 1 = participates in at least 80% of hours	1	N/A	N/A	N/A	3 APs	2023–24 2024–25
Coaching Goals	At least one goal is set based on coherence review results	Administrators (AP)	Portico coaching notes	Portico coaches; provided to evaluator each semester	0 = No evidence that goals were set by the October coaching session	1	N/A	N/A	N/A	3 APs	2023–24 2024–25

**Key Component 1 (of 4) – Coaching for School Administrators (APs) and 5Cs Coaches.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
	each year				1 = Evidence that at least one goal was set by the October coaching session						
Plan CS practices with a continuum of supports	Schoolwide adoption of CS and CT plan of practices that include a continuum of supports	School	School accountability plans (SAP) and coherence review	Implementation evaluators; provided to evaluator each semester	0 = No evidence of schoolwide CS practices and related supports 1 = Explicit mention of schoolwide CS practices OR continuum of supports 2 = Explicit mention of schoolwide CS practices AND	1	N/A	N/A	N/A	3 Schools	2024–25

**Key Component 1 (of 4) – Coaching for School Administrators (APs) and 5Cs Coaches.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
					continuum of supports						
Key component score					Sum of indicator scores: 2022-23: 0 - 3 2023-24: 0 - 3 2024-25: 0 - 5	School-Level Sum Score: Adequate Implementation = 2022-23: 3 2023-24: 3 2024-25: 4	NA	NA	Adequate = 100% of schools meeting the implementation threshold score 2022-23: 3 2023-24: 3 2024-25: 4	All schools in which the intervention is being implemented (n = 3)	2022–23 2023–24 2024–25
					Threshold				100% of Schools	# of Units Measured (of 3 schools served)	Year of Measurement
Fidelity Results					Achieved Score at Sample Level:					3	2022-23
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Achieved Score at Sample Level:					3	2023-24
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Score:					3	2024-25
					Implemented with Fidelity (Yes, No, N/A)						

Key Component 2 (of 4) – Professional Learning for 5Cs Coaches and Teachers

Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
Summer Institute	12 of hours of in-person training	5Cs Coach	Grantee attendance records	OCDE; provided to evaluate or at the end of the Summer Institute	0 = participates in < 100% of possible training hours 1 = participates in 100% of possible training hours	1	N/A	N/A	N/A	3 5Cs Coaches	2022–23
Summer Institute	12 of hours of in-person training	Teachers	Grantee attendance records	OCDE; provided to evaluate or at the end of the Summer Institute	0 = participates in < 100% of possible training hours 1 = participates in 100% of possible training hours	1	School: 0 = < 90% of teachers achieve 1 1 = 90% of teachers or more	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25

Key Component 2 (of 4) – Professional Learning for 5Cs Coaches and Teachers

Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
							achieve 1				
Community of Practice Participation	Full Group CoP Meetings during the academic year 2022-23: 9 hours	5Cs Coach	Grantee attendance records	OCDE; provided to evaluator each semester	0 = participates in < 90% of possible training hours 1 = participates in at least 90% of possible training hours	1	N/A	N/A	N/A	3 5Cs Coaches	2022–23
Community of Practice Participation	Full Group CoP Meetings during the academic year	Teachers	Grantee attendance records	OCDE; provided to evaluator each semester	0 = participates in < 90% of possible training hours 1 = participates in at least	1	School: 0 = < 90% of teachers achieve 1 1 = 90% of	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25

Key Component 2 (of 4) – Professional Learning for 5Cs Coaches and Teachers

Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
	2022-23: 9 hours 2023-24: 24 hours 2024-25: 24 hours				90% of possible training hours		teachers or more achieve 1				
Community of Practice What's The IDEA Homework	Completions of the IDEA Homework 2022-23: 9 posts	5Cs Coach	Grantee tracking records	OCDE; provided to evaluator each semester	0 = completed < 75% of IDEA posts 1 = completed at least 75% of IDEA posts	1	N/A	N/A	N/A	3 5Cs Coaches	2022–23
Community of Practice What's The IDEA Activities	Completions of the IDEA Activity 2022-23: 9 activities	Teachers	Grantee tracking records	OCDE; provided to evaluator each semester	0 = completed < 75% of IDEA activities 1 = completed at least 75% of	1	School: 0 = < 80% of teachers achieve 1 1 = 80% of	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25

Key Component 2 (of 4) – Professional Learning for 5Cs Coaches and Teachers

Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
	2023-24: 4 activities 2024-25: 4 activities				IDEA activities		teachers or more achieve 1				
Key component score					Sum of indicator scores: 2022-23: 0 - 6 2023-24: 0 - 3 2024-25: 0 - 3	School-Level Sum Score: Adequate Implementation = 2022-23: 6 2023-24: 3 2024-25: 3	NA	NA	Adequate = 100% of schools meeting the implementation threshold score 2022-23: 6 2023-24: 3 2024-25: 3	All schools in which the intervention is being implemented (n = 3)	2022–23 2023–24 2024–25
					Threshold					# of Units Measured (of X units served)	Year of Measurement
					Achieved Score at Sample Level:					3	2022-23

Key Component 2 (of 4) – Professional Learning for 5Cs Coaches and Teachers

Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Achieved Score at Sample Level:						
					Met Threshold Implemented with Fidelity (Yes, No, N/A)					3	2023-24
					Score:						
					Implemented with Fidelity (Yes, No, N/A)					3	2024-25

**Key Component 3 (of 4) – Development of Computational Thinking Curriculum.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
CT Unit Team Release Days	12 hours of release time to meet for CT unit development and reflection	Teacher	Grantee tracking records	OCDE; provided to evaluator each semester	0 = participates in < 80% of possible hours 1 = participates in at least 80% of possible hours	1	School: 0 = < 100% of teachers achieve 1 1 = 100% of teachers achieve 1	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25
CT Curriculum Unit Development	2 new CT-infused curriculum units developed by teacher teams	Teacher	Project records; Curriculum	OCDE; provided to evaluator each semester	0 = < 2 CT units developed 1 = 2 CT units developed	1	School: 0 = < 100% of teachers achieve 1 1 = 100% of teachers achieve 1	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25

**Key Component 3 (of 4) – Development of Computational Thinking Curriculum.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
							achieve 1				
CT Curriculum Unit Implementation	2 new CT-infused curriculum units implemented by individual teachers	Teacher	Grantee tracking records; Classroom Observation data; Student Work Samples	OCDE & Inflexion; provided to evaluator each semester	0 = Teacher did not implement new CT units 1 = Teacher implemented 2 new CT units	1	School: 0 = < 100% of teachers achieve a 1 1 = 100% of teachers achieve a 1	N/A	N/A	14 Teachers / 3 schools 21 Teachers / 3 schools TBD	2022-23 2023-24 2024-25
Key component score					Sum of indicator scores: 2022-23: 0 - 3 2023-24: 0 - 3 2024-25: 0 - 3	School-Level Sum Score: Adequate Implementation = 2022-23: 3 2023-24: 3 2024-25: 3	NA	NA	Adequate = 100% of schools meeting the implementation threshold score 2022-23: 3	All schools in which the intervention is being implemented (n = 3)	2022-23 2023-24 2024-25

**Key Component 3 (of 4) – Development of Computational Thinking Curriculum.
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
									2023-24: 3 2024-25: 3		
					Threshold					# of Units Measured (of X units served)	Year of Measurement
Fidelity Results					Achieved Score at Sample Level:					3	2022-23
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Achieved Score at Sample Level:					3	2023-24
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Score:					3	2024-25
					Implemented with Fidelity (Yes, No, N/A)						

Key Component 4 (of 4) – Student Career Exploration and Mentoring Fidelity Matrix and Fidelity Results Reporting Table

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
Use of Pathful Connect	Teachers use Pathful Connect in their courses platform as part of the student CT experience	Teacher	Pathful analytics	AUHSD & OCDE, provided to evaluate or each year	0 = Teacher did not use Pathful Connect in their course 1 = Teacher used Pathful Connect in at least one lesson	1	School: 0 = < 80% of teachers achieve a 1 1 = 80% of teacher achieve a 1	N/A	N/A	21 Teachers / 3 schools TBD	2023-24 2024-25
Use of Pathful Explore	Teachers use Pathful Explore in their courses platform as part	Teacher	Pathful analytics	AUHSD & OCDE, provided to evaluate or each year	0 = Teacher did not use Pathful Explore in their course	1	School: 0 = < 80% of teachers achieve a 1 1 = 80% of	N/A	N/A	21 Teachers / 3 schools TBD	2023-24 2024-25

**Key Component 4 (of 4) – Student Career Exploration and Mentoring
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
	of the student CT experience				1 = Teacher used Pathful Explore in at least one lesson		teacher achieve a 1				
Key component score					Sum of indicator scores: 2023-24: 0 - 2 2024-25: 0 - 2	School-Level Sum Score: Adequate Implementation = 2023-24: 2 2024-25: 2	NA	NA	Adequate = 100% of schools meeting the implementation threshold score 2023-24: 2 2024-25: 2	All schools in which the intervention is being implemented (n = 3)	2023–24 2024–25
					School-Level Threshold					# of Units Measured (of X units served)	Year of Measurement
Fidelity Results					Achieved Score at Sample Level:					NA	2022-23
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						

**Key Component 4 (of 4) – Student Career Exploration and Mentoring
Fidelity Matrix and Fidelity Results Reporting Table**

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to sample level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure (n = # units in which the intervention is being implemented)	Expected years of fidelity measurement
					Achieved Score at Sample Level:					3	2023-24
					Met Threshold Implemented with Fidelity (Yes, No, N/A)						
					Score:					3	2024-25
					Implemented with Fidelity (Yes, No, N/A)						

Appendix P. Propensity Score Matching for SBAC and Cast Analyses

This appendix details the process of selecting appropriate comparison groups to examine potential differences in SBAC and CAST performance of students at schools which received the BTCSEI intervention compared to students at non-participating schools.

Propensity Score Matching

Propensity score matching is a technique used to balance meaningful covariates across treatment and control groups (Rosenbaum & Rubin, 1985). For example, if female students performed better on a test overall and the control group had a higher percentage of females in the group than the treatment group, then the control group would have an advantage because of the disproportionate groups. Separate matching procedures were used for each test (SBAC and CAST), based on the relevant pre-test score. Propensity score matching was conducted using the MatchIt plugin for R (version 4.5.0; Ho et al., 2011). This custom dialog uses logistic regression as the estimation algorithm and uses nearest neighbor as the matching algorithm. A caliper width of 0.2 standard deviations of the logit of the propensity score was set to exclude bad matches (Austin, 2010). Students were matched on available student-level demographic information (i.e., gender, ethnicity, English proficiency, SES), and grade 8 test scores (mathematics SBAC or CAST). Matches were based on overall test score, as well as testing level (i.e., 1-4 scale), and students were forced to match on testing level. Balance statistics produced by the plugin and logistic regression weights of group differences were used to assess the balance of covariates across treatment and control student groups. Results of the propensity score matching procedures are described below.

There were limitations with the propensity score matching procedure. As there were only 3 schools receiving the BTCSEI intervention and 3 business-as-usual schools, the pool of control students was actually smaller than the pool of students at treatment schools. The resulting matches large met acceptability criteria, however, there were a number of treatment students ($N = 207$, representing 17% of the intervention group) who could not be matched because the control pool was small. Thus, a limiting factor of the analyses is that the control pool was not large enough to result in an ideal match. The results of all analyses should be interpreted with caution and not findings should not be overstated due to this limitation.

Mathematics SBAC

Using the custom dialog, 1,011 treatment students (out of a pool of $N = 1,211$) were matched with 1,011 students from the control group ($N = 1,057$), representing an 83% success rate (see Figure A-1). After matching, the balance of all observed covariates, interactions among all covariates, and quadratic terms of covariates were examined. Standardized mean differences and maximum empirical cumulative density functions (eCDFs) between treatment students and control students were generally lower after matching than before matching, and any variables

which saw increases were still below the recommended guideline of .10 (Stuart, Lee, & Leacy, 2013; see Tables P-1 and P-2). Additionally, the average absolute within-pair difference for each covariate (std. pair diff.) were below recommended guidelines (King & Nielsen, 2019), suggesting that the matching procedure created an acceptable balance across all variables used for the matching procedure. Finally, logistic regression analyses were conducted to determine whether any of the matching variables remained significant predictors of condition. None of the matching variables were significant predictors of condition, providing further evidence that the treatment and control groups were balanced across covariates.



Figure P-1. Comparison of SBAC analytic matched group sizes BTCSEI and Control schools.

Table P-1. Results of Propensity Score Matching Procedure for Mathematics SBAC.

Variable	Mean Diff (Pre)	Mean Diff (Post)	eCDF Max (Pre)	eCDF Max (Post)	Std. Pair Diff.
Grade 8 SBAC Score	0.04	-0.06	0.02	0.01	0.20
Grade 8 SBAC Level	0.07	< 0.001	0.02	< 0.001	< 0.001
Gender	0.07	0.08	0.03	0.04	0.21
Latinx	-0.07	0.01	0.03	0.01	0.32
FRL Status	-0.08	0.02	0.04	0.01	0.39
ELL Status	0.10	-0.02	0.04	0.01	0.08

Table P-2. Comparison of Treatment and Control groups on SBAC matching variables.

Variable	Treatment % (N)	Control % (N)	Wald	p	OR
% Female	50.7 (513)	46.8 (473)	3.17	.08	1.17
% Latinx	75.0 (758)	74.7 (755)	0.02	.88	1.02

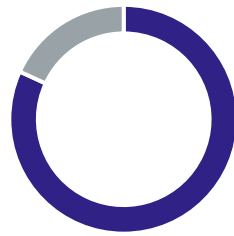
Variable	Treatment % (N)	Control % (N)	Wald	<i>p</i>	OR
% FRL	60.8 (615)	59.6 (603)	0.30	.59	1.05
% ELL	16.5 (167)	17.2 (174)	0.17	.68	0.95
Grade 8 SBAC Score*	2480.27 (115.56)	2488.00 (113.53)	2.30	.13	1.00
Grade 8 SBAC Level*	1.68 (0.98)	1.68 (0.98)	0.00	1.00	1.00

*Means and standard deviations provided, rather than % of students in treatment vs control

California Science Test (CAST)

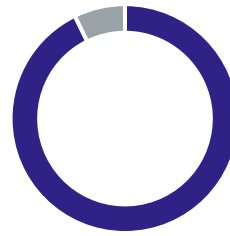
It should be noted that there were a small number of students (treatment $N = 12$, control $N = 3$) who had Grade 11 mathematics SBAC scores but did not have Grade 11 CAST scores, so the available pool of students for matching was slightly smaller for CAST than for mathematics SBAC. Using the custom dialog, 987 treatment students (out of a pool of $N = 1,201$) were matched with 987 students from the control group ($N = 1,054$), representing an 82% success rate (see Figure P-2). After matching, the balance of all observed covariates, interactions among all covariates, and quadratic terms of covariates were examined. Standardized mean differences and maximum empirical cumulative density functions (eCDFs) between treatment students and control students were generally lower after matching than before matching, and any variables which saw increases were still below the recommended guideline of .10 (Stuart, Lee, & Leacy, 2013; see Tables P-3 and P-4). Additionally, the average absolute within-pair difference for each covariate (std. pair diff.) were below recommended guidelines (King & Nielsen, 2019), suggesting that the matching procedure created an acceptable balance across all variables used for the matching procedure. Finally, logistic regression analyses were conducted to determine whether any of the matching variables remained significant predictors of condition. Only free/reduced lunch status emerged as a significant predictor of condition, providing evidence that the treatment and control groups were balanced across covariates.

CAST: BTCSEI



■ Matched (N = 987)
 ■ Unmatched (N = 219)

CAST: Control



■ Matched (N = 987)
 ■ Unmatched (N = 77)

Figure P-2. Comparison of CAST analytic matched group sizes BTCSEI and Control schools.

Table P-3. Results of Propensity Score Matching Procedure CAST.

Variable	Mean Diff (Pre)	Mean Diff (Post)	eCDF Max (Pre)	eCDF Max (Post)	Std. Pair Diff.
Grade 8 CAST Score	0.08	0.06	0.06	0.04	0.15
Grade 8 CAST Level	0.10	< 0.001	0.06	< 0.001	< 0.001
Gender	0.07	-0.05	0.4	0.02	0.13
Latinx	-0.07	0.01	0.03	0.01	0.21
FRL Status	-0.07	-0.11	0.04	0.05	0.19
ELL Status	0.10	< 0.001	0.04	< 0.001	< 0.001

Table P-4. Comparison of Treatment and Control groups on CAST matching variables.

Variable	Treatment % (N)	Control % (N)	Wald	p	OR
% Female	45.3 (447)	47.7 (471)	1.17	.28	0.91
% Latinx	74.8 (738)	74.2 (732)	0.10	.76	1.03
% FRL	57.0 (563)	62.5 (617)	6.14	.01*	0.80
% ELL	18.0 (178)	18.0 (178)	0.00	1.00	1.00
Grade 8 CAST Score*	399.65 (19.80)	398.43 (19.85)	1.84	.18	1.00
Grade 8 CAST Level*	2.12 (0.73)	2.12 (0.73)	0.00	1.00	1.00

*Means and standard deviations provided, rather than % of students in treatment vs control

Appendix Q. SBAC & Cast Analyses

Data were obtained for students at three schools participating in BTCSEI as well as 3 schools that were not participating (i.e., business-as-usual). Students at BTCSEI schools were matched with students at non-participating schools using propensity score matching. Matched analytic samples were created for each test being examined: the Grade 11 Mathematics Smarter Balanced Assessment Consortium (SBAC), and the Grade 11 California Science Test (CAST). Demographic information (including % female, % Latinx, % eligible for free/reduced lunch, and % classified as English language learners) for students at BTCSEI and business-as-usual schools is provided for each test in Figures Q-1 and Q-2.

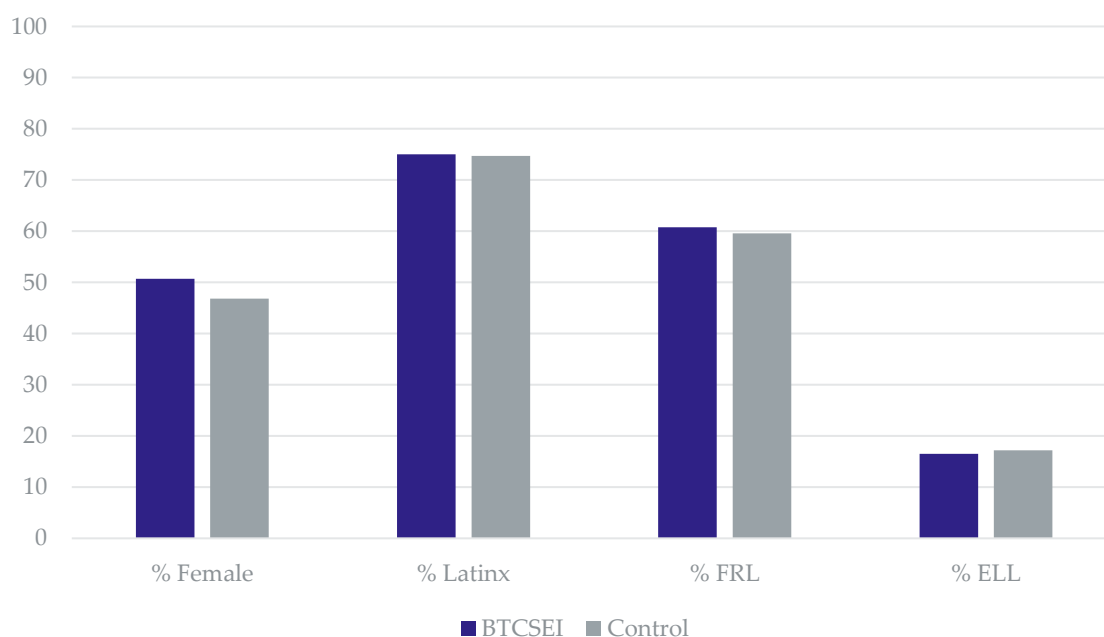


Figure Q-1. Student demographics at BTCSEI and control schools for SBAC matched analytic sample.

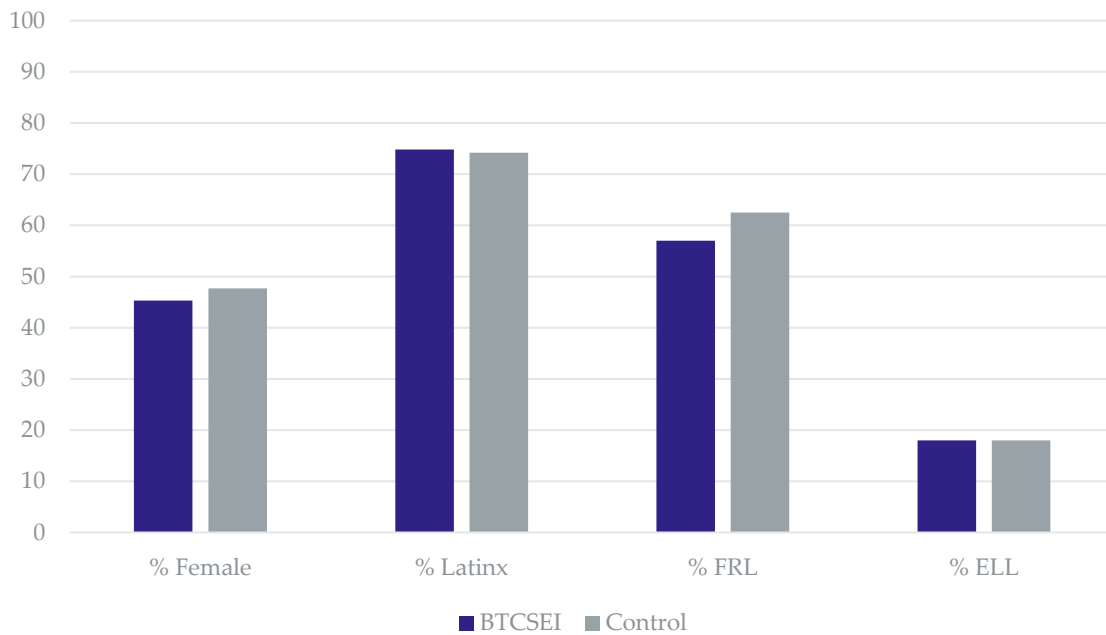


Figure Q-2. Student demographics at BTCSEI and control schools for CAST matched analytic sample.

SBAC Analysis

Grade 11 mathematics SBAC scores were examined to determine whether the BTCSEI intervention had an impact. A multiple linear regression model was assessed including all matching variables as covariates (except for Grade 8 SBAC level). Results demonstrated that condition was not a significant predictor of Grade 11 mathematics SBAC scores, $\beta = -.001$, $p = .92$. In other words, Grade 11 mathematics SBAC scores did not significantly differ for students at schools where the BTCSEI intervention was conducted ($M = 2533.13$, $SD = 130.81$) as compared to students at business-as-usual schools ($M = 2533.49$, $SD = 129.87$; see Table Q-1 for full model).

Table Q-1. Linear regression examining predictors of Grade 11 mathematics SBAC scores.

Variable	B (SE)	β	t	p	η_p^2
Gender	-3.90 (3.64)	-.02	-1.07	.28	.001
Ethnicity	-27.51 (4.74)	-.09	-5.80	< .001	.02
FRL Status	-2.70 (3.77)	-.01	-0.72	.47	< .001
ELL Status	-24.67 (5.33)	-.07	-4.63	< .001	.01
Grade 8 SBAC Score	0.80 (0.02)	.70	41.88	< .001	.47
Condition	-0.37 (3.62)	-.001	-0.10	.92	< .001

CAST Analyses

Grade 11 CAST scores were examined to determine whether the BTCSEI intervention had an impact. A multiple linear regression model was assessed including all matching variables as covariates (except for Grade 8 CAST level). Results demonstrated that condition was a significant predictor of Grade 11 CAST scores, $\beta = -.04$, $p = .003$, even beyond the other covariates in the model. However, this result was in the opposite direction of what was hypothesized. In other words, Grade 11 CAST were significantly lower for students at schools where the BTCSEI intervention was conducted ($M = 602.63$, $SD = 19.35$) as compared to students at business-as-usual schools ($M = 604.34$, $SD = 20.58$; see Table Q-2 for full model). It should be noted that the effect size for this result was miniscule, and likely due to the large sample sizes rather than an effect that is meaningful or practical.

Table Q-2. Linear regression examining predictors of Grade 11 CAST scores.

Variable	B (SE)	β	t	p	η_p^2
Gender	2.02 (0.59)	.05	3.44	< .001	.006
Ethnicity	-2.24 (0.75)	-.05	-3.01	.003	.005
FRL Status	1.64 (0.61)	.04	2.68	.007	.004
ELL Status	-2.93 (0.85)	-.06	-3.46	< .001	.006
Grade 8 CAST Score	0.73 (0.02)	.73	41.43	< .001	.47
Condition	-1.71 (0.58)	-.04	-2.94	.003	.004

