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A. SIGNIFICANCE

The Riverside County Office of Education (RCOE), in partnership with San Bernardino County Superintendent of Schools (SBCSS), Cal Baptist University (CBU), Riverside and San Bernardino K12 districts, and faculty from Cal State University, San Bernardino (CSUSB), Chaffey Community College (Chaffey), and Riverside City Community College (RCC), is seeking EIR Early-phase funding to develop, and field test an innovative professional learning series and third-year mathematics standards-aligned lessons designed to accelerate learning. CBU, CSUSB, Chaffey, and RCC are all minority-serving institutions (CPP1). The design of **M**aking **C**onnections in **M**athematics: Empowering Students by Empowering Teachers (MCM) is a result of student and teacher feedback and data collected from a current successful collaborative project.

The goal of MCM is to accelerate learning of underperforming 11th grade high school math students in order to meet grade-level expectations, positively influence students' mathematical identities, and increase teachers' mathematical agency. To accomplish this, the MCM course, and corresponding professional learning (PL) series, will build teacher capacity in the use of the eight mathematics teaching practices defined in NCTM's Principles to Action (Appendix K) (NCTM, 2014) to design instruction that: engages students in mathematical discourse as the vehicle for learning; builds thinking classrooms; uses technology to enhance learning; and engages teachers and students in the formative assessment process.

MCM addresses Absolute Priorities 1: Demonstrating a Rationale (AP1), AP3: Field Initiated Innovations - *Promoting Equity in Student Access to Educational Resources and Opportunities: Science, Technology, Engineering, or Mathematics (STEM)* (AP3), and Competitive Preference Priority 1 (CPP1). Additional information is found in the logic model (Appendix G) and Evidence Form. Additional supporting documents are provided in Appendices. J - U. The partnership will sustain the project through a training-of-trainers (ToT) model, content development teams, and professional learning networks. Over five years, MCM project plans to serve over 100 teachers and 3,000 students across a large, diverse ethnic and socioeconomic region spanning Riverside and San Bernardino counties, called the Inland Empire region (IE) in Southern California.

A. 1. Development of promising new strategies that build on existing strategies.

Throughout the state of CA (Owens & Tom, 2022) and nationally (Conwell, 2021), teachers are faced with a crisis in math achievement and persistence which is exacerbated by student feelings of anxiety and lack of confidence in math (Ashcraft, 2002; Luttenberger et al., 2018), conditions which negatively impact underserved students.

Riverside and San Bernardino Counties in California, collectively called the *Inland Empire* region (IE), houses over 1,093 schools serving over 800,000 K12 students. Both counties have a majority Latinx population (51.6% - RC; 55.8% - SBC), and students are predominately high-need (over 71% on free or reduced lunch). Based upon 2022 California's Smarter Balanced Assessment System (SBAS) test results, less than 7% of Grade 11 students in the IE received a score indicating they were prepared for the rigor of college-level math courses. (See Section B.3. for additional IE student demographics and achievement data). The persistence of 11th grade students in math is particularly critical for future success, especially for groups traditionally underrepresented in math (Walton & Cohen, 2007; Harackiewicz et al., 2012). However, California only mandates a minimum of 2 years of math for high school graduation, while admission into University of California (UC) and California State University (CSU) systems requires at least 3 years of math. Students' disillusionment with math in high school causes them to finish their high school math career after Geometry/Integrated Math 2. Students who do not complete their 3rd year of math, therefore, limit their future postsecondary opportunities and may only be eligible for the community college pathway, presenting even more challenges (see B.3).

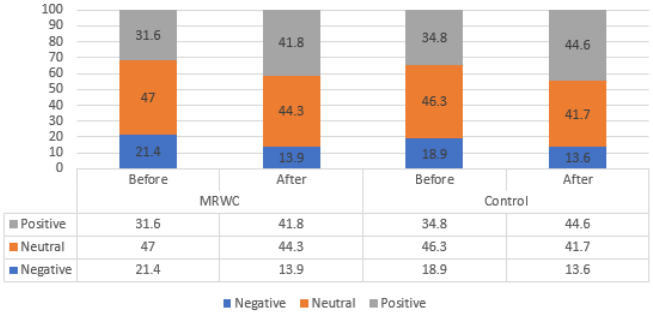
Along with the crisis in math achievement and persistence, math teachers in today's post-pandemic environment are not only leaving the field in record numbers but sharing frustrations with curriculum practices that continue to dehumanize students who live in communities of color (Fortin & Fawcett, 2022; Zahn & Wilde, 2022).

The key to solving this crisis is finding courses that empower math teachers with empowering instructional strategies (see B.1) and, in turn, change students' attitudes to motivate and empower them to continue and succeed in high school math. RCOE is uniquely positioned to succeed in this endeavor because of its previous experience developing math curricula, interventions and PL.

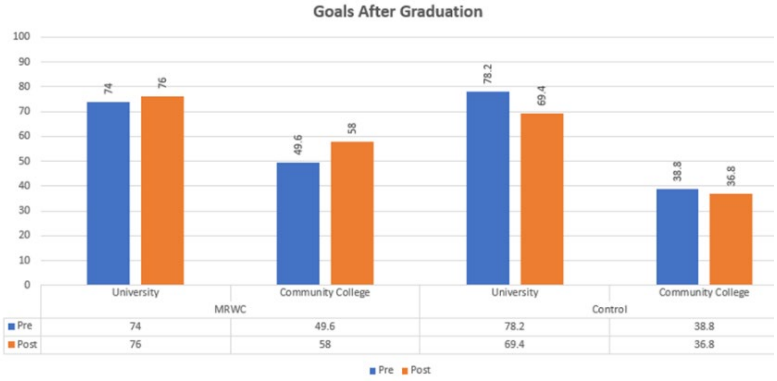
Building on Promising Existing Strategies. Since 2017, RCOE and its partners have created and implemented an i3-funded, 12th grade math course and corresponding professional learning (PL) titled, i3 Mathematical Reasoning with Connections (MRWC). MRWC was designed to prepare students for the expectations and rigor of college math by engaging students in authentic mathematical practices and creating vibrant mathematical discussions in a supportive environment. MRWC was created to bridge Algebra 2/Integrated Math 3 and College Algebra, PreCalculus, or Trigonometry courses at the postsecondary level. MRWC was *not* meant to be a preparation for Calculus. Nevertheless, an impact analysis conducted as part of that i3 evaluation indicated that MRWC students significantly outperformed their counterparts in traditional advanced math high school courses (Pre-calculus, Statistics and Probability, and Integrated Math IV), as measured by the Precalculus Concept Assessment, by an average of 5 percentage points (Forrester, 2022). Since the 2017-18 school year, 200 teachers have been trained and implemented the MRWC course in 78 high schools across the IE.

MRWC has significantly increased student achievement and attitudes towards math in all years data was collected, compared to control students. The distinction between MRWC and MCM lies in the latter's inclusive approach, catering to all students as opposed to only those who scored a C or better in IM3, the target group for MRWC. This shift in focus is based on data from MRWC students, who were disproportionately labeled as "underperforming," using 11th grade SBAS scores and 11th grade math course grades, compared to control students enrolled in PreCalculus, AP Statistics, Integrated Math 4, and other 4th year high school math courses. Among MRWC cohorts with previous year SBAS scores available, about 75% were either in Level 1 (Not Meeting) or Level 2 (Nearly Meeting) the standard, while the distribution of control students in the same performance levels in corresponding cohorts was about 65%. These significantly "underperforming" students not only outperformed their counterparts taking other advanced courses, but also grew in engagement and interest in studying after taking the course (See Graphs 1 and

Overall Attitude Toward Mathematics (Before/After the Course) Graph 1 (Appendix L)



Graph 2 (Appendix L)



2). As students progressed through the MRWC course, their mathematical identity became more positive as shown in the graphs and in student quotes (Appendix L). Moreover, MRWC students showed significantly higher interest in attending college.

The success of i3 MRWC is limited to 12th grade students only. Both teachers and administrators asked for a similar course for their 11th grade students, and students wished that there was a similar course in earlier grades.

The proposed **M**aking **C**onnections in **M**athematics: Empowering Students by Empowering Teachers (MCM) project will fulfill these wishes, bringing underperforming grade 11 math students to grade level through teachers trained to deliver high-cognitive depth lessons utilizing empowering instructional strategies. Through this fundamental shift in teacher perspectives and tools, students will be able to identify themselves as doers of mathematics (Master & Meltzoff, 2016), enabling academic progress and significantly broadening their future career and life prospects, especially in STEM (Simpkins et al., 2006). There has been much debate over Algebra 2 or Integrated Math 3 (IM3) being the only option for third year, especially given the number of students who do not successfully complete Algebra 2/IM3. Data Science was an approved Advanced Math course for University of California entrance. This June, the UC System decided to rescind the designation for Data Science for 11th and 12th graders, further demonstrating the need for an alternative way to approach 11th grade math. MCM is groundbreaking and fits that need.

Development of an Innovative Strategy. MCM draws its name from the many mathematical connections, whether conceptual, pedagogical, or social, which the professional learning (PL) will instill in teachers, and in turn students, through empowering instructional strategies (Appendix K). The unique and vital contribution of MCM lies in the innovative pedagogical techniques and standards-aligned lessons and resources being developed, which are evidence-based, but not commonly found within the typical IE mathematics classroom. MCM will consist of two main

components, (1) standards-aligned lessons and (2) professional learning (PL) sessions.

Standards-Aligned Lessons. MCM will provide standards-aligned lessons for our teachers to transform the mathematical environment within their 11th grade classrooms. MCM will align with California Math Content Standards (CA MCS) for Integrated Math 3 (IM3) and Algebra 2, as well as the new California Math Framework (Appendix M). For details on pathway alignment and theme structure see Appendices M and N.

MCM lessons will align with the new CA Mathematics Framework, which strongly emphasizes equitable and engaging teaching practices (CA Mathematics Framework, 2023) (Appendix M). MCM will align with this emphasis by using embedded Standard for Mathematical Practices (SMP), opportunities for productive mathematical discourse, and formative assessment to increase access to students with unfinished learning in prior math courses. The use of Building Thinking Classroom strategies, where students work in groups of three at vertical non-permanent surfaces with an engaging task, encouraging mathematical discourse, will help provide the conditions for deep mathematical thinking to occur (Liljedahl, 2016; Liljedahl, 2021). Lesson activities will include engaging students in the formative assessment process using structured critique of student work and thinking (Booth et al., 2013). By creating engaging activities with many points of entry and solution methods, discussion of these activities will support students in building relationship skills and social awareness (Durlak et al., 2011; National Research Council, 2012).

Professional Learning (PL). NCTM's Effective Mathematics Teaching Practices are how teachers engage their students with mathematics. MCM will utilize these 8 practices to provide professional learning (PL) sessions in which presenters model empowering instructional strategies (Appendix K). MCM PL will be focused on training teachers in the content and pedagogical shifts necessary to implement a math class focused on vibrant discussion and investigation (Hill, 2021). Teachers will have opportunities to reflect and collaborate with intra- and inter-district K12, community college, and four-year university educators, focusing on empowering instructional strategies and raising the bar to reimage schools (Appendix K).

This focus is backed by research discussed in B.1. For example, critical reasoning in the classroom demands productive discourse (Koedinger & McLaughlin, 2010). Through discourse,

students can build a shared understanding of mathematical ideas, clarify understandings, and construct convincing arguments (Smith & Stein, 2018). Furthermore, discourse promotes the development of sound mathematical language and procedural flexibility, allowing students to see solutions from multiple perspectives (Star & Rittle-Johnson, 2008; Star & Seifert, 2006).

Teachers will also be trained on appropriate use of technology platforms (such as Desmos and Geogebra), which learning can be focused and barriers to entry removed, creating a more equitable learning environment where knowledge gaps are circumvented (Santos et al., 2003). MCM will support the professional growth of educators beyond PL through a bi-county professional learning network (PLN). The bi-county PLN will meet monthly each school year. Teachers will be required to attend once per quarter during their first year of implementation but can continue to attend in subsequent years. MCM will also allow teachers and coaches an opportunity to build leadership capacity by implementing a training-of-trainer (TOT) model.

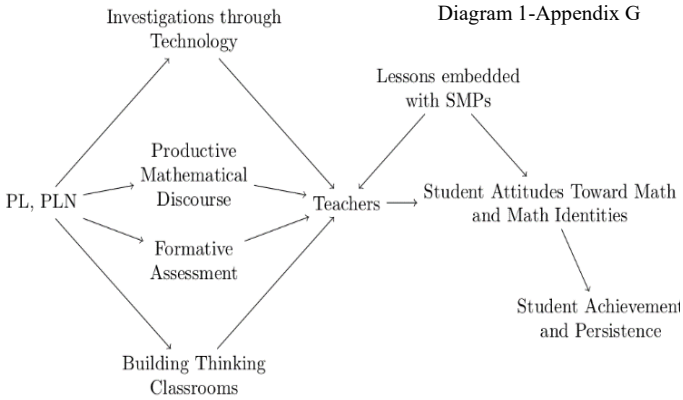
B. QUALITY OF THE PROJECT DESIGN

B. 1. Concept framework demonstrates research, activities and framework quality.

MCM will change student attitudes towards math and identities as mathematicians through a drastic alteration of the classroom environment for grade 11. This change will be effected through the development of high-cognitive depth lessons with embedded SMPs, and an extensive teacher PL and PLN that supports teachers in implementing effective evidence-based empowering instructional strategies. The MCM logic model and conceptual framework is depicted here and in Appendix G.

The main goal of MCM, as depicted in diagram 1 is the change in student attitudes towards math and towards themselves as learners and as doers of math. Student attitudes towards math and mindset as mathematicians are paramount for retention and achievement in math (Hulleman & Harakiewicz, 2009;

Diagram 1-Appendix G



Harackiewicz et al., 2012; Dweck, 2006; Boaler, 2013). Furthermore, understanding and respecting student identities is central to achieving equity in math education (Aguirre, 2013).

Effecting this change in student attitudes are three related areas of focus: SMPs, meaningful discourse, and empowering instructional strategies. These areas each separately play a part in changing student attitudes and increasing student achievement (Bernander et al., 2020; IES, 2019; Durlak et al., 2011), but they are also highly interconnected and interdependent (Dana Center; Kentucky SEL; NCTM, 2014).

To support teachers in implementing these changes, MCM will provide lessons focusing on technology explorations, games, and investigations and embeds SMPs with *empowering instructional strategies* (Appendix K) (Bernander et al., 2020; Durlak et al., 2011). MCM topics, lesson activities, and problems will be chosen for their intellectual challenge and rigor highlighting connections between procedural and conceptual knowledge, and encouraging recognition of math opportunities in everyday events (IES, 2021; Gaspard, 2020). They will require something beyond a single algorithm, such as making connections across topics in math that require creative and divergent thinking (IES, 2018). Embedding the formative assessment process into MCM lesson activities will be central to achieving the above goals (Gerzon, 2020). The formative assessment process intends to center students as primary agents in the learning process. Students taking an active role in and ownership of their learning involves their ability to develop insights into their learning and to improve upon it (Dweck, 2006). Such inclusive ownership and self-assessment opportunities will impact lesson designs, encouraging teachers to be intentional about formative assessment techniques that not only elicit and use evidence of student thinking but also fosters responsibility for others learning as well as their own (Kobett et al., 2016). Implementing Building Thinking Classroom strategies, along with other strategies such as games, technology exploration, interactive group projects, etc., that will help create the conditions for students to engage in deep mathematical thinking and discourse.

Teachers will also be supported through 18 days of PL and a bi-county professional learning network (PLN). The PL will model *empowering instructional strategies* (Appendix K) approaches and present teachers with a growth mindset model of student learning to change teacher attitudes

toward their students (Chestnut et al., 2018). These teacher mindset changes will in turn allow their students to achieve more (den Bergh et al., 2010; Rattan et al., 2012; Jamil et al., 2018). This mindset has typically occurred in MRWC PL and has dismissed the belief that they, or especially their students, would be incapable of engaging in activities requiring high cognitive demand. The prevalence of this attitude is also clear from the literature (Ladson-Billings 1997, Lubienski 2002). At the same time, teachers must be willing and able to take advantage of the students' assets through a classroom discourse that shifts power to students and empowers their abilities (Hand, Nasir, Taylor 2008). A primary goal of the MCM PL will be to model classroom discourse which leaves the teachers (learning as students) empowered within their new teacher community.

These empowering instructional strategies will support a power shift in the classroom, centering students as primary investigators. Investigations built within platforms such as GeoGebra and Desmos will allow students to easily manipulate complex mathematical objects and discover patterns and properties which may or may not be planned or anticipated. Teachers, through the PL sequence, will experience a focus on the process rather than the practice of answer-getting (Delazer et al., 2005, IES, 2019). They will be equipped with strategies to engage students in learning relevant math (Gaspard, 2015). Students will use known procedures to explain math concepts as they integrate topics within a single problem to solidify conceptual understandings (IES, 2018). Finally, following the lead of Durkin and Rittle-Johnson (2017) students will discuss alternative strategies for solving a problem to enhance the development of flexibility and fluidity with the application of procedures to given problems.

Project Implementation Strategy. A collaborative team has already created dozens of activities as a significant first step toward what we will need for the 11th grade MCM course. We have tested these approaches with MRWC teachers during prior PL sessions. Table 1 discusses the MCM strategies that promote the development of essential skills for students to take action in their learning, becoming critical, engaged, and active doers of math.

Table 1. MCM Key Project Strategies (Appendix O)

1. **Professional Learning (PL)** will include development of the PL content and corresponding standards-aligned math lesson activities and resources with embedded SMP. The cross-segmental team of mathematicians from high school through university will conduct a pilot with an alpha cohort of teachers for beta testing starting Summer of

2024 (n=15) with 5 PL days. The project will be implemented with cohorts of high school teachers and coaches starting in the Summer 2025. Each PL cohort will include 18 days of PL. Subsequent cohorts of teachers and coaches will be added yearly (Cohort 1 = 30, Cohort 2-3 = 35). At least 100 educators will be trained over the 5-year grant period. This PL will incorporate hands-on experiences for teachers to reflect on their learning in addition to reflection on the learning of their students. Teachers will experience the content and pedagogical shifts from the student and educator lens as presenters model effective teaching practices.
2. **Professional Learning Network (PLN)** will support the professional growth of teachers and coaches beyond the 18 days of PL by creating and supporting a bi-county professional learning network. This will be modeled off MRWC's successful PLN, where teachers and coaches continue PL and collaboration through an online platform and regular meetings via Zoom and in person. The impact of MRWC's PLN on individual educators' professional growth can be seen in the letters of support written by teachers and coaches (Appendix C). MCM will allow teachers and coaches an opportunity to build leadership capacity in the IE region by implementing a TOT model. TOTs will lead PLN sessions to support a shared leadership environment and sustainability post-grant funding.
3. **Administrator PL** is key to implementation to a successful initiative. We will support principals as "lead learners" at LEA school sites (McKibben, 2015), developing their capacity as instructional leaders in the transition to MCM strategies. MCM leadership will consult with principals and district leaders to develop a model for administrator learning, building off the successful MRWC administrator training. Through various engagement activities, administrators will deepen their understanding of math content, empowering instructional strategies, and pedagogical implications for effective teaching and learning. This will enable principals/administrators to more effectively monitor, evaluate, and support professional growth in their math teaching staff as well as improve their ability to interpret student achievement data on CA CCSSM and other assessment tools measuring college readiness.
4. **Counselor PL** and engagement is critical, as we have learned over the last 5 years. As the teaching style in MRWC and MCM are different from traditional math courses, students are often uncomfortable and rush to switch to a more traditional style of math instruction. If the counselor has a strong understanding of MCM philosophy and foundation, we believe it will reduce the number of students allowed to transfer out of the courses, as we have seen with MRWC counselor engagement. This student quote illustrates some students' uncomfortableness with the teaching and learning style of MRWC and MCM, "*I would have said no, don't do this class, because I didn't understand it. But now I'm like, yeah, you should, because it helps a lot with other stuff, too."*
5. **PL Trainer Certification** will support the districts' adoption of MCM, and to accommodate and support the ever-growing cadre of teachers who teach MCM each year, we will develop a PL certification program modeled closely on the CSU ERWC model (USDOE i3 and EIR funded) that has allowed for wide dissemination and adoption of the 6th -12th grade English curriculum and strategies throughout the West Coast. All PL trainers will go through a certification process. PL sessions will be delivered collaboratively with at least one postsecondary faculty member and a certified K12 trainer. This allows for better alignment between K12 and postsecondary.
6. **Training-of-Trainer Model (TOT)** will be employed to help support the sustainability of ongoing PL. As the cadre of teachers grows within schools and districts, a larger network of peer support for ongoing PL enables sustainability through an MCM TOT certification
7**. Technology Integration** - Technology strategies will be infused into the PL to enhance the learning and engages teachers and students in the formative assessment process. Technology integration will also help with absenteeism. Technology will be used to support the engagement of students in a more robust, creative, and playful medium. Specifically, we will teach MCM participants, through modeling during PL workshops, how to incorporate Desmos and GeoGebra into their courses. These platforms run on any modern browser with no downloads or installs. They run seamlessly on iPhones, iPads, Android phones, and Windows touch devices.

B. 2. Goals, objectives, and outcomes are clearly specified and measurable.

Goals, Objectives, and Measurable Outcomes. For the five-year project, we will accomplish the following goals, objectives, and measurable outcomes. The **primary goal** of this project will be to **provide development, implementation, and initial impact research that will contribute to the**

knowledge base of teaching practices and student learning in secondary math. Two smaller goals will focus on the two participating populations of the project: teachers and students, to support primary goal achievement. The **overall goal for teachers** will be to **improve teacher instruction, pedagogical skills, and content knowledge through continuous PL and a supportive PLN focused on inclusive and responsive lesson design** that incorporates SMP, productive mathematical discourse, formative assessment, Building Thinking Classroom strategies, and investigation through technology (Referred to in this proposal as, empowering instructional strategies, see B.1 section) (Appendix K). The **overall goal for students**, **especially those of high need, is to improve student math performance, perception of their math abilities, and confidence for taking a 12th grade math course in preparation for college-level math courses.**

Table 2. Project Goals, Objectives, and Targets (Appendix P)

<u>Program Goal #1:</u> Improve teacher instruction, pedagogical skills, and content knowledge through continuous professional learning.
Objective 1a: Increase the level of math subject-matter competence in participating MCM teachers.
Expected Outcome 1a: Target teachers will report significantly higher levels of subject-matter competence upon completion of PL and utilizing the MCM practices in their classrooms for a year compared to control teachers, as measured by pre-post math Habits of Mind (MHoM) paper and pencil assessment.
Objective 1b: Increase the number of participating teachers utilizing "core practices": discourse, student-led inquiry, mathematical connections, and SMPs in their math courses as measured by M-SCAN.
Expected Outcome 1b: Target teachers will be observed to have a significant increase in utilizing "core practices" directly after finishing the MCM PL and after a year of teaching based on their pre-post Measure of Standards-based Mathematics Teaching Practices (M-SCAN) scores.
Objective 1c: Increase the level of teacher professional confidence to teach advanced math content and prepare students for college-level math.
Expected Outcome 1c: Target teacher professional confidence to teach advanced math content and prepare students for college level math will increase by at least 5% when comparing their perception before MCM participation and upon teaching for at least a year, as measured by MCM Teacher survey.
Objective 1d: Increase positive perceptions of MCM implementation and its impact on student math achievement and learning motivation.
Expected Outcome 1d1: Target teachers will report significantly higher perceptions of the positive impact of the various components of MCM on student math achievement following a full year of delivery of MCM strategies and content, as measured by MCM Teacher survey.
Expected Outcome 1d2: Target teachers will report significantly higher levels of student learning engagement with MCM following a full year of delivery of MCM strategies and content, as measured by MCM Teacher Efficacy survey.
<u>Program Goal #</u>2: Improve student math performance, perception of their math abilities, and confidence for taking college-level math courses as they pertain to math performance.

Objective 2a: Increase participating student academic achievement in math.
Expected Outcome 2a: Target students who complete a course taught by an MCM teacher will demonstrate a significantly higher math achievement compared to students in other secondary math courses (control group), as measured by overall scale score on Grade 11 SBAS assessment and higher performance in Problem Solving and Communicating Reasoning areas of the assessment.
Objective 2b: Increase student self-reported learning motivation for math and perceived confidence with advanced mathematical content.
Expected Outcome 2b: Target students will report significantly higher levels of learning motivation and perceived confidence with advanced math curriculum following completion of a course taught by an MCM teacher compared to students in other secondary math courses (control group) as measured by MCM student math perception survey.
Objective 2c: Increase student enrollment and success in fourth year math course, following completion of the MCM course in 11th grade.
Expected Outcome 2c: Target students will demonstrate significantly higher levels of enrollment and success in fourth year math courses following completion of a course taught by an MCM teacher compared to students in other secondary math courses (control group) as measured by grade 12 course enrollment and grades.
Program Goal #3: Increase the number of Inland Empire teachers receiving MCM training and the number of students successfully participating in coursework taught by MCM teachers.
Objective 3a: Provide PL for math teachers from target schools in Years 2-4 of the grant.
Expected Outcome 3a1: Up to 35 teachers from target schools will receive MCM training in Years 2-4 (fully operational cohorts) of the grant, with at least 100 teachers trained by the project completion.
Expected Outcome 3a2: At least 85% of target group teachers will attend 100% of the planned PL.
Expected Outcome 3a3: At least 85% of teachers will be satisfied with the PL and coaching support provided by the project and its ability to improve their mathematical teaching practices.
Objective 3b: Increase the number of students who successfully participate in a course taught by an MCM teacher in Years 2-4 of the grant.
Expected Outcome 3b: At least 750 students annually will participate in a course taught by an MCM teacher in Years 2-4 of the grant, with at least 3,000 served by project close.
Program Goal #4. Provide professional learning to coaches, counselors, and principals (or other district administrators) to enable greater understanding of the nature of MCM, goals of the project, and to develop school principals/district administrators as instructional leaders in math.
Objective 4a: Provide PL and collaboration opportunities on MCM to target school principals, coaches, counselors, and district administrators.
Expected Outcome 4a1: At least 75% of principals, counselors, and previously-trained coaches from target schools will attend a professional learning meeting on MCM.
Expected Outcome 4a2: 85% of newly trained coaches will attend 100% of the planned PL.
Objective 4b: Increase administrators and coaches' ability to recognize the SMPs, productive mathematical discourse, Building Thinking Classrooms strategies, formative assessments, and understand how students can engage in mathematical thinking across various high school curricula.

Expected Outcome 4b: By project close, at least 20 coaches, principals, and counselors who participate in additional MCM PL opportunities beyond the initiation meeting will be able to recognize the use of and explain the effectiveness of the SMPs, productive mathematical discourse, Building Thinking Classrooms strategies, and formative assessments used in MCM teachers' daily lessons.
Program Goal #5. Using a train-the-trainer model, develop at least 10 teacher leaders who are certified in provision of the MCM PL curriculum for on-going support and dissemination to district teachers.
Objective 5a: Develop a MCM PL trainer certification workshop to support district adoption and sustainability of ongoing implementation of the MCM strategies and content through teacher PL.
Expected Outcome 5a: At least 10 teacher leaders will attain certification to provide PL to teachers by project end.

B. 3. Project design successfully addresses the needs of the target population.

The Inland Empire Region Overview. The *Inland Empire* region (IE) collectively has 172 rural, suburban, and urban K12 students in traditional and alternative education high schools. Each county has a majority Latinx population (51.6%; 55.8%), along with significant Black (7.5%; 9.4%) and Asian American (7.5%; 8.5%) populations (U.S. Census Bureau, 2022). Our students are predominately high-need (over 71% on free or reduced lunch); many attending high-minority schools (RC student population is 81.1% non-white and SBC is 83.9% non-white), with high population of students who are currently, or were previously, classified as English Learners (RC: 35.2%; SBC: 32.5%). Far too many of our students do not graduate high school within four years (RC: 9.4%; SBC: 19.2%). Based upon 2022 California's Smarter Balanced Assessment System (SBAS) test results, less than 7% of Grade 11 students in the IE received a score indicating they were prepared for the rigor of college-level math courses.

By 2030 up to 43% of all jobs will require some postsecondary education (Growing Inland Achievement, 2020). Despite this, a recent 2020 Lumina Foundation report states that, of the 25 largest urban areas in the nation, the Riverside and San Bernardino Counties have the lowest percentage (27.2%) of adult residents with postsecondary degrees. This is impactful. For instance, within the region the average income for a high school diploma is $53,474 but earnings with a college degree is $86,446. A college degree has become even more important in the national COVID-19 job recovery landscape. In March 2021, over 900,000 jobs returned to the economy, with only 7,000 going to adults with no college degree (Long, 2021). Therefore, within RC and SBC, college completion is a critical concern for community economic potential, and we would like

an opportunity to intervene. In this environment, our local postsecondary institutions face a difficult challenge. Recognizing this project's importance, some of our content writers come from CSUSB and CBU, Chaffey, and RCC, all minority-serving institutions in IE (CPP1).

Importance of High School Math. High school math is central to solving this problem (TNTP, 2018). Several studies indicate that high school students with chronic math achievement problems are less likely to enroll in college after graduating (Woods, et al., 2018; Adelman, 2006; Schneider, 2012; Adelman, 1999). Moreover, those with low math achievement that do enroll are less likely to persist (Trusty. J & Niles. S, 2004). Byun et al. put it bluntly: "MATHEMATICS IS A GATEKEEPER for future educational and occupational opportunities" (2015). The effect of succeeding in math is stronger than that of high school test scores, grade point average, socioeconomic status (SES), and race/ethnicity. Many of the IE region's high school students struggle with high school math, very few graduate college-ready in math, and the majority of those that continue are behind and lack mastery or true understanding.

MCM will emphasize math practices and pedagogy to a critical juncture for 11th grade high school students in the IE. CA only mandates a minimum of 2 years of math for high school graduation, while admission to CA State University (CSU) requires at least three years of math. Students who do not complete their 3rd year of math, therefore, limit their future postsecondary opportunities and commit to the community college pathway. In 2020-21 over half of high school graduates in SBC did not meet the minimum requirement for admission to CSU or UC (SBCSS Open Data Portal). The promise of transferring from a community college to a four-year university remains unfulfilled for many as the transfer rates for community college students in the IE remain meager (21% 4-year transfer rate for 2015-16 Cohort for all IE CCs; 25% 6-year transfer rate for 2013-14 cohort) (CalPASSPlus).

Our team will include key members representing both RC and SBC County Offices of Education, numerous school districts, regional community colleges (CPP1), CSUSB, and CBU, many of whom have been working together in a focused manner on i3 MRWC since 2017. The lead content development experts on our team are [redacted], PhD (CSUSB) and [redacted], PhD (CBU) (see description of responsibilities in Table 3 and resumes in Appendix B).

Target Students. The target audience for MCM is predominantly students from underrepresented groups and low-income backgrounds in traditional and alternative education high schools (See letters of support from high schools in Appendix C). The project will serve over 3,000 high need students over the 5 year grant in the IE region. By creating pedagogical shifts and rigorous, student-centered, engaging lessons in the grade 11, we can increase equitable access to higher-level math courses at the collegiate level and open pathways into math and other STEM fields for females, Hispanic/Latinx, African-American students, and other underrepresented populations.

Target Teachers. The primary target teachers for MCM are in schools and districts with high percentages of disadvantaged students (71% FRL), who are struggling with high school math. MCM will develop proficiency, deepen math understanding and math habits of mind (Cuoco et al., 1996), along with metacognitive skills and study skills, and increase math efficacy among students and teachers in high school math (Wade et al., 2018).

Teacher and Instructional Coach Professional Learning. Due to the innovative pedagogy, our project strongly emphasizes shifting teacher mindsets around how math is taught. To achieve implementation with efficacy and ensure the teacher and instructional coach outcomes are achieved, teachers will participate in a rigorous PL sequence that will be delivered over 18 days (McCray, 2013; Yoon et al., 2007). The PL will be focused on enhancing key math content, SMP, productive mathematical discourse, formative assessment, Building Thinking Classrooms strategies, investigation through technology, knowledge and beliefs for teaching math, self-efficacy for teaching math (Tschannen-Moran & Hoy, 2001), and pedagogical fluency. The teachers and coaches will continue to work collaboratively throughout the academic years in a larger PL Network monthly with postsecondary faculty, teachers, coaches, and CDIT members. This will also result in dissemination of the pedagogy to lower course levels.

C. QUALITY OF PROJECT PERSONNEL

A diverse and comprehensive personnel group has been established to implement the MCM project. Our members represent groups that have been traditionally underrepresented and have extensive experience working with individuals from various races, gender, age, disability, and

socioeconomic levels, all of which accurately reflect our current student population. The MCM team, with over 50% of team members represented from underrepresented groups including, African American, Mexican-American, Latinx, Chinese American, or multi-racial, is focused on inclusion and equity and ensuring all students and teachers receive support and resources needed to be successful. See Appendix R for a full description of diversity, equity, and inclusion to ensure the team accurately reflects the communities we serve.

RCOE currently provides educational and administrative support services to 23 school districts and over 431,000 students in highly diverse Riverside County, California, and serves as an intermediary with the California Department of Education (CDE). RCOE collaborates with districts to ensure the success of all students by assisting with implementation of high-quality educational programs and successfully operates early learning, preschool, special education, vocational, migrant, alternative, and dropout recovery programs. RCOE's mission is to ensure the success of all students, and has a deep commitment to employing persons from diverse groups.

Staffing Plan. A team of experienced professionals will implement the project within efficacious timelines and allocated budget. RCOE and partners have staff in place to start immediate planning; many of these staff have been working collaboratively since 2017. All staff have relevant training and experience (See resumes in Appendix B). RCOE, as the fiscal agent, will be responsible for all aspects of the project oversight and coordination, including recruiting and retaining schools, teachers, and students, monitoring implementation fidelity, oversight of continuous improvement plan, and collaborating with the external evaluator. A RCOE fiscal manager assigned to the grant will conduct ongoing fiscal support and monitoring. This fiscal manager will work closely with the MCM team to monitor the budget, and expenses, ensure at least quarterly drawdowns are made, and assist with required fiscal reporting.

Based upon the needs of the project and partners, additional matching support from RCOE may include the Assessment, Accountability, and Continuous Improvement Unit for student data and test scores; the College & Career Readiness Unit for financial literacy support and college resources; the Equity and Access Unit for support, resources, and training to ensure recruitment and project diversity; IT resources and support for online learning; the Leadership Wellness & Student Services

Unit for student mental health and wellness services; the Alternative Education Unit to support alternative education students who are enrolled in MCM; and the Student and Program Services Unit to support foster youth, migrant education, and special education students. Other key team members are listed in Table 3 and in Appendix B.

The proposed project will be achieved through strict monitoring imposed and facilitated by Leadership led by the Project Director. The Math and PL Content Development and Implementation Team (CDIT) will meet twice a month for the first two years and monthly in years 3 - 5. Leadership will meet weekly and twice a year with the Advisory Committee to ensure all grant activities, goals, and requirements are on track (Tables 3 - 5). RCOE has the capacity, infrastructure, and ability to oversee, implement, and lead coordinated MCM efforts to increase bi-county collaboration and communication to maximize resources leading to increased student achievement.

Table 3. MCM Key Team Members Roles & Responsibilities (Appendix Q)

Title	Members/Orgs.	Role & Responsibilities
LT-Leadership Team	[redacted]	Team will meet weekly to ensure on-track project management, implementation, communication with other partners, maintaining MCM commitment, recruitment of districts, sites, and teachers, presentation of reflection and evaluation data, capacity building and project implementation oversight and management.
Project Director/ Leadership Team Member	[redacted], EdD, RCOE (.1 FTE Matching)	Serve on the leadership team. Supervise and support project manager, provide high-level administrative oversight of EIR administration, compliance and fiscal oversight to ensure project goals and outcomes are successfully achieved on time and within budget. Advocates for MCM with District Superintendents.
PM/DD-Project Manager/ CDIT/Leadership Team Member	[redacted] PhD, RCOE (1 FTE)	Serve on the leadership team. Responsible for daily operation. ensure consistent, timely communication, feedback to all partners. Manage/maintain project budget, and documentation to ensure fiscal compliance, with RCOE fiscal team. Secure and maintain contracts from partners, maintain cooperative relationships with partners, including the external evaluator. Communicate objectives, progress, and outcomes of the grant to Project Director, and other stakeholders, disseminate results at state and national conferences, and facilitate recruitment of target and control sites. Work with colleges, universities, and CA Dept. of Ed. to advocate for MCM strategies and content to be offered widely across CA, including preservice math teachers. Analyze basic data and complete reports in accordance with program guidelines, summarize results for stakeholders and oversee and facilitate the CDIT. [redacted], who has been a part of multiple 5th - 12th grade math curriculum development teams, will oversee/manage the Math and PL content development to ensure on time delivery.

COE Administrators/ Leadership Team/PL and K12 Pedagogy Experts	[redacted] (RCOE) (.2 FTE/.2 FTE Matching) and [redacted] (SBCSS) (.25FTE)	Serve on the leadership team. Lead PL and TOT content creation, K12 math standards experts, and primary point of contact for recruitment high schools in their respective counties. They will support the identification of appropriate diverse sites, collaborate in development of MOU's and data sharing agreements, communicate with superintendents, principals, counselors, coaches, and teachers and support the growth and development of participating instructional coaches. They will also serve as members of the CDIT.
AC- Advisory Committee	Leadership Team, teacher, instructional coach, counselor, site and central office administrator, parent & student representative	The Advisory Committee is composed of leaders from many partner institutions. As such, they are individually and collectively able to facilitate the implementation of this project across the region. Provide high- level policy/political support. Advocate for MCM strategies and content to be offered widely across CA, including preservice math teachers, and changes to math teacher PL opportunities. Align and mobilize additional resources for support of this project. Coordinate across their respective organizations to avoid unnecessary competition or duplication of effort. Support MCM's sustainability.
Math Content Development Lead/Co-lead	[redacted], PhD (Lead) and [redacted] (Co-lead)	Lead/Co-lead will provide guidance to the CDIT members about math content, postsecondary math content alignment, standards, and policy. [redacted] will have primary responsibility for the math content development. [redacted] is an internationally recognized expert on the investigation of new axioms for math, having published in top-ranked journals in math logic. [redacted] has published in top journals in his field and been directly involved in high school education by teaching AP and SAT courses.
ETA - Education Technology Advisor	[redacted], Coordinator- Ed. Technology, RCOE (.1 FTE Matching)	Will support leadership in ensuring best practices of educational technology are embedded in MCM lessons and PL series, provide support and resources for effective implementation. [redacted] will also serve on the CDIT as a content developer.
CDIT: PL and Math Content Development & Implementation Team	Leadership team, plus [redacted] (Chaffey), [redacted] (RCC) [redacted] (CSUSB), [redacted], (CBU); [redacted]	The CDIT members are all experienced math educators, representing K12 and postsecondary with combined 280+ years of experience. Over 50% of the CDIT identifies as Latinx/Hispanic, African-American, or Multi-racial. CDIT will work collaboratively to complete the math content, PL, and TOT certification materials, as well as deliver the PL sessions. They will provide on-going coaching and support to the teachers and coaches, and to the certified PL trainers. They will also conduct the orientation workshops with site and central office administrators and counselors. K12 teachers will support with content review and feedback. The CDIT team will work collaboratively with the evaluator where appropriate. Additional teachers, coaches, and/or postsecondary faculty will be contracted with if funded.
AS- Administrative Support	[redacted], RCOE (.25 FTE/.25 Matching)	Responsible for daily support for MCM to help plan and coordinate trainings and events, complete required paperwork, communicate with partners, and general administrative support.
GO- Grant Oversight	[redacted], GPC, RCOE (.05 FTE)	Certified Grant Administrator who will provide grant support and resources to ensure effective implementation and compliance. The grant oversight will also assist the MCM team with the required USDOE trainings, dissemination of results, reports, and annual reporting.
EE- External Evaluator	[redacted], PhD, Impact Research	Responsible for research design, instrument development, appropriate assignment to condition and matching, data collection, analysis, and reporting as outlined in the evaluation section. Collaborate with the national evaluator and US DOE. Will attend CDIT and Leadership meetings as needed. Over 15 years of experience in evaluation, data analysis, and research.

D. QUALITY OF MANAGEMENT PLAN

Management plan to achieve project objectives on time, timelines, and milestones.

The management plan and timeline have been developed based on research, lessons learned from previous projects, and the needs of partners and participants.

On Time and Within Budget. In order to ensure the project is implemented efficiently, on time, and within budget, we have enlisted a team of professionals and experts in the field as described above in section C and in Resumes. Led by [redacted], PhD, the team has collaborated on a successful i3 implementation on-time and within budget, meeting all 15 out of 15 performance measures. The Business Office will monitor the budget monthly to ensure the project stays within budget. RCOE has successfully administered various competitive grants exceeding $800 million over the past five years. RCOE has administrators and staff in place who can start immediately. The CDIT has already begun crafting lessons and obtaining feedback from teachers. Over double the matching funds have been committed to greater leverage US DOE funds (Appendix H).

Organizational, Administrative, and Fiscal Capacity- With over 125 years of successful education history, RCOE is highly experienced in providing effective programs and services, operating state and federal grants, and serving students, families, and the community. RCOE currently provides educational and administrative support services to 23 school districts and over 435,000 students and serves as an intermediary with the CA. Dept. of Ed.

Fiscal and Administrative Controls in Place. RCOE operates a fund-based government financial accounting system with a secure financial condition due to the strong management of its resources and rigorous internal controls. Clear and consistent policies/procedures have annually yielded passing audits and budget approval by the Board of Education. RCOE has administrative regulations, policies, and procedures to incorporate the requirements set forth under Uniform Grant Guidance, fiscal and administrative controls, and a Certified Grant Administrator in place to manage federal funding effectively and efficiently.

Clearly Defined Roles and Responsibilities. The management plan is three-tiered for effective partnership management and to ensure those closest to the work have a voice. See Table 3, Table 4

and Appendices Q and R for Roles & Responsibilities for roles and responsibilities to ensure effective collaboration and implementation.

Table 4. Three-tiered Effective Partnership Management Structure (Appendix Q)

Tier 1: Leadership	Meet weekly and is the working group responsible for project implementation. This team will be responsible for strategic planning, key components, benchmark goals, assessments as well as working with the evaluation to determine project effectiveness.
Tier II: Math and Professional Learning Content Development and Implementation	Meet bi-weekly for the first two years and monthly in years 3 - 5 to discuss math and professional learning content development, recruitment, progress towards goals and objectives, and to reflect and adjust off feedback and data collected from participants. Small subsets of teams will meet weekly over the first year as the math and PL content is created.
Tier III: The Advisory Committee	Composed of representatives from all major partners and stakeholders, including parents, students and teachers, will meet twice yearly to discuss progress towards project goals and objectives.

Project Timeline and Milestones. Numerous critical tasks, activities, and milestones must be coordinated and executed at key points for effective implementation of our project plans. Key milestones include: We provide detail concerning the implementation strategy, with key milestones, tasks, and activities with corresponding timelines in Table 5. *Below is a modified timeline of tasks/milestones for Years 1 – 3, with corresponding lead team members. Years 4-5 will follow Year 3 timeline with Year 5 including summative evaluation and dissemination and sustainability plans.* ***Full Implementation Tasks/ Milestones description and Timeline for Years 1-5, with corresponding key members can be found in Appendix S.***

Table 5. Implementation Tasks and Key Milestones Timeline

Ledger: Q-Quarter, ON- Ongoing, A-Annually. **Key Terms**: AC- Advisory Committee, CDIT- Math and PL Content Development & Implementation Team (Includes CDIT Director), CT-Control Teachers, DD-CDIT Director, EE-External Evaluator, GO- Grant Oversight, PD-Project Director, PM-Project Manager, PD/M-Project Director and Manager, RC- Riverside County, SBC- San Bernardino County, TT- Target Teachers, TOT- Training-of-Trainers

Infrastructure & Reporting Milestones, Tasks, & Activities	Lead	2024	2025	2026
Finalize CDIT List and confirm commitments and responsibilities	PD	Q1		
Implement regular CDIT, Leadership, Advisory Committee meetings	PD/M	ON	ON	ON
Finalize partner roles & responsibilities, management plan	PD/PM	Q1		
Create and implement project management documents	PM	ON	ON	ON
Determine document sharing platform, and appropriate access	PM	Q1		
Prepare monthly update reports	PM	ON	ON	ON

Alpha MOUs created and signed	PD	Q1/Q2		
Creation of Cohort 1-3 MOUs	PM	Q3		
Prepare quarterly reports	PM/GO	ON	ON	ON
Prepare and distribute yearly implementation report for all partners	PD/PM		Q1	Q1
Prepare and submit APR	PM/EE/GO		Q1	Q1
MOUs signed by Target Teachers (TT) and / Control Teachers (CT)	PD		Q2/Q3	Q2/Q3
Attend Project Directors Convening	PD	Q4	Q4	Q4
Develop/finalize dissemination plan, present preliminary/final results-Y4/5	EE			
Develop/Finalize sustainability plan (Y3/5)	PD/AC			Q2
Planning & Implementation Milestones, Tasks, & Activities	**Lead**	**2024**	**2025**	**2026**
Develop math content Theme I & PL content for Alpha (Began pre-award)	CDIT	Q1/2		
Recruitment of Alpha teachers to beta test MCM Theme I	CDIT	Q1/2		
PL sessions – Alpha Cohort	CDIT	Q3/4		
Alpha Cohort pilot implementation of Theme 1 content only	CDIT	Q3/4		
Recruitment of TT	CDIT		Q1/2	Q1/2
Develop math content Themes 2-3 & PL content days 6-18	CDIT	Q4	Q1-2	
Cohort PL Sessions- 18 days per cohort- minimum of 35 teachers/cohort	CDIT		Q2-4 (C1)	Q1(C1) Q2-4 (C2)
TT implement MCM in classrooms	CDIT		Q3/4 C1	Q1/2(C1) Q3/4(C2)
Monthly PLN meetings	CDIT		Q4	ON
Develop TOT content	CDIT		Q3/4	
Train/certify TOT	CDIT		Q1/2	Q1/2
Continuous Improvement & Evaluation Milestones, Tasks, &	**Lead**	**2024**	**2025**	**2026**
Participate in EIR CoP's and trainings	PM/GO	ON	ON	ON
Development of data collection instruments/protocol	EE	Q1/2		
Secure Alpha informed consents	EE	Q3		
Alpha observations & data collection	EE	Q3/4		
Mid-implementation interviews/surveys with Alpha teachers and students		Q4		
Post focus group interviews/surveys with Alpha teachers and students	EE	Q4		
Refinements made to Theme 1 math and PL content off Alpha feedback	CDIT	Q4	Q1	

Secure informed consent; pre-surveys, test data collection	EE		Q3	Q3
Evaluation data collection, post-surveys/test data collection	EE			Q2
Train TT & CT on in-class data collection pre/post- surveys/test	EE		Q3	Q3
TT classroom observations and data collection	EE		Q3/4 C1	Q1/2(C1) Q3/4(C2)
Post MCM interviews with students, teachers, and coaches	EE			Q2
Edits, adjustments, and refinements of math and PL content based on feedback.	CDIT		Q3/4	Q1-4
Yearly review of pre/post student and teacher surveys	CDIT			Q2
Yearly review of SBAS data to determine adjustments needed	CDIT			Q3
Preparation of summative evaluation and reports (Y5)	EE			

Procedures for Feedback & Continuous Improvement. The MCM project has numerous processes and procedures that it will use for effective and efficient feedback to support continuous improvement. Data-driven decision-making is critical to project success. We will utilize data collection and review procedures for all project activities. For example, we will collect online survey and reflection data for all PL workshops, PLN sessions, and meetings. We will also collect lesson reflection surveys. These surveys are reviewed after each session to provide feedback and continuous project improvement. We will use multiple ongoing monitoring and assessment methods to adjust to real-time participant feedback. We will also interview students yearly to collect feedback for future adjustments. The leadership team will collaborate closely with the external evaluator and meet at a minimum quarterly to discuss the state of the evaluative efforts. (see Section E and Appendix T for in-depth content).

Recruitment. The team will work to ensure teachers and coaches recruitment is diverse and equitable and meets the participant requirements. Fifteen teachers will participate in a pilot (Alpha) cohort exposed to several components of the developing MCM course, providing feedback and vetting of the materials as they are developed in year 1 of the grant. After the initial pilot cohort, the plan is to recruit at least 30 teachers for the fully operational cohort #1 (starting in year 2) and 35 teachers for each of the fully operational cohorts 2 and 3 (starting in year 3 and 4). (Cohort 1 = 30 will participate in Years 2 & 3; Cohort 2-3 = 35 each will participate in Years 3 - 5). RCOE and

SBCSS have close existing relationships with 23 school districts and 73 high schools through the i3 funded MRWC implementation. As the MCM grew out of MRWC teachers and students requesting an 11th grade course be created, we have confidence that many of the districts and high schools will participate in MCM. We have a list of teachers and schools who already want to participate in MCM if we are able to secure funding. See Appendix C for MCM letters of support from some of these districts and teachers of their support of MCM.

CDIT members will immediately begin outreach to IE schools and districts to discuss engagement, if awarded. Recruitment of Alpha Cohort for beta-testing previously written lessons and corresponding PL has already begun. Cohort 1 training will begin in Spring 2025, giving ample time to recruit the initial cohort of 30 teachers and coaches while the CDIT finalizes the MCM curriculum and corresponding professional learning content during 2024. Control teachers will also be recruited to participate. Control teachers will receive $500 worth of school supplies to participate. Control teachers will also be given first priority to participate as target teachers in subsequent years. These were successful strategies used to help recruitment control teachers who became target teachers during the successful MRWC implementation. The Leadership team will monitor recruitment efforts at weekly leadership meetings.

Providing Insights in Education and Disseminating work. The findings and implications of this research project will have the ability to provide better insights into teacher characteristics that contribute to student success in secondary and postsecondary math. The external project evaluator will prepare in-depth written and oral presentations of findings at the end of each funded year and upon grant completion. Additionally, [redacted] (external evaluator) will work closely with the MCM team to prepare one or more articles for presentation at national and state conferences (such as NCTM and/or CA Educational Research Association conferences) and at least one publication to a peer-reviewed journal. Such publication will add to replication efforts by giving this project wider exposure to a professional and academic/scientific audience.

For greater impact, we will engage in policy advocacy across the state of CA. If our belief is correct that MCM content/strategies in 11th grade math courses prepare students to be successful in college math at matriculation, the evidence we collect will be used to advocate for MCM teaching,

learning strategies, and content to be offered widely, including preservice teachers and changes to math teacher PL opportunities. We feel an urgency among our partners to work together to overcome this long-standing problem with low math achievement in our region.

E. QUALITY OF PROJECT EVALUATION

E. 1. Evidence that Would Meet the What Works Clearinghouse Standards.

Impact Research Consulting (IRC) will lead the project evaluation. IRC is a woman-owned small business that conducts educational research, consultation, and systems development, with over 15 years of experience in the field. IRC has extensive experience in conducting project evaluation on various federal and state-funded grants, including evaluating two i3 grants in the past.

The logic model hypothesizes how the professional learning model can improve student math performance and teachers' mathematical habits of mind, empowering instructional strategies, and content knowledge. IRC will independently test these hypotheses to study MCM implementation and impact on teacher and student outcomes across over 100 Inland Empire classrooms. The research design will use valid and reliable outcome measures and industry-standard analytic methods that will ensure that the study will allow us to meet What Works Clearinghouse Standards (v. 4.1), with reservations.

Key Evaluation Components. The proposed evaluation will be a mixed-methods study with two components: 1) program implementation fidelity analysis and 2) impact analysis of project effectiveness for teacher and student outcomes using a quasi-experimental, comparison group design to draw causal inferences about the effects of MCM on students and teachers. The implementation study will examine facilitators and barriers to high-fidelity implementation and provide continuous feedback to the project leadership to improve program development and implementation fidelity. The impact study will be a quasi-experimental matched comparison group design that will assess the impact of the MCM on students' high school math achievement, college readiness, grade 12 math course enrollment and success. The impact study will use valid and reliable outcome measures. In addition to the main impact analysis, we will study variation in

program effects across student and school demographic characteristics, fidelity of implementation levels and teacher experience and contextual factors (covariates and mediators).

Participants. The primary target population will include approximately 3,000 11th grade students taught by 100 MCM teachers. There will be approximately 30 student participants in each teachers' classrooms, for a total of 3,000 student participants. Control sample will include approximately 2,000-3,000 grade 11 students from high schools in neighboring schools or districts that did not receive treatment or participation in MRWC. Target and control students will be matched on average grade 10 math grade earned, gender and ethnicity using propensity score matching techniques. IRC will conduct baseline equivalence testing on demographic and outcome data gathered at baseline, including grade 10 math grades and demographic variables. This study design should have adequate power (using a two-tailed test at a 5 percent significance level with 80 percent power) to detect the MCM project effect on outcomes and yield a Minimal Detectable Effect Size (MDES) of .10 (Hedges' g) after four years of data collection for student outcomes. Our proposed sample of at least 3,000 target and about 3,000 comparison students should have adequate power to detect an effect of this size. The teacher sample (100 at target schools and 100 at comparison schools) should yield an MDES of 0.4 (Hedges' g).

Leadership and the external evaluator will closely monitor attrition (teacher and student-level). We define teacher attrition as teachers who, after attending MCM PL project, do not implement the content in their 11th grade math classes or do not submit end-of-course student or teacher data. Based on this team's experience working with schools on a previous i3 project (Grade 12 MRWC course), we expect such teacher attrition to be less than 5% in any given cohort year. Student attrition will be defined as students dropping the grade 11 math course, after being assigned to a target teacher's 11th grade math classroom or not completing the student measures. We expect such attrition to be minimal as well. Students will be participating in the grade 11 math courses (and will participate in the impact evaluation) as part of their regular school attendance. All CA schools require Grade 11 SBAS math assessments for accountability purposes, so the majority of the enrolled grade 11 students will take them. Student surveys will be administered during regular class time. Based on student retention rates in our senior-level MRWC classrooms in previous years, we

anticipate a student attrition rate from the project of less than 5% due to dropping the class or leaving the school, with an additional attrition rate of 5% for students who refuse to complete the survey measures.

Data Sources. The methods of evaluation will be aligned with the goals and objectives of the project, including the performance measures, research design, data collection, and analysis. The evaluation will use multiple measures with several sources of data (e.g., SBAS math scores, grade 10 math grades, student math perception surveys, MHoM teacher assessment data, M-SCAN teacher observation data, MCM teacher fidelity surveys, teacher and principal perception surveys among the quantitative measures, as well as feedback surveys collected during MCM PL, standardized observation forms and teacher and student interviews).

Table 6. Implementation and Impact Research Questions (Appendix T)

#	**Implementation Research Questions**
1	Were the planned number of teachers, coaches, principals, and counselors successfully recruited? What challenges or obstacles to recruitment were encountered and how were they overcome?
2	What proportion of MCM teachers are participating in all days of MCM PL?
3	What proportion of MCM teachers are satisfied with the PL and collaboration provided by the project and its ability to improve their math teaching practices?
4	What proportion of study teachers are implementing the MCM strategies and content with adequate fidelity as measured by MCM teacher fidelity surveys and observation forms?
5	Were the planned number of students enrolled in and completed a course taught by an MCM-trained teacher? What challenges or obstacles to recruitment were encountered and how were they overcome?
6	What proportion of students enrolled in a course taught by an MCM-trained teacher successfully completed it with a grade of C or better?
7	What proportion of school site principals and counselors attend the project orientation workshops?
8	Were the planned number of teacher leaders trained using the developed TOT model by project close?
#	**Impact Research Questions**
1	What is the impact of MCM on teachers' math content knowledge and teaching measured by the MHoM teacher assessment?
2	What is the impact of the MCM strategies and content on students' math performance and college preparedness measured by Grade 11 SBAS assessment?
3	What is the impact of the MCM strategies and content on students' enrollment and success in fourth year math courses measured by grade 12 math course enrollment and grades?

#	Covariates and Mediators
1	Does the impact of the MCM project on student math performance differ by student subgroups (SES, gender, EL status, ethnicity/race)?
2	How does fidelity of implementation of the MCM contribute to the observed effects on student performance, college readiness and grade 12 math enrollment and success?
3	How does teacher experience with the MCM strategies contribute to the observed effects on student performance, college readiness and grade 12 math enrollment and success (first-year MCM teachers vs experienced MCM teachers).

Impact Analysis Research Design and Analysis. A quasi-experimental comparison group design will be utilized as the most rigorous design possible given the constraints of field-based research within a K12 setting, such as those of equal access. Baseline equivalence analysis will be conducted on the MCM and control participants on the final matched sample to assure that both groups had comparable initial demographic characteristics and math achievement. We will confirm that baseline differences in student achievement and demographic characteristics between the target and comparison groups, measured in standardized effect size units, are less than 0.25. Baseline variables with baseline effect size differences greater than .25 will be considered non-equivalent. For baseline effect size differences between .05-.25 the analysis will include an acceptable statistical adjustment for the baseline characteristics to meet the baseline equivalence requirements (WWC 4.1, 2020). After matching is completed, the impact study will utilize a quasi-experimental comparison group design to assess the impact of MCM on student math performance, college math readiness skills and enrollment/success in fourth year math courses during the three years of the grant (2024-2027) and teachers math content knowledge and habits of mind. Impact data analysis for student math outcome will utilize Hierarchical Linear Modeling (HLM). Analyses of student results will consist of an intervention versus comparison, 2-level model with grade 11 students nested in teachers' classrooms (MCM schools vs comparison classrooms). This method was selected because students' performance within the same classroom is expected to be correlated. Thus, these correlations must be represented in the analysis. We will estimate the math achievement impact with a HLM model that includes covariates (the same that were used for matching) plus random effects for teachers/classrooms. We have chosen a random effects model to allow for greater generalizability and interpretation of teacher-level factors. Covariates will be grand-mean centered for analysis.

Effect sizes will be calculated using *Hedge's g* with the pooled standard deviation. A logistic model will be used for binary student outcomes (e.g., grade 12 math enrollment). Impact on teacher's content knowledge and mathematical habits of mind (MHoM) will be analyzed individually using a difference-in-difference comparative analysis. Difference-in-difference analysis will use a single pre- and single post-project score, and measure the impacts of the project as the average "difference in differences" between the target and comparison groups. These difference-in-difference models will produce an estimate of impact that represents the mean difference in pre-to-post project change for the two groups. We will infer impact if that estimate is significant and meaningful in magnitude.

Covariates and Mediators. Exploratory research will go beyond confirmatory impact analysis to determine not just whether the project is effective at improving identified student and teacher-level outcomes, but how the project works for different groups of students, and under what circumstances it is most/least effective. To assess the degree to which impact varies among students with different demographic characteristics, similar analyses will be conducted on sub samples of students who reflect different demographic indicators.

Additional formative pre- and post-test comparisons of psychosocial factors such as math efficacy, learning motivation, pedagogical competence, understanding of SMPs and teaching practices and the like will be conducted on the target students, teachers, coaches, principals and counselors, using the survey data collected as part of their respective involvement in the project. All proposed outcomes will be analyzed in Years 2-4 when the full cohorts of training/teaching occur. Several qualitative analyses are planned for Year 1 (interviews and focus groups) with Alpha cohort participants who will be trained on lessons as the content is being developed and provide their feedback for content improvement.

Outcome measures selected for the impact analysis are objective measures that are valid and reliable and not over-aligned with the intervention. These measures include standardized assessment scores (SBAS), a reliable and validated measure of high school math teachers' habits of mind (MHoM) and an observational measure of math teaching practices, with well-documented evidence of validity and reliability. Brief descriptions of the impact outcome measures and information on their validity and reliability evidence can be found in Appendix T.

MCM impact evaluation will answer three confirmatory and two exploratory questions. Confirmatory analyses will explore the impact of MCM on student math end-of-course math performance and college preparedness, student fourth year math course enrollment and success and teacher content knowledge. Exploratory analysis will examine whether the MCM impacts students differently based on their demographic characteristics and how implementation fidelity affects the MCM impacts. These subgroup analyses will only be conducted if there is an overall effect of the intervention on student performance.

E. 2. Evaluation will provide performance feedback and permit periodic assessment.

Implementation Fidelity Design & Analysis. The formative phase of the evaluation will assess the fidelity of implementation of the MCM strategies and content in 11th grade classes, including procedures necessary to ensure effective project management. The formative evaluation components align with the MCM project logic model and project timeline. The MCM logic model, Conceptual Framework (Appendix G), and Principals, Strategies, and Categories (Appendix N), illustrate the MCM project's key components as it is intended to be implemented. To monitor and assess the implementation process, the evaluator will attend a sample of planned meetings, PL sessions, and classroom observations and will receive copies of all attendance logs from all planned team meetings, PL sessions, orientation sessions, and regular (monthly) reports from the Project Director and Project Manager, PL and CDIT concerning progress on recruitment of schools, principals, counselors, etc., and on their curriculum/PL development activities. In Year 1, most student and teacher outcome data will not be available due to the continued PL model and content development. Year 1 annual data collection will focus on the content development and implementation.

The evaluator will review and analyze the implementation data from these sources and compare progress and compliance with plans, timelines, and achievement of the objectives planned for implementation. The evaluator will seek to understand and explain any deviations from plans and provide regular feedback to the leadership team to support continuous improvement and implementation effectiveness. The evaluator will prepare a detailed descriptive report concerning

the fidelity of implementation and provide a 'road map' of best practices and resource needs for future MCM replication.

As discussed above, IRC will prepare formative reports to examine which aspects of the project are implemented effectively. An in-depth oral and written presentation of findings will be made at the end of each funded year and upon completion of the grant through a summative report. The evaluator will also give periodic oral presentations of the findings to the relevant project stakeholders (leadership team, curriculum and PL development team, teachers /administrators). When possible, all results will be reported graphically and will target a specific stakeholder group. In collaboration with the MCM leadership team, the external evaluator will prepare the US DOE Annual Performance Reports and engage in final project evaluation and publication of results. In addition, the leadership team and the external evaluator will seek to widely present MCM results at relevant professional math education conferences and publish MCM results in professional journals.

E. 3. Evaluation plan articulates key components, mediators, outcomes and threshold.

The primary purpose of the MCM project is to expand the existing body of knowledge of teaching practices and student learning in secondary math. To determine the impact of this project on teacher and student outcomes, the project, following WWC standards, will adopt rigorous and well-defined methodology. The MCM project research design will employ a quasi-experimental matched comparison design that would allow for group comparisons of students in MCM classrooms and control students in the neighboring districts that did not participate in the project. A prerequisite to interpreting impact findings for the MCM project is establishing whether the key project components were implemented with fidelity. Therefore, the implementation data analysis will precede the impact analysis for each cohort. The design of the proposed implementation evaluation described in the previous section is based on clearly articulated key MCM components (content/curriculum and professional learning) and outcomes as depicted in the logic model. Table 7 proposes data sources and measurable thresholds for each MCM project component. MCM teachers in participating schools must meet each component's threshold to reach fidelity each year; to meet overall project fidelity for a year, 25 out of 30 teachers in Cohort 1, and 29 out of 35 teachers in Cohorts 2 and 3 must meet fidelity.

Table 7. Implementation Fidelity Metrics for MCM Evaluation (Appendix T)

Activity/Component	Metric/Threshold	Data Source
Component 1: MCM Curriculum and Learning Model		
Year 1: MCM Curriculum and Learning model will be developed by the CDIT team (6 sections)	At least 5 out of 6 sections will be fully developed by the end of the planning and development year (Year 1)	Independent review of curriculum and PL model materials by the external evaluator
Year 2-5: MCM Curriculum including teacher and student materials distributed to the participating teachers prior to the implementation of each section.	At least 95% of all teachers will confirm the receipt of all of the materials	Material receipt logs kept by the evaluator, verified with each participating teacher, curriculum materials were received.
Component 2: MCM Professional Learning		
Year 2-5: MCM teachers attend professional learning and collaboration workshops	At least 85% of all teachers in each cohort will attend at least 85% of the PL workshops (15 out of 18 days)	PL attendance rosters
Year 2-5: MCM teachers receive coaching observations and support throughout the first implementation year.	At least 85% of all MCM teachers will receive at least 3 coaching observations	Coaching observations
Year 2-5: MCM principals and counselors will attend MCM school implementation workshops	1 administrator and 1 counselor from each participating site will attend both MCM administrator workshops (1 pre-implementation, 1 during implementation).	PL attendance rosters
Component 3: MCM Course Implementation		
Year 2-5: MCM teachers teach MCM sections with adequate fidelity during implementation year (out of 6)	At least 80% of all teachers in each cohort will teach at least 5 out of 6 sections with adequate fidelity.	Teacher implementation fidelity rubrics completed by teachers 2 weeks after completing each section, sent to evaluator.
Year 2-5: MCM teachers complete all of the required teacher and student assessments, surveys, and observation forms	At least 80% of the teachers in each cohort will complete all of the pre and post assessments, surveys and observation forms, required by the project.	Data collection records kept by the evaluator.