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A. PROJECT DESIGN

While the nation is projected to become majority-minority by 2044, Orange County (OC), California (the 6th largest County in the US by population) reached that milestone in 2004. Skills in highly technical or creative occupations, such as those in STEM fields, need to be cultivated for the future workforce to stay relevant (Orange County Workforce Indicators Report, 2020). Home to Disney, Boeing, Parker Aerospace, and Edwards Lifesciences, OC has long been fertile soil for new, transformative ideas. OC's diversity is a major asset to the global economy, but notable inequities and disparities exist. This presents opportunities to demonstrate breakthroughs in computational and design thinking for female students and students of color, who are historically underrepresented in STEM.

This proposal represents a strategic partnership between the Orange County Department of Education (OCDE) and Inflexion, with the *goal of increasing enrollment and retention of female students and Latinx students in computer science (CS) courses, by improving computational thinking (CT) skills, developing school-wide and student-targeted CS-identity, and creating an ecosystem of supports to facilitate equity and inclusion in CS.* The project will examine systemic and practical deficiencies (root causes) that contribute to four interconnected problems: 1) challenges of implementing whole school change efforts in large secondary schools; 2) lack of CS identity in schools and in students who are typically underrepresented in CS courses and fields; 3) lack of exposure to and development of computational and design thinking skills as a critical foundation prior to engaging in a CS coursework; and 4) the 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 design and CT skills and dispositions tied to the Next Generation Science Standards (NGSS) and the Information, Computer Science, & Technology (ICT) sector Career Technical Education (CTE) track. Together, these deficiencies result in widening disparities of CS educational opportunities for students of color, especially female students of color. Creating an ecosystem that establishes and supports school and student CS identity and CT, focused on whole school transformation (Inflexion Approach) and establishing a continuum of supports through California Multi-Tiered System of Support (CA MTSS), with an equity-centered model of continuous improvement, will result in improved access to, and retention in, CS courses for female students and students of color.

A1. Clearly Specified and Measurable Goals, Objectives, and Outcomes

Table A1 below describes the proposed goals, objectives, and outcomes with the CA MTSS Domain (outlined in **Appendix A1-1**), Inflexion Approach step, and CS-focused connections from the Inflexion Approach Implementation Map Deep Dives **(Appendix A1-2)**:

Table A1: Goals, Objectives/Activities, and Outcomes	
Goal 1. Build CT Skills through Academic Instruction Focused on Inclusive Practices and Culturally Relevant Teaching *Theory of Action: If we embed CT into core coursework, then more students will develop the needed foundation for CS, and more students will pursue formal CS coursework.*	
CA MTSS Domain: *Inclusive Academic Instruction – Identify and implement key universal, supplemental, and intensified supports necessary to ensure students historically underrepresented in CS courses have the exposure and opportunity to develop their capacity for CT. Create approach to developing and promoting school-wide CT.* ***Inflexion Approach:*** *Vision for Readiness & Identity – Student outcomes identified by the School Leadership Teams (SLTs); Shared values and beliefs identified by the SLTs; School-wide outcomes for all students include CT skills; School identity includes high expectation for all students and a belief in the potential of all students.* ***CS-Focused Connection:*** *Think, Know, Act, Go - How do the Four Keys to Readiness connect to and support CS? [Deep Dives 2-5]*	
Objectives/Activities: ● Create school-wide readiness to build identity for CT through an equity lens ● Provide professional learning (PL) to SLTs focused on CT, CA MTSS, and the Inflexion Approach ● Identify and develop a range of universal, supplemental, and intensified supports for student development of computational and design thinking skills and dispositions ● Build awareness of CT: Provide PL to 9th and 10th grade math and science teachers on CT, inclusive instruction and culturally relevant teaching practices ● Implement culturally relevant instruction and inclusive practices, while actively recruiting girls and students of color for introductory CS coursework, with a focus on grades 10-11; monitor fidelity to integration of CT into instruction, counseling practices, and improved identity	**Outcomes**: ● Increased number of teachers who incorporate CT into teaching ● Increased teacher knowledge and confidence to incorporate CT into math and science courses ● Improved CT skills in female students and Latinx students ● Increased enrollment of female students and Latinx students in CS courses ● Increased CTE pathway enrollment and completion of female students and Latinx students ● Increased SLT knowledge and competence to apply principles of CT, MTSS, and Inflexion approach to system transformation

<table>
<tr><td>● Actively retain female students and students of color in advanced CS classes, with a focus on grades 11-12</td><td></td></tr>
<tr><td colspan="2">Goal 2. Build CS-Inclusive Identity through Social Emotional Learning and Exposure to Role Models
Theory of Action: If we focus on inclusive social emotional instruction in CS courses, and exposure to role models, then students will develop stronger CS-inclusive identities, and more students will pursue and persevere in formal CS coursework.</td></tr>
<tr><td colspan="2">CA MTSS Domain: Inclusive Social Emotional Learning (SEL) Instruction - Identify and implement universal, supplemental, and intensified supports necessary to ensure students historically underserved in CS courses and careers have the exposure and opportunity to develop their capacity for design and CT.
Inflexion Approach: Aligning Instruction & Learning - Universal classroom tools developed and aligned with shared vision for readiness; Transforming the student experience developed; Articulate, analyze, and evaluate your continuum of supports; Identify and plan to fill gaps within continuum of supports.
CS-Focused Connections: Focus on culturally-relevant instruction and inclusive practices in CS courses [Deep Dives 11 & 13]; and Focus on building continuum of supports for CS students [Deep Dive 14]</td></tr>
<tr><td>Objectives/Activities:
• Develop classroom tools
• Evaluate and enhance continuum of supports
• Build, strengthen and solidify student CS identity:
o Build Identity: Exposure to CS and CS-adjacent role models reflecting the diversity of the community through the Nepris virtual platform
o Strengthen Identity: Near field mentor (IHE partners) and/or extended role model exposure
o Solidify Identity (mentee becomes mentor): Position students in place of authority in working with students in younger grade levels (either MS partnership or grades 9-10)</td><td>Outcomes:
● Increase student CS identity, with greater increases for female students and Latinx students
● Students exposed to CS and CS-adjacent role models will report stronger CS identity, and greater intention to enroll in CS courses and/or ICT pathway
● Students exposed to mentor/extended exposure to role model will report stronger CS identity, be more likely to enroll in advanced CS courses and/or ICT pathways
● Students who develop stronger CS identity will be more likely to complete ICT pathway, and feel more confident to mentor younger students in CS
● A more robust continuum of supports will lead to more equitable enrollment in CS courses and ICT pathways, for female students and Latinx students</td></tr>
<tr><td colspan="2">Goal 3. Create an Ecosystem of Supports and School-Wide CS Identity Through Community of Practice
Theory of Action: If we create a diverse community of practice, with representation from schools, local IHE and CS industry partners, parents and students, we can create a CS-ecosystem within schools that supports students in building identity and accessing CS coursework.</td></tr>
<tr><td colspan="2">CA MTSS Domains: Inclusive Policy, Structure, & Practice; and Integrated Educational Framework – Identify who has access, use non-categorical language in practices, build trusting family partnerships, and build strong school-to-district relationships to promote school-wide transformation and improved student outcomes.
Inflexion Approach: Building Coherent Structures - Assess how well school structures support CT and CS participation; Articulate and refine internal and external communication strategies; Align hiring and onboarding strategies to school identity and vision for readiness; Align observation and evaluation strategies to the school's vision for readiness; use continuous improvement process anchored to school identity and vision for readiness.
CS-Focused Connections: Focus on building community through relationship building [Deep Dive 16]; and Expand CoP to reflect community engagement [Deep Dive 8]</td></tr>
<tr><td>Objectives/Activities:
• Provide PL to SLTs focused on CT, CA MTSS, and the Inflexion Approach
• Expand CoP to reflect community engagement
• Promote whole system engagement
• Link school, district, and county resources
• Share best practices across school sites within the intervention group</td><td>Outcomes:
● Participation in CoP - Attendance by diverse members (teachers, administrators, counselors, students, parents, IHE, business/community members, and other partners)
● Build new knowledge as a result of collaboration
● School-wide adoption of CS and CT mindset/practices
● Increase SLT knowledge and competence to apply CT, MTSS, and Inflexion approach to system transformation</td></tr>
</table>

Details regarding the project design and operationalization of concepts are found in Section A3. **Appendix A1-3 (Logic Model)** further details intervention activities, and short-, mid-, and long-term outcomes, and continuous improvement activities that will ensure fidelity and high-quality implementation of the proposed project. Details of how these objectives will be measured are outlined in Section C. Evaluation.

A2. Target Population and Identified Needs

Large discrepancies exist in CS/ICT pathway enrollment for female students in OC. While female students represent nearly half of all students, they represented less than 30% of students enrolled in CS or ICT pathways in the past 5 years at schools with ICT pathways (CALPADS, 2014-15 to 2018-19). Similarly, while Latinx students in OC represent just over half of the student population in high schools with ICT pathways, they only represent 31% of CS course and ICT pathway enrollments. Discrepancies are larger for some districts than others (see **Table A2**). No other ethnic student groups show notable underrepresentation in CS courses.

The proposed longitudinal quasi-experimental design intervention will be implemented in sixteen (16) high schools, reaching approximately 32,000 students. An additional sixteen (16) high schools, selected based on Propensity Score Matching (PSM), will serve as a comparison group to be monitored on key outcome indicators over time. To determine a candidate pool for the intervention and comparison groups, we started with fifteen (15) OC school districts that reported 5-year CS course and/or Information and Communication Technologies (ICT) track enrollment data for 64 high schools. For each district, we 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. After an initial review showed that Latinx students were the only student group with large discrepancies in these schools, in addition to female students, we set the following criteria for inclusion: 1) Schools with 15%+

discrepancy between the 5-year aggregate proportion of female students enrolled in CS/ICT and the district proportion of female students; and/or 2) Schools with 15%+ discrepancy between the 5-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 eleven (11) school districts, met the threshold and will be included as potential sites to be selected for the intervention. Districts with three or more eligible high schools will be prioritized for intervention site selection. An additional 5 school sites that met the criteria will be included in the pool of candidates for selection into the comparison group. **Table A2** show CS inequities by school district, for the 54 schools, representing over 110,000 high school students, with potential for selection as intervention and comparison sites.

Table A2: CS Class/ICT Pathway Enrollment Inequities in District with Potential for Selection			
District (Unified School District=USD; Union High School District=UHSD)	# High Schools in Selection Pool	% Discrepancy District vs. CS/ICT Enrollment *Female Students*	% Discrepancy District vs. CS/ICT Enrollment *Latinx Students*
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%
Saddleback Valley USD	4	25.6%	3.7%
Tustin USD	3	31.7%	17.5%
Additional School Sites Eligible for Selection into Comparison Group			
	# High Schools in Expanded Pool	*% Discrepancy Schools vs. CS/ICT Enrollment Female Students*	*% Discrepancy Schools vs. CS/ICT Enrollment Latinx Students*
Anaheim UHSD	*2*	*17.3%*	*10.8%*
Brea Olinda USD	*1*	*26.4%*	*22.3%*
Laguna Beach USD	*1*	*17.4%*	*2.5%*
Los Alamitos USD	*1*	*25.6%*	*11.4%*

School Leadership Teams (SLTs) and 9th and 10th grade math and science teachers will be critical to implementing the intervention. CS SLTs will include at least one representative of each of the math, science, and CS departments, with the purpose of ensuring that the CS work is responsive to the developing school identity and vision developed through the Inflexion approach. Teachers will include Math/Algebra (or other relevant 9th/10th grade mathematics course), Life Science/Biology or Earth Science (or other relevant 9th/10th grade science courses), and CS (traditional and CTE, depending on what pathways are offered at the school site) teachers. Eligible schools have a combined total of more 900 than math, science, and CS teachers. Designated teachers will receive training on computational and design thinking skills and participate in their site SLT and a community of practice (CoP).

A3. Conceptual Framework of Proposed Research and Practices

OC is well-positioned to implement equity-minded CS in its schools and districts by recontextualizing the California K-12 CS standards. The CS Equity Guide (2019) provides guidance to school administrators to transform CS education implementation in the state by increasing opportunities for all students. The guide spotlights some alarming statistics that reflect unequal opportunities across the state, particularly for Latinx and African American students, as well as female students. Latinx and female students are similarly underrepresented in CS coursework and ICT pathways in OC.

Key Systems to Deliver Schoolwide Equity-Minded CS Interventions

This project is structured around the design principles of the STEM Ecosystem, particularly the following domains: School, Home, Community, Higher Education, and Business. These domains have been wrapped around the CA MTSS and Inflexion implementation circles, illustrated in **Figure A3**. The **STEM Ecosystem** utilizes PL and a Community of Practice (CoP) model to transform how students learn, how educators teach, and how society supports STEM education. Through the CoP, the project will promote best practices, shared resources, peer learning, leadership development, and strong internal and external communication across partners in the ecosystem.

Figure A3: Proposed Integrated Framework of STEM Ecosystem, CA MTSS Domains, and Inflexion Approach Phases (detailed framework in ***Appendix A3****)*

The School, Home, Community, and Business partners within a STEM Ecosystem contribute to ***identity*** building. The School, Higher Education, and Business partners augment the organizational ***structure***, which is the linchpin for establishing a school-wide approach to support quality ***learning*** that empowers ***readiness*** for all students (to access the School and Higher Education domains of the STEM Ecosystem). Recent research supports using the Inflexion Approach to support school-wide implementation. School change expert James Spillane and colleagues found that districts' redesigned organizational structures (systems and policies) became organizational routines, that facilitated changes in teacher beliefs, promoted collaboration, and supported teachers' ability to implement a new mathematics curriculum (Hopkins, Spillane, Jakopovic, & Heaton, 2013; Spillane et al., 2018; Spillane, Parise, & Sherer, 2011). Additional research (described in **Appendix A3-1**) supports the use of the Inflexion Approach to design an intervention infrastructure that leverages school identity to drive intentional changes in organizational structures necessary to implement CA MTSS to promote equity-minded computational and design thinking. How classes are taught, how students are recruited, and how the classroom culture supports diverse learners and promotes retention are keys to striving for equity (Margolis et.al., 2012). The proposed project will bring together participating districts and schools to offer an equity-minded computational and design thinking intervention through the CA MTSS intervention delivery system that is guided by the Inflexion Approach implementation strategy.

Led by OCDE as a statewide initiative since 2016, CA MTSS offers the potential to create needed systematic change through intentional design and redesign of services and supports to identify and match to the needs of all students. Together with the Inflexion Approach, the MTSS framework supports and facilitates inclusive academic, behavioral, and social emotional instruction, provides universal approaches to support computational and design thinking skills with an intentional focus on the least served student groups, as well as supplemental and intensified supports for students who need them. **Table A3** provides an overview of the intervention frameworks and key program components.

Table A3: Intervention Framework and Key Components
1. 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 for all students through inclusive, equitable learning environments, as well as 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, a range of universal, supplemental, and intensified supports for student development of computational and design thinking skills, CS identity, and engagement in CS courses/ICT pathways.
2. The Inflexion Approach operates on the central assumption that systemic change fails when a school does not articulate and communicate a shared vision for readiness and a set of beliefs, values, and mental models that define its identity. School, home, community, and business partners within a STEM Ecosystem contribute to identity building. The Inflexion Approach further asserts that a school's identity should inform and be reflected in its organizational structure (e.g., systems, policies). *Identity informs Structure; Structure supports Learning; Learning empower Readiness for all students.*
3. Community of Practice (CoP). A CoP, with district-centered teams, will support the prototyping and testing of innovations at identified sites, review data for continuous improvement and iterative innovation design, and develop practice profiles, CoPs will include teachers, site administrators, counselors, students, parents, Institutions of Higher Education, business/community members, and other partners (e.g., Female students Who Code).
4. School Leadership Teams (SLTs) will be the intervention focal point, receiving professional development and engaging in Communities of Practice focused on computational and design thinking, the CA MTSS Framework, and the Inflexion Approach. SLTs will develop clear school identities, coherent organizational structures, and aligned learning approaches to improve student outcomes and equity in STEM and CS. SLTs will engage in an iterative equity-centered model of continuous improvement. They will develop and refine a universal learning approach that prioritizes computational and design thinking, as well as solidifying a measurement system for identifying students who need supplemental and intensified interventions. They will examine stakeholder data and

feedback, and utilize root cause analysis tools to define necessary educational shifts, as well as develop a theory of action that includes evidence-based project innovations to support implementation.
5. Professional Learning (PL) will be provided during summer months to administrators and educators to promote computational and design thinking and connection to CS, STEM, and other courses. CT forms the foundation of CS, and represents a skillset that is transferable, particularly to math (CCSS-math) and science (NGSS) coursework. PL will include training on MTSS tiered intervention matrix (strategies to facilitate supplemental and intensified support) and the Inflexion Approach.
***6. Role Models and Building CS Identity*.** Identity is central to student decision making when considering what careers to pursue. Strategies to develop student identity and self-awareness related to CS and build a holistic school identity that fosters STEM aspiration, including for historically underserved students, will be implemented. SLTs will use the Inflexion Approach to examine structures (systems and policies) and ensure school support for the development of CS school identity that support access for all to CT, and to CS curriculum. To further develop CS identity in students, the Nepris mentoring platform will be used to connect industry and subject-relevant STEM professionals to classrooms, bringing real-world relevance and career exposure to students. Nepris provides opportunities for students to meet and engage virtually with role models from similar backgrounds and communities. Students will be supported by trusted role models inside and outside of the school, and those with additional barriers to engagement and inclusion in CS (e.g., female students, Latinx students) will receive supplemental and/or intensified support from role models, as appropriate. (e.g., extended mentor engagement). Students who are more advanced in CS will also serve as mentors to younger students.

Fidelity and Continuous Improvement

Two main fidelity questions will guide the project: (1) To what extent can the intervention, guided by the CA MTSS framework and Inflexion Approach, be implemented with fidelity? (2) Does high fidelity implementation of the intervention increase access to, participation, retention, and performance in CS classes and ICT pathways for traditionally underrepresented student groups across treatment schools? To ensure fidelity of implementation, throughout implementation, SLTs will engage in a Plan-Do-Study-Act (PDSA) cycle to achieve continuous improvement. This will allow SLTs to collect student- and system-level data from multiple sources, analyze the data to identify trends, hypothesize why data patterns exist, brainstorm possible strategies to address needs, apply evidence-based interventions, assess outcomes, and plan appropriate next steps. A coherence audit (available within Inflexion's Implementation Fidelity Index) will be also conducted, which is designed for SLTs to determine what new organizational structures and learning approaches are needed to create computational and design thinking supports (universal, supplemental, and intensified) for students, and what existing structures are not aligned.

Scalability and Other Considerations

Post-intervention, the CoP will examine iterations and refinements to the intervention, to inform the development of a scalable model that can be replicated in other schools, beginning across the southern California geographic lead areas, and then spreading across the state through the MTSS network. Scalability plans are outlined further in Section B5 (Dissemination Plan). The sequence of learning activities (outlined in **Appendix A3-2**) links directly to school capacity-building activities for a broad range of stakeholders (staff, students, families, and community), while incorporating the key features of high quality MTSS and assisting SLTs with developing the necessary infrastructure to support each and every student. In light of the COVID-19 pandemic, the proposed project can pivot into a distance/virtual learning or hybrid learning environment through an online delivery model for all components of the intervention.

Literature Review: The Importance of Diversity, Equity, and Inclusion (DEI) in Computational and Design Thinking Interventions

The notion of equity in CS, as described by Margolis et. al (2012), is not to prepare all students to major in CS and go on to careers in software engineering or technology. Instead, it is about ensuring that all students have the foundational knowledge that will allow them to productively participate in today's world and make informed decisions about their lives. Learning should build on students' cultural wealth and funds of knowledge, concepts originally coined by Moll, Amanti, Neff, & González (1992); in other words, learning should be culturally situated and relevant, and needs to improve students' understanding of the world through their cultural lens. Goode, Johnson, and Sundstrom (2020) further postulate that long-term professional development in growing teachers' understandings and capacity around equity, race, and education is important to allow for teachers' own developmental growth around race, pedagogy, and education.

A4. Potential of the Proposed Project to Increase Understanding of Educational Problems

Demonstration of Promising New Strategies that Build on Existing Strategies

The proposed project builds on existing approaches to STEM and CS, via computational and design thinking, to create an innovative solution to a persistent problem in college and career readiness – developing the critical thinking, creativity, and collaboration skills needed to succeed in the 21st century. Students need to learn to become creators and innovators, not just passive consumers, in order to become active members of a rapidly pivoting modern society. Increased equitable access to the foundational learning of CS can allow students to discover innovative ways to solve problems in their communities and learn about college and career pathways never before considered. In OC and the southern California region at-large, recontextualizing the classroom system through building universal approaches to support computational and design thinking skills with an intentional focus on the least served student group/s in mind – while cross-walking core content standards, pathway industry sectors, and labor market needs, will cultivate skills that improve equitable representation in the workforce and talent supply chain.

Educational Problems, Issues, and Effective Strategies

Historically, students have been denied access to CS due to a multitude of factors, including: 1) counselors and teachers enrolling students in computing classes based on stereotypes about who they believed could/should excel in computing; and/or 2) lack of professional development for educators who were siloed in their disciplines within school systems, and/or 3) education policies, practices, and structures that did not allow all students to participate (Margolis, Estrella, Goode, Jellison-Holme, & Nao, 2017). Intentional equity-minded implementation must be present across multiple levels of the educational system, taking into account the structure of the school, belief systems, pedagogy, and policy impacting student access to quality CS education (Goode, Flapan, & Margolis, 2018), and this must all take place within the larger ecosystem which includes parents, students, school staff and administrators, IHEs, business and community partners (potential future employers), and other members of the ecosystem. All students must receive education that is based on research-informed best instructional practices, including (1) rigorous, engaging, and culturally responsive content knowledge, (2) a belief that with appropriate support, all students are capable of learning and succeeding in any field of study, and (3) an empowering learning environment that welcomes, incorporates, and respects the identities, cultural assets, and cognitive skills that each student brings into the classroom, so that the contributions of each student are valued, CS has meaning for students' lives (Ladson-Billings, 1995; Sleeter, 2012), and pathways are paved for all students to see themselves in, and to have equitable access to, the world of CS.

B. MANAGEMENT PLAN

The project team includes key personnel from both OCDE and Inflexion, who have worked in partnership during the past six years to support work within and beyond OC. The proposed project will be led by Dr. Christine Olmstead (OCDE), Associate Supt. of Educational Services, and Holly Steele (OCDE), STEM Administrator, along with Dr. Kristine Chadwick (Inflexion), Director of Planning, Research, & Evaluation, building on their collective experience in education and in directing complex, multiyear state and federal grant-funded projects.

B1. Clearly Defined Responsibilities, Timelines, and Milestones

An internal team of OCDE Educational Services staff will oversee all aspects of the intervention, including (a) assuming fiscal and reporting responsibility for the grant; (b) organizing PL with schools; and (c) assisting in intervention development, implementation, and research. OCDE will work in partnership with Inflexion to (a) develop intervention materials, (b) implement the intervention with schools, (c) conduct evaluation activities, and (d) continuously improve the intervention materials and process using feasibility and usability mini-case studies.

Redwood Consulting Collective Inc. (RCC) will serve as the external evaluator and will oversee and conduct the evaluation outlined in Section C.

The proposed project timeline allows for implementation of interventions to occur across four (4) full academic years, bookended by a School Recruitment and Program Preparation period at the beginning, and a Wrap-Up & Dissemination period at the end.

The staggered cohort implementation ensures adequate staff resources needed to implement the intervention, and allows for changes in implementation from Cohort 1 to Cohort 2 based on lessons learned. The two cohorts will serve as the intervention group. **Table B1** presents the activities, milestones, and associated responsibilities.

Table B1: *Management Plan Overview*

Activities/Milestones	**Respons. Party**	**Years (**C1=Cohort 1; C2=Cohort 2)				
		Y1 (2021)	***Y2 (2022)***	***Y3 (2023)***	***Y4 (2024)***	***Y5 (2025)***
Develop and iterate intervention, fidelity, and evaluation materials	OCDE Inflexion	X Sprg(C1)	X Sprg (C2)			
Recruit/confirm schools (develop MOUs)	OCDE	X (C1,C2)	X (C2)			
Collect baseline data for intervention and comparison sites	Inflexion RCC	X				
Summer PL(1-2 days on CT and 1-2 days for unit development)	OCDE Inflexion	X Summer (C1)	X Summer (C2)			
CoP established and continues to meet, monitor, iterate intervention	OCDE Inflexion	X Fall (C1, C2)	X (C1, C2)	X (C1, C2)	X (C1, C2)	X (C1, C2)
Conduct coherence audit for SLTs, to determine what new structures and learning approaches are needed to create supports for students and ID existing structures not aligned	Inflexion Districts	X Fall(C1)	X Sprg(C1) Fall(C2)	X Sprg(C2)		
Guide SLTs through process of examining how school structures and practices are aligned with school identity and vision for readiness	Inflexion		X	X	X	
Incorporate CT into 9th & 10th grade core math and science courses	Districts	X Fall(C1)	X Sprg (C1) Fall(C2)	X Sprg (C2)		
Identify/enhance universal, supplemental, intensified supports	OCDE Districts	X Fall(C1)	X (C1, C2)	X	X	X
Develop tool/process for identifying students who need supplemental and/or intensified supports	OCDE Districts		X (C1)	X (C2)		

Cohort with foundation in computational and design thinking, enrolled in CS	Districts		X (C1)	X (C2)	X (C1,C2)	
Inclusive teaching practices, culturally relevant instructional practices (Retention)	OCDE Districts		X (C1)	X (C2)	X (C1, C2)	
CS role model implementation	Nepris Districts		X (C1)	X (C2)		
Near field mentor (IHE partnership) and/or extended role model exposure	IHEs Districts			X (C1)	X (C1, C2)	X Sprg(C2)
Position students in place of authority to serve as role models for students in younger grades	Districts			X Fall (C1)	X Sprg(C1) Fall(C2)	X Sprg(C2)
Examine structural transformations, including scaffolded supports for teachers, counselors, and school leaders to promote CT	Inflexion Districts		X	X	X	
Examine change practices needed to shift computational and design thinking skills and dispositions	Inflexion Districts	X	X	X	X	
Assess implementation fidelity	Districts RCC		X (C1)	X (C1,C2)	X (C1,C2)	X (C2)
Conduct evaluation of program impacts; monitor comparison sites	RCC		X (C1)	X (C1,C2)	X (C1,C2)	X (C2)
CoP to examine iterations/refinements to intervention; develop scalable model	OCDE Inflexion Districts				X	X
Disseminate findings and scalable	OCDE Inflexion RCC					X

B2. Reasonableness of Costs in Relation to Objectives, Design, and Significance

The proposed interventions will be implemented in sixteen (16) OC high schools, reaching approximately 32,000 students. Moreover, the intervention will have long-term impacts on over 1,000 teachers and SLT members from participating schools in which system-wide engagement through the CoP and Inflexion approach creates wide-reaching change. Effective models for equity-based, CS-focused system transformation will emerge from this intervention research that can be adopted by other districts and counties in the Southern California geo-region, as well as across the state as part of its implementation of CA MTSS.

OCDE project personnel (grant funded and in-kind) includes educators, practitioners, and education innovators in STEM/CS and career technical education (CTE), and a data analyst with expertise in databases at the county, district, and school levels. Inflexion brings education innovators, researchers, and evaluators with expertise in organizational change, web-based tools, qualitative and quantitative methods. **Table B2** below lists the project personnel committed to this project. Detailed descriptions and cost breakdowns are in the Budget Narratives.

Table B2: Project Personnel and Annual FTE Commitments

EIR Grant Requested	FTE	In-Kind	FTE
Project Co-Director (Associate Superintendent, Educational Services, OCDE)	8%	Executive Director, Educational Services (OCDE)	3%
Project Co-Director (Administrator of STEM and Esports, OCDE)	8%	Director, Career Education (OCDE	3%
Coordinator, STEM (New, OCDE)	100%	STEM Coordinator (OCDE)	6%
Instructional Program Assistant (New, OCDE)	100%	STEM Coordinator (OCDE)	6%
Project Co-Director (Inflexion)	25%	STEM Coordinator (OCDE)	6%
Inflexion Approach Expert (Inflexion)	10%	Math Coordinator (OCDE)	6%
Design Researcher (Research Associate, Inflexion)	25%	Curriculum Specialist (OCDE)	6%
Implementation Researcher (Research Associate, Inflexion)	30%	Network Analyst II (OCDE)	6%
System Architect (Inflexion)	20%		

For the external summative evaluation, Redwood Consulting Collective Inc. (RCC) will include the following staffing: Project Manager, Data Specialist, & Research Associate. At 8% of the project budget, the resources allocated to the external evaluation team ensures a rigorous impact evaluation. Through the commitment of a well-rounded project team with support from expert consultants, including school practitioners, the proposed project has allocated substantial resources to develop all aspects of the intervention and study feasibility, usability, fidelity, and outcomes. Together with the proposed Inflexion staff to lead an internal implementation evaluation, we estimate 15% of the project budget will directly support evaluation work.

B3. The Qualifications and Relevant Training and Experience of Key Project Personnel

The key personnel from OCDE and Inflexion have the relevant training and experience in the core projects components and in creating infrastructure for educators that facilitates effective PL and system transformation.

Key Personnel	Organization	Relevant Experience

Project Co-Director Dr. Christine Olmstead	OCDE	Extensive experience with MTSS and has led the procurement and directs the on-going implementation of the CA MTSS Initiative
Project Co-Director Holly Steele	OCDE	Led a large team in planning and delivering STEM professional learning, including six years of experience in implementing an ecosystem approach to STEM
Project Co-Director Kristine Chadwick	Inflexion	15-year history conducting complex, multi-partner, multiyear research and development projects
The budget narrative shows details on FTE allocations, and training and experience of Key Project Personnel.		
Evaluator	**Organization**	**Relevant Experience**
Executive Directors Dr. Silvana McCormick Dr. Molly Rottapel	Redwood Consulting Collective Inc. (RCC)	Both hold PhDs in Psychology from Claremont Graduate University where they received comprehensive training in program evaluation and applied research methodology. RCC has extensive experience using a collaborative, utilization-focused approach (Shulha et al., 2015; Patton, 2008) to evaluate federally funded projects in education, particularly in evaluating initiatives that aim to increase diversity in STEM (e.g., NSF Robert Noyce Grant- a STEM educator intensive professional development program for pre-service teachers). Additionally, RCC has served as the evaluator on federally funded projects that focus on CS education in K12 and community colleges (e.g., National Science Foundation C5 grant - AP CSP Curriculum evaluation).

B4. Ensure Continuous Improvement of Intervention Design Through Feedback Loops

The project team will ensure relevance and utility by remaining process-focused, user-centered, and open to feedback through small-scale usability and feasibility studies at treatment schools during each year of implementation. With Inflexion, ongoing user satisfaction feedback will be gathered through the web platform on which the Implementation Fidelity Index, coherence audit, and associated resources are housed; school leadership teams will have multiple opportunities both to self-assess school implementation and provide feedback through the platform on the self-assessment instrument and on their experiences with project supports and training. Modifications to the proposed intervention design will be made, when indicated by feedback. Representing the end user during iterative field tests of interventions is essential to discover their specific needs, especially related to the context and content of new processes (Powell & Diamond, 2011). Without this step, interventions may not be practical, ultimately limiting implementation fidelity, and long-term sustainability of intended change.

An implementation science approach will be used to examine the type of school identity, organizational structure, and learning approach needed to implement evidence-based practices effectively and the adaptation demanded by unique contexts (Blase, Fixsen, Sims, & Ward, 2015). Each treatment school's leadership team will develop an implementation plan, receiving continuous feedback from Inflexion staff. Inflexion will guide treatment schools through a coherence audit process that will result in school plans to increase the levels of alignment between the school's identified commitment to computational and design thinking and its structures and learning approaches. This iterative coherence process has school leadership continually revisit the plan, gather new evidence on coherence, and update action steps.

B5. Dissemination Plan

Through successful iterations and refinements, this model can be replicated across schools with similar demographics and characteristics, beginning across the southern California geographic lead areas. As the lead organization, OCDE has built the necessary relationships and the regional architecture that can serve as a natural point of dissemination and scale-up throughout the Southern California geo-region and replicate the model to new school districts and regions across the state. The California MTSS Initiative, led by OCDE since 2016, includes a regional infrastructure designed to provide direct support to districts across the state.

Within OC, this model can be shared across all secondary districts through the K12 Strong Workforce Program leadership meetings, in addition to the membership meetings of the OC STEM Initiative. Across the State of California, the model can be presented at the annual CISC Symposium and within the CISC CS Subcommittee, in which Project Co-Director Holly Steele is the Regional Lead representing OC. Given the strong connection to the STEM Ecosystem model, the project findings can also be shared at the STEM Learning Ecosystem Community of Practice convening through an "E2E" (ecosystem to ecosystem) presentation.

Finally, units of study developed by schools and a summary of key research findings will be posted on the OCDE STEM website for accessibility by any interested LEA.

C. PROJECT EVALUATION

Redwood Consulting Collective (RCC), as the external evaluator, will lead the impact evaluation and will review and vet the implementation data collected by Inflexion. Inflexion, as the internal evaluator, will lead implementation evaluation activities. Together, implementation and outcome data will provide a comprehensive understanding of the project's effectiveness in the initial set of schools and inform effective strategies for replicating the project in other settings.

C1. Implementation Fidelity and Evaluation of Data Collection

The implementation evaluation will focus on the extent to which the intervention is delivered as intended (Breitenstein, et. al., 2010). Implementation data, collected annually by the Inflexion team and vetted[1] by the RCC team, will provide support for continuous improvement at school sites. Implementation fidelity data will also allow for (a) a more nuanced understanding of the intervention effects on 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.

C2. Key Project Components, Mediators, Outcomes, and Thresholds

Internal and external evaluators will use an integrated monitoring system to assess school implementation through a common set of indicators compiled into an Implementation Fidelity Index. The Fidelity Index, developed by Inflexion and OCDE and reviewed by RCC, will

[1] Vetting the implementation fidelity data will consist of independent reviews of documentation from a subset of schools, reanalysis of survey data, and independent review of transcripts of interviews from a subset of schools, as well as co-observation of 10 classrooms to facilitate the calculation of interrater reliability. RCC will vet implementation fidelity data in Years 2 and 5 only.

include indicators of program adherence, quality, exposure, and responsiveness, including: teacher and school leader engagement with project components; teacher knowledge of, comfort with, and use of CT instructional strategies; school-level changes in structures/schedules; student CS identity and CT skills; and student access to, success in, and completion of CT-focused courses. Fidelity index scores will be calculated per school in spring of grant Years 2-5, and these fidelity variables will serve as mediators in impact analyses.

Each indicator will include benchmarks for *ideal*, *acceptable*, and *unacceptable* levels of implementation fidelity. Some indicator thresholds are set in this proposal. Others will be set after the first six months of the grant. To assist in setting thresholds, Inflexion researchers will interview school leaders across the country who have successfully integrated CT and have high rates of CS or ICT pathway participation by traditionally underrepresented student populations. Findings from how these schools built infrastructures and learning environments, together with the treatment schools' readiness baseline (using *Drivers Assessment*) will inform development of indicator thresholds for the implementation evaluation. Relative criticality of each program component to increasing underrepresented student participation in CS and ICT pathways, as determined through empirical literature, research on successful schools, and treatment school drivers scores, will be used to weight the intervention's most critical aspects in the fidelity index.

Implementation measures and outcomes. To measure baseline implementation and structural coherence across sites, the *Drivers Best Practices Assessment* (Ward, Metz, Louison, Loper, & Cusumano, 2018) will be adapted for this project. This assessment will be administered with treatment schools prior to grant Year 2, with results providing critical feedback to schools to use in setting implementation thresholds for each project component. SLTs will complete coherence check self-assessments to gauge progress on aligning structures to support implementation. Inflexion will use annual observations, document analyses, SLT interviews, teacher surveys, and teacher/student focus groups to assess SLT understanding of intervention goals, identify facilitators and barriers affecting implementation, and to assess structural coherence to support the intervention (corroborating self-assessment coherence checks).

Goal/Objective	Outcome	Indicators (Fidelity Threshold)
Goal 1: Build CT Skills through Academic Instruction Focused on Inclusive Practices and Culturally Relevant Teaching		
Create schoolwide readiness to build identity for CT through an equity lens	Increased number of teachers who incorporate CT into teaching	● Number of school visions for readiness that include CT (threshold: All Tx schools by end of Y3) ● SLT plans to train math & science teachers in CT instructional practices (threshold: 60% teachers Y2; 100% teachers by Y3) ● Observations of (a) teaching and (b) *Teacher CT Survey* demonstrate 20% increasing use of CT each intervention year.
● Provide PL to SLTs focused on CT, CA MTSS, and the Inflexion Approach ● Provide PL to 9th/10th grade math and science teachers on CT, inclusive instruction, and culturally relevant teaching practices	● Increased teacher knowledge and confidence to incorporate CT into math and science courses ● Build teachers' awareness of CT.	● *Teacher CT Survey*, including adaptations from DeChenne and Enochs GTA-Teaching Self-Efficacy Scale (2010) with additional items identifying the components of computational and design thinking, including understanding of and use of the components; administered at beginning of Y1 and end of each intervention year (80% of science and math teachers' scores are in highest 10th of scales.) ● Observations of teaching corroborate teacher self-reports, with 20% increasing incorporation of CT into instruction
Identify and develop a range of universal, supplemental, and intensified supports for student development of computational and design thinking skills	● Improved CT skills in girls and Latinx students ● Strong system of supports in place that meet all students needs	● Improving scores (over years) of annual student *CT Test* (CTt), with greater gains in girls and Latinx students compared to other groups (administered fall of Y1 and every spring through 3 yrs of implementation) ● Mathematics and science grades (90% of girls and Latinx students receive final grades of A or B) ● Internal evaluator review and external evaluator vetting of coherence checks, SLT interviews about supports, and school documentation
Implement culturally relevant instruction and inclusive practices, while actively recruiting girls and students of color for introductory CS coursework, with a focus on grades 10-11; monitor fidelity to integration of CT into instruction,	Increased numbers and percentages of girls and Latinx students enrolled in CS courses	● Numbers and percentages of girls and Latinx students enrolled in CS courses (10% higher enrollments each year in Y2 and Y3 of intervention over Y1 baseline). ● Implementation fidelity monitoring (annual teacher survey, teacher focus groups, SLT interviews - increasing CT in instruction). ● Annual student CS identity/CTt survey (10% increase in identity scores annually for girls and Latinx students)

counseling practices, and improved identity		
Actively retain girls and Latinx students advanced CS courses with a focus on grades 11-12 (Y3)	Increased numbers and percentages of girls and Latinx students who complete CTE pathway	● CALPADS data on pathway completion (20% increase in girls and Latinx students completing CTE pathway over baseline)
Goal 2: Build CS-Inclusive Identity through Social-Emotional Learning and Exposure to Role Models		
Develop classroom tools	Math, science, CS, and ICT Pathway teachers have enhanced classroom materials for computational and design thinking instruction	● Teacher CT Survey (Y2 survey indicates 90% of teachers agree they have adequate classroom resources related to CT ● Annual spring SLT interviews describe the tools developed and shared with teachers
Evaluate and enhance continuum of supports	SLTs plan and implement a continuum of supports that is evaluated annually and enhanced as needed	● Annual coherence check of supports indicates increasing levels of implementation with supporting documentation. ● Schools with stronger continuum of supports demonstrate more equitable enrollments in CS courses and ICT pathways by Y3.
Build, strengthen, and solidify student CS identity	Increase student CS identity, with greater increases for girls and Latinx students	Cole's (2012) measure of science identity, adapted to CS (administered at baseline/beginning of Y1 of intervention then every spring; 10% increase in student scores each year of intervention) (Student CS Identity/CTt Survey)
Goal 3: Create an Ecosystem of Supports and School-Wide CS Identity Through Community of Practice		
Develop PL for SLTs	PL sequence on CT, MTSS, and the Inflexion Approach developed	● Review of PL sequence ● Completion of full PL sequence by >80% of each school's SLT members
Expand CoP to reflect community engagement	Attendance and participation in CoP by diverse members (e.g. teachers, administrators, counselors, students, parents, IHEs, business/community members, and partners).	Increases over time in frequency, attendance, and diversity of represented stakeholder groups
● Promote whole system engagement ● Link school, district, and county resources ● Share best practices across intervention schools	Building new knowledge together as a result of collaboration	● Review of number of formal and informal grant partners, increasing over grant years. ● Review of project documentation on links among schools, districts, and OC. ● Review of CoP participation and activity; evidence of best practices sharing across schools
Build capacity aligned with Local Control and Accountability Plan (LCAP) or Single Plan for Student Achievement (SPSA)	Schoolwide adoption of CS and CT mindset and practices	Incorporation of CS and CT goals in district (LCAP) and/or site-level (SPSA) plans by end of Y2

a. *Teacher CT Survey* demonstrates adequate internal consistency; **b**. 28-item *CT test* (Roman-Gonzalez et al, 2017) demonstrates good convergent validity (r > 0.5 with a previously validated measure), internal consistency α=0.92, and test-retest α=.70; **c**. The Cole (2012) measure of *Science Identity* exhibits adequate internal consistency, and convergent and discriminant validity.

Implementation analysis. The Fidelity Index will assess implementation fidelity at the school level. Though analytic power may limit the detection of moderating effects, the fidelity index itself will be analyzed during Year 5 by the RCC team to determine whether different configurations of weighted indicators demonstrate higher relationships to project outcomes, thus suggesting certain program components may have been more or less central to this project than would have been predicted by the prior research.

C3. Impact Evaluation

The overall aim of the project is to develop and evaluate the effectiveness of a whole-school intervention designed to increase students' computational and design thinking competencies as expressed by mathematics proficiency, and participation and success in CS or ICT pathway courses, particularly for student groups traditionally underrepresented in CS. Table C3 presents the three primary research questions the impact evaluation will address.

Table C3. *Overview of Impact Evaluation Research Questions, Outcomes, and Measurement Timeline*

Research questions	Data Source	Measurement Timeline
1. Does the intervention result in differential outcomes for students between treatment and comparison schools?	● Grade 11 Mathematics Smarter Balanced Assessment ● % of students participating in and completing CS classes or ICT pathway	● Smarter Balanced scores collected annually Y1-5 (Y1&2=baseline) ● CS and ICT course enrollment and completion data collected in Y1-5 (Y1=baseline)
If the intervention is successful, the treatment schools will have higher scores on Grade 11 Mathematics and/or greater gains across time in Grade 11 Mathematics scores than do the comparison schools. The treatment schools also will have higher percentages of students--particularly students from traditionally underrepresented groups--participating in, and completing CS or ICT pathway courses.		
2. Are there differential outcomes for students in treatment schools based on characteristics of the students or schools?	● Student demographics ● Student CS identity/CT survey ● School-level demographics ● Teacher CS Efficacy Survey	● Demographics supplied annually by districts ● Student and teacher surveys administered in beginning of

	• School-level participation and completion of Inflexion Approach implementation strategy modules • Grade 11 Mathematics Smarter Balanced Assessment • Percentages of students participating in and completing CS or ICT pathway courses	intervention Y1 and each spring of intervention Y1-3 • School personnel completion of IA implementation strategy modules supplied each June. • Assessment and course enrollment and completion data supplied to external evaluators annually
Whether or not the overall intervention produces differential outcomes between treatment and comparison schools, there may be pockets of success among the schools that are attributable in part to school- and/or student-level characteristics. Finding these instances of success will inform the continuous improvement of project components and the content of dissemination efforts.		
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?	• Annual Fidelity Index scores • Student demographics • Student CS identity/CT survey • School-level demographics • % of students participating in and completing CS or ICT pathway courses	**See above for timeline of each of these indicators**
Levels of implementation fidelity are expected to affect how strong the effect sizes are for student outcomes. It will be critical to assess not only the overall impact of implementation fidelity on school outcomes but also the fidelity of implementation effects on outcomes for students from traditionally underserved groups, as school-level fidelity to implementing universal approaches and adopting computational and design thinking as core readiness schools are predicted to have consequential effects on reaching these students.		

For the impact analyses, RCC will employ a longitudinal, quasi-experimental mixed-methods evaluation design with a comparison group identified through propensity score matching (PSM). This design meets the **What Works Clearinghouse Standards *with reservations***. Covariates will adhere to guidance in the PSM literature and from WWC Standards (e.g., only exogenous covariates). Potential covariates may include demographics (e.g., % female, % Latinx), experience (e.g., # CS courses offered), and academic performance (e.g., pre-intervention math scores). Of the 54 schools identified as meeting eligibility criteria for inclusion in this project, 16 schools will be selected to receive the intervention, based upon existing relationships with OCDE and schools' willingness to participate. Because schools will be the point of intervention, school-level matching will be performed. RCC evaluators will use one-to-one nearest neighbor PSM without replacement to create a comparison group of schools in OC. To ensure adequate covariate balance, evaluators will apply a caliper of 0.2 standard deviations (SD) of the logit of propensity score (suggested by Austin, 2010). RCC will examine propensity score balance quality and individual covariates balance numerically (e.g., standardized mean difference, variance ratio) and visually (e.g., jitter graphs, quantile-quantile plots). RCC will strive to balance groups on the covariates, while maintaining the treatment group sample size to ensure representation and generalizability of results.

Validity and Reliability of Performance Data on Relevant Outcomes

Impact evaluation outcomes. The impact outcomes will primarily include the Grade 11 Smarter Balanced Summative Mathematics Assessment and the annual percentages of students participating in and completing CS/ICT pathway courses. Predictor variables in the impact analysis will include Teacher CT Survey scores, Student CS Identity Scale, Student CT test, Levels of School Implementation, student demographics at student and school levels, student grades, and student engagement in mentoring and internship (ICT pathway) opportunities. As recommended by PSM literature, covariates included in the matching model that remain unbalanced after matching will be included in outcome analyses (Pan & Bai, 2015; Rosenbaum & Rubin, 1985), as this approach can produce accurate estimates of treatment effects regardless of PSM methods (Schafer & Kang, 2008; Shadish et al., 2008).

Impact analysis. To ensure the study meets WWC Standards if attrition exceeds the liberal boundary, RCC evaluators will establish baseline equivalence of analytic samples on WWC-eligible measures of achievement, as well as percent eligible for free or reduced-price lunch. Allowable adjustments will be made for baseline differences between .05 and .25 *SDs*. Only schools with complete baseline and outcome data will be included in the analytic sample.

The impact evaluation will estimate the average treatment effect on school-level rates of CS and ICT pathway enrollment and course completion after three years of implementation, and exploratory analysis will examine average treatment effects for student groups. To correct for multiple comparisons and effect sizes (Hedge's *g*), Benjamini-Hochberg adjustment will be used to determine the magnitude of impacts. Specifically, treatment effects will be estimated using a 2-level hierarchical linear model (HLM), detailed in **Appendix C-1**, to account for possible variation in treatment effects across schools. District means and *SD*s of achievement measures will be used to create standardized scores for comparison across districts. CS course/ICT pathway enrollment and completion outcomes will be reported as percentages. Impact analyses estimating treatment effects on average levels of student outcomes will be conducted in Year 5.

RCC will rely on sensitivity power analyses to estimate the minimum detectable effect size (see results of power calculation table in **Appendix C-2**). Although the study design is slightly underpowered, the PSM design will ensure the impact evaluation achieves the highest level of internal validity while also meeting the EIR Early-phase Grant requirements.

***Providing Guidance about Strategies Suitable for Replication in Other Settings*.** The proposed plan to collect detailed information on implementation successes and challenges across treatment schools and their connections to ultimate outcomes will provide nuanced information about factors affecting successful implementation of CT strategies, allowing school leaders in other settings to adapt implementation to their context.