SRI Education
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Linked Learning San Bernardino (LLSB): Accelerating College and Career Readiness in Low-Performing Schools

An Investing in Innovation (i3) Development Grant Evaluation

Technical Report

2018

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The research reported here was supported by the Office of Innovation and Improvement, U.S. Department of Education, through Grant #U411C130103 to ConnectEd: The California Center for College and Career.

Suggested citation: Arshan, N. L. & Bosetti, K.R. (2018). *Linked Learning San Bernardino: Accelerating College and Career Readiness in Low-Performing Schools: An Investing in Innovation (i3) Development Grant Evaluation. Technical Report.* Menlo Park, CA: SRI International.

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Introduction

Linked Learning is an educational approach that combines college-focused academics, rigorous technical education, work-based learning, and personalized student supports in small, career-themed high school academies[1] contained in multiple schools (i.e., small schools within larger comprehensive schools) in the same district. A leading architect of the Linked Learning approach to education, ConnectEd: The California Center for College and Career Readiness (ConnectEd) forms partnerships with districts in which they collaborate with educators and administrators to help build high-quality Linked Learning academies.

In 2013, ConnectEd received an Investing in Innovation (i3) Development grant to support the development of Linked Learning career-themed academies in four high schools in San Bernardino City Unified School District (SBCUSD). The Linked Learning San Bernardino (LLSB): Accelerating College and Career Readiness in Low-Performing Schools development grant supported both the development of new academies, as well as the further development of four existing California Partnership Academies (CPAs). The i3 grant also supported an independent evaluation—a quasi-experimental design—to examine both the program implementation and the impact of the program on students' cognitive and noncognitive outcomes. Researchers at SRI Education conducted the independent evaluation.

This technical report begins with a discussion of the Linked Learning San Bernardino (LLSB) logic model in which key program components and intended outcomes are specified. Next is a description of the intervention followed by a description of the research design, including implementation fidelity and the two quasi-experimental designs; student samples; and data collection and analysis methods. We then present the findings on program implementation and student outcomes. This technical report does not include interpretation of these findings.

The Linked Learning San Bernardino Logic Model

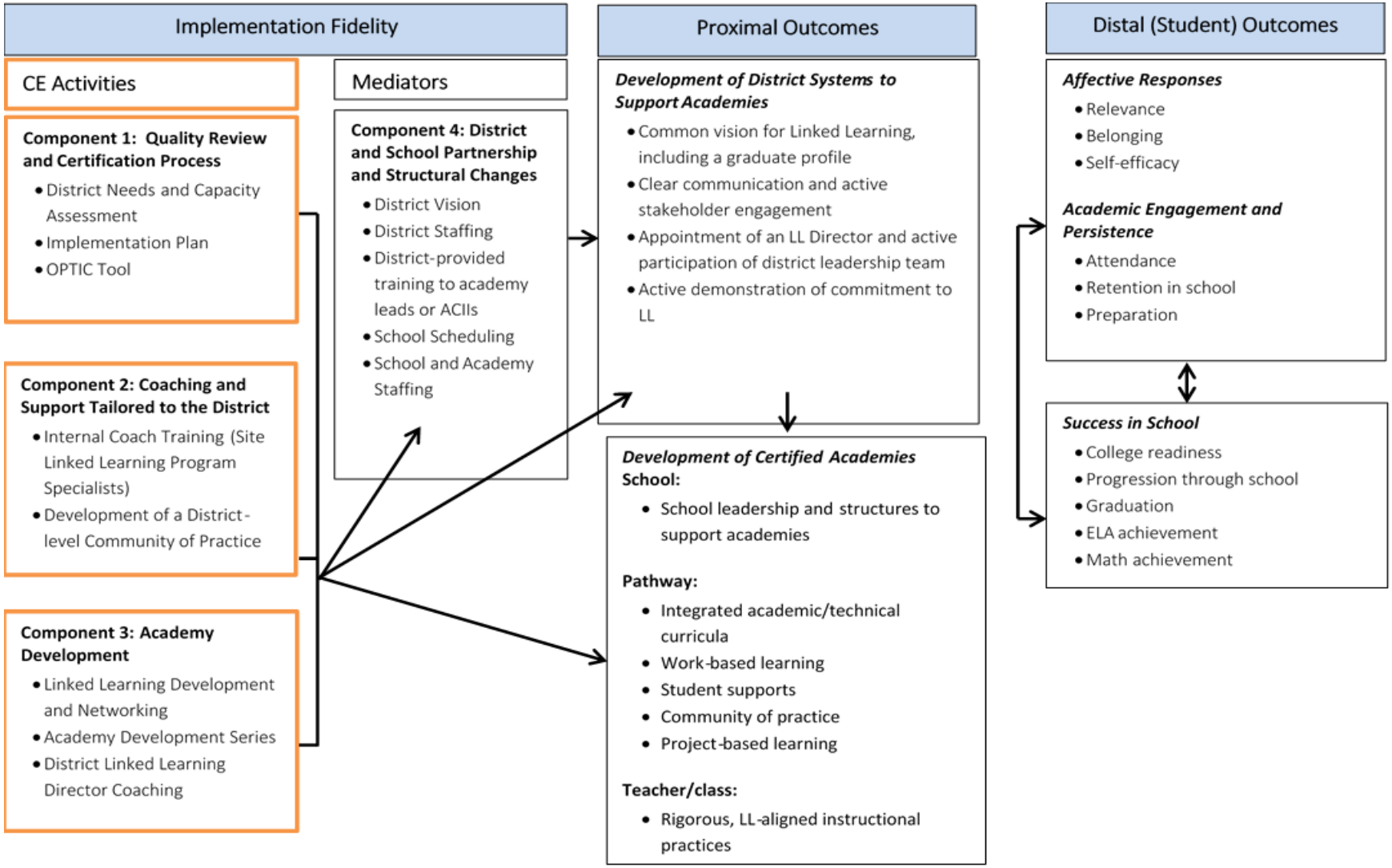
The Linked Learning San Bernardino (LLSB) project was designed to create Linked Learning career-themed academies offering learning environments for students that support their success in school and improve their college and career readiness and postsecondary outcomes. Creating these learning environments includes changing teachers' instructional practices with the goal of improving students' cognitive and noncognitive outcomes. To achieve these outcomes, ConnectEd provides a system of supports designed to address the varied needs of actors in different organizational positions (e.g., district leaders, principals, academy teachers) over the course of the grant that was responsive to both their context and their individual knowledge, skills, and abilities. The system of supports are professional development events comprised of in-person trainings or workshops, online learning opportunities, as well as individual and group coaching. At the district level, ConnectEd staff work with San Bernardino City Unified School District (SBCUSD) leaders to create systems and policies (e.g., school choice and transportation policies, leadership capacity) that allow for Linked Learning pathways to be successful, equitable, stable, and sustainable. At the school level, ConnectEd works with school leaders, academy leads, and academy teachers to plan, develop, and implement the Linked Learning

[1] ConnectEd typically refers to the academic programs it develops as "pathways." However, within this project, the district referred to the programs as "academies." The two terms are interchangeable. To avoid confusion, we have chosen to use "academy" to refer to these programs, as it is specific to this project's context. The term "pathway" may arise as part of a title for a report, tool, or framework developed outside of this project (e.g., "Online Pathway Tool for Improvement and Certification").

academies. The focus of this work includes school structures that support academies, as well as the program of study and instruction. Here we describe the program's theory of action in detail, beginning with student outcomes.

The figure below is the logic model of how the LLSB project proposed to achieve its intended long-term outcome of improving students' cognitive and noncognitive skills crucial for success in both college and career. The logic model provides a conceptual framework for understanding the project's core components, mediators, and expected outcomes. The LLSB project's core components are shown in the first column, followed by their link to mediators. These district-level mediators must occur if the expected proximal outcomes (for the district, school, pathway, and student) and distal outcomes (near-term and long-term outcomes for students) are to take place. The ultimate impact of the project is to create learning environments for students that support their success in school and improve their college and career readiness and postsecondary outcomes. Below, we briefly describe the core components, mediators, and expected outcomes.

Exhibit 1. Linked Learning San Bernardino Logic Model



Core Components

The logic model outlines the four components deemed integral by ConnectEd lead staff and SRI for the purposes of the Linked Learning San Bernardino Evaluation: Quality Review and Certification Process; Coaching and Support Tailored to the District; Pathway Development; and District and School Partnership and Structural Changes. The first three components are inputs or activities from ConnectEd or its affiliates. The fourth component, District and School Partnership and Structural Changes, represents an input from the district and is considered both a core component and a mediator. Together, these four components comprise a network of supports designed to address the varied needs of actors in different organizational positions (e.g., principals, academy teachers) over time.

Component 1: Quality Review and Certification Process

The ConnectEd (CE) Quality Review and Certification Process is a way for academies and districts to assess the overall quality of the academy and to establish a system of continuous improvement and sustainability. It includes ConnectEd tools and supports in using the tools. The process begins with a structured needs and capacity assessment at the district level that feeds into the development of a district-level implementation plan. These first two steps are designed to be conducted during the planning phase. During the implementation phase, academy teams use the OPTIC tool[2] annually to self-assess their progress toward earning their Linked Learning certification.

Component 2: Coaching and Support Tailored to the District

The focus of this component is the development of the district systems that will support the development of the academies. This component comprises the training and coaching that are tailored specifically to the needs of the SBCUSD, the four schools in the study, and the academies under development at those schools. Those expected to receive training include the district leadership team, the district Linked Learning Director, school administrators, and school-based coaches (called internal coaches). The training and coaching will be responsive to their needs and will be provided by ConnectEd, its affiliate organizations, and SBCUSD.

Component 3: Academy Development

The focus of this component is the development of the academies. The indicators include professional development events for cross-functional teams (district, school, and academy), professional development events for academy teams, and job-embedded coaching for the Linked Learning Director.

Component 4: District and School Partnership and Structural Changes (Mediator)

This component comprises the activities that SBCUSD needs to engage in to support the work of LLSB. It represents the establishment of leadership for the project, the dedication of resources to the project, and structural revisions necessary to support the development of a district system to support academy development at the school level.

[2] OPTIC (Online Pathway Tool for Improvement and Certification) supports academy teams to work together to self-assess the quality of their academy against the established criteria for Pathway Quality Review and Continuous Improvement, a set of standards that had been in use for over five years at the launching of the LLSB project.

Proximal Outcomes: District, School, Academy, Teacher/Classroom

The logic model identifies proximal outcomes for the LLSB project. These represent both institutional and individual changes at the district and school levels expected from the work of the grant partners, primarily ConnectEd, San Bernardino City Unified School District (SBCUSD), and the San Bernardino County Office of Education (SBCOE). Institutional level changes are expected at the district and school level while individual changes are expected of teachers as they modify their instruction in accordance with the Linked Learning approach.

The district-level institutional outcome of LLSB is expected to be the development of a district system that supports the development of certified Linked Learning academies. Expected changes include:

- Creating a common vision for Linked Learning
- Fostering clear communication and active stakeholder engagement
- Appointing a Linked Learning Director and establishing active participation of the district leadership team
- Actively demonstrating commitment to Linked Learning

The school-level institutional outcomes of LLSB are expected to be the development of school leadership and structures that support the development of certified Linked Learning academies and improved instructional practices. Each certified Linked Learning academy should reflect five essential features:

- Integrated academic and technical curricula
- Work-based learning
- Project-based learning
- Student supports
- Community of practice

At the individual level, administrators at the district and school levels must adopt the leadership practices that support the development of the certified Linked Learning academies, and teachers must adopt the rigorous, Linked Learning-aligned instructional practices that will foster the desired student outcomes.

While the elements of a Linked Learning pathway (rigorous academics, real-world technical skills, work-based learning, personalized supports, community of practice) can be defined and described, it can be more difficult to determine how much of any of these elements is "enough" to be called a Linked Learning academy. ConnectEd works with all programs working towards the goal of becoming a *Certified* Linked Learning academy. The certification process consists of seven different elements[3] and it can take years to develop an academy to the point of reaching certification. Additionally, the development of an academy is not always a purely linear,

[3] Linked Learning Essential Elements for Pathway Quality. ConnectEd. Retrieved September 2014. Available at: http://www.connectedcalifornia.org/direct/files/Essential%20Elements%20for%20Pathway%20Quality_Descriptors.pdf

predictable process. District layoffs, for example, may cause turnover of key personnel, derailing an academy before it can progress towards certification.

Similarly, student participation in an academy can be difficult to define, as the ideal of "pure" academy classes can be difficult to achieve given (a) the need to fill each class to capacity (e.g., if only 25 academy students can fit an academy class into their schedule, high schools will typically fill the rest of the class with nonacademy students) and (b) students' needs to take coursework appropriate to their academic needs (e.g., if a student fails Algebra in the 8th grade, she must retake it in 9th, even if pathway curriculum calls for Geometry).

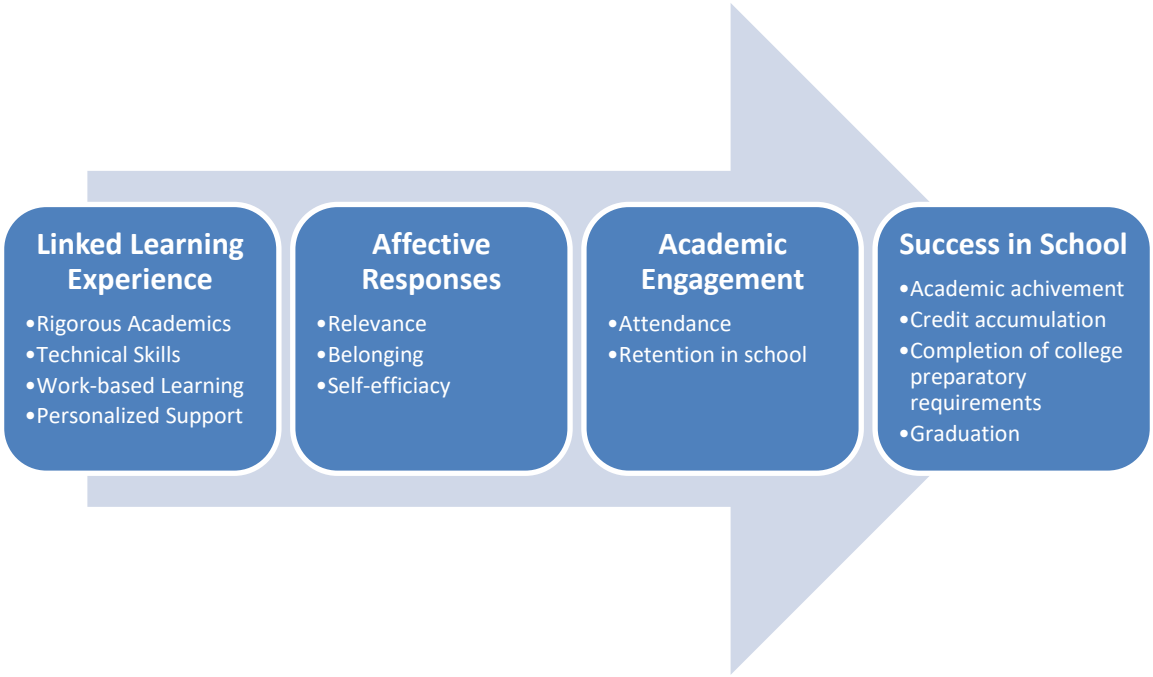
Students who choose to enroll in an academy will be expected to take a more proscribed curriculum than most traditional high school students would take. These classes should include a full schedule of college-preparatory academic classes integrated with the career theme (i.e., including work- and project-based learning) and a 3-year sequence of career and technical education (CTE) courses. Ideally, these classes would all be designated as "academy" courses, be taught by academy teachers, and contain only academy students. Academy teachers would have dedicated time to work as a team and plan interdisciplinary projects. Academy students should also have additional academic and social supports through this academy. These supports would both be informal (i.e., a smaller community should create a stronger sense of belonging and accountability) and formal (e.g., tutoring, a dedicated academy counselor). ConnectEd will both work to develop new academies and support the district to set policies and procedures that make these academies sustainable for the long term.

Student Outcomes

Linked Learning seeks to affect students' cognitive and noncognitive outcomes. Linked Learning seeks to improve students' success in school broadly, including course-taking behavior, completion of college-prep requirements, attendance, and dropout prevention— outcomes that go beyond the standard "cognitive" measure of standardized test scores to touch on a range of student outcomes that involve not just learning but also student behavior. Noncognitive factors are conceived of broadly as all relevant factors (save content knowledge and academic skills) that play a role in students' success in school (e.g., self-efficacy, growth mindset).

The logic model for the LLSB project identifies outcomes for students that include three domains: affective responses, academic engagement and persistence, and school success. We start with the pillars of Linked Learning, and then focus on the affective responses (e.g., emotions) Linked Learning students may have as they internally process their responses to their schooling experience. Next, we assess how those affective responses might influence academic engagement (e.g., attendance). Finally, we review the school successes that could result from these positive behaviors. While we present the relationships in the framework as linear, there is likely a cyclical nature to the interactions between these outcomes. For example, by simply attending class regularly, a student may begin to feel more comfortable and supported in her academic community, and as a result she may develop a greater sense of belonging which, in turn, may motivate her to go to class more often. These terms are defined below.

Exhibit 2. The Relationship between Linked Learning and Student Achievement



Linked Learning experience. The five essential features of a certified Linked Learning academy described above are designed to foster a "Linked Learning experience" for students. The Linked Learning focus on integrated academic and technical curriculum and work-based learning target students' sense of the relevance of their work, tying their academic experiences with the kinds of real-life work experiences they will see as directly applicable to their lives. The academic community and student supports at the core of Linked Learning lead to a feeling of belonging and a sense of self-efficacy for students who enroll in a pathway.

Affective responses. The affective response of a student can be thought of as the way that a student internally processes his or her experiences at school. These affective responses moderate the relationship between the inputs of the school experience and the academic behavior of the student. Essentially, students who feel better about school will be motivated to work harder during the experience. We highlight the three internal affective states that are both most malleable and best aligned to Linked Learning: a sense that schoolwork is relevant, a feeling of belonging, and a sense of personal self-efficacy. These affective, or emotional, responses are highly context specific (Farrington et. al., 2012). That is, a Linked Learning student who feels as though she belongs in her high school does not necessarily carry that sense of belonging with her to other situations. These affective responses therefore should not be considered a characteristic that Linked Learning fundamentally changes in that student.

Academic engagement and persistence. Students make daily decisions about how to interact with their education and the tasks required to succeed in school: should I do my homework?, should I go to class? When students have the kinds of positive affective experiences Linked Learning aims to foster, they are more likely to choose to engage in school by showing up and doing the work required to be successful. This definition of engagement focuses on the area of behavioral engagement, "considered crucial for achieving positive academic outcomes and preventing dropping out" (Fredricks et. al., 2011, p. 2). Students engage in countless academic behaviors in order to succeed in school, but we chose to focus here more narrowly on

two behaviors both aligned to the affective responses above and cited by Farrington as particularly critical to academic achievement: attendance and retention in school.

Success in school. While cognitive ability is important to academic success, so too are the daily behavioral decisions students make that accumulate over time. For example, showing up to class every day and consistently completing coursework will generally lead to passing classes; similarly, choosing to take rigorous classes over 4 years will lead a student to graduate more prepared for postsecondary life. For these reasons, credit accumulation, a-g completion, and graduation are indicators of student success that may also be considered noncognitive outcomes.

State, District, and School Context

At the outset, ConnectEd and SBCUSD leaders understood that context at multiple levels would influence academy development and teacher participation. For example, ConnectEd expected whether the district leaders messaged support toward prioritizing the cohorting of Linked Learning academy students (e.g., at the possible risk of Advanced Placement or popular elective courses) would affect principals' willingness to make the hard choices when establishing the master schedule. Likewise, they expected that the extent to which teachers viewed the Linked Learning work as aligned with other curricular priorities and curriculum and assessment policies and practices would influence their classroom implementation of the desired behaviors of learning and teaching espoused by ConnectEd and supported in their professional development.[4] LLSB project leaders also understood that teacher, principal, and district staff turnover along with student mobility were likely to affect implementation of the 4-year program.

Linked Learning academy certification was another important contextual element for the LLSB project. LLSB leaders thought the certification process could motivate or stymie academy staff as they worked to develop and refine their academies. Too intensely focusing on certification and the development of documents to show evidence of meeting certification criteria can risk making the process a compliance exercise rather than the opportunity to establish systems of continuous improvement. Evolving criteria, documentation, and procedures can have a similar frustrating experience for academy staff.

The Linked Learning San Bernardino Project

The Linked Learning San Bernardino (LLSB): Accelerating College and Career Readiness in Low-Performing Schools development grant supported the development of Linked Learning career-themed academies in the four highest-poverty and lowest-achieving high schools in San Bernardino City Unified School District (SBCUSD). The i3 grant was implemented over 3 years. Year 1, the 2013–14 school year, was primarily a planning phase, wherein ConnectEd focused its efforts exclusively in the district office. The next 3 years, the 2014–15, 2015–16 and 2016–17 school years, ConnectEd planned to support both the district office and the individual schools and academies working towards development of certified academies.

[4] ConnectEd established a framework that defines key characteristics of student and adult learning and teaching practices within Linked Learning. The Learning, Teaching, and Leading Framework accessed June 2018 is available: http://connectedcalifornia.org/direct/files/Behaviors%20of%20Learning%20and%20Teaching%20Continuum%2006112014%20Overview.pdf

Exhibit 3. LLSB High School Demographics

	2013–14			2012–13
School	Total Enrollment	% FRPL	% English Learners	% Students Scoring Below Proficient on ELA CST
San Bernardino High School	1,790	98%	20%	68%
San Gorgonio High School	2,079	95%	12%	59%
Pacific High School	1,588	97%	19%	66%
Arroyo Valley High School	2,603	98%	20%	63%
Note: free or reduced-price lunch (FRPL); California Standards Test (CST); English Language Arts (ELA)				

SBCUSD has a history of career-themed classwork for students. At the outset of the evaluation, they had a robust CTE (career and technical education) program at the district level, and multiple options for CTE coursework in the four study schools. Two of the four study schools (San Bernardino and Arroyo Valley) also had well-established California Partnership Academies (CPAs). These CPAs are programs that share important structural features with Linked Learning academies (namely a career theme and smaller cohorts). Prior research that SRI has done evaluating Linked Learning indicates that these CPAs typically do not develop to the same level expected of a Linked Learning academy (e.g., project-based learning is unlikely to link multiple subjects; CPA coursework may not meet the college entrance requirements for the 4-year California public colleges and universities ["a-g curriculum"]; etc.). In addition to helping SBCUSD build new academies from scratch, ConnectEd set out to further develop these four existing CPAs to achieve Linked Learning certification.

The i3-funded (and evaluated) work represented only a portion of the district's vision for implementing Linked Learning. The district set an ambitious goal not only of implementing Linked Learning at the four high schools in the study but also of rolling out Linked Learning across the entire district so that 100% of students from grades K-12 would be in a career-themed academy by 2017–18.[5] Going "wall-to-wall" with Linked Learning academies meant that all high schools would need to have enough academies to house all of its students and that the district would need to define what Linked Learning academies would look like for middle and elementary schools. This broad, district-wide focus for implementation, meant that the four high schools in the study received only a fraction of the district's overall effort to implement Linked Learning during the term of the study.

Additionally, ConnectEd faced an implementation challenge in that the certification process effectively went dormant at a critical period during the LLSB project. When the study began, the external review process for certifying a Linked Learning academy was managed by ConnectEd or by NAF (previously the National Academy Foundation), a national network of college and career academies, based on indicators of pathway quality. Certification indicates that an academy has attained a certain level of fidelity to the core components of Linked Learning. Over the course of the study, responsibility for certifying Linked Learning pathways shifted from ConnectEd to the Linked Learning Alliance, a statewide coalition of education, industry, and community organizations dedicated to implementing Linked Learning.[6] The transition between certifying bodies cast some doubt on the longevity of the established certification criteria and the

[5] Interview respondents in 2016-17 described the district's vision for implementing Linked Learning.

[6] The Linked Learning Alliance Certification Requirements are available online. Accessed June 2018. Available at https://certification.linkedlearning.org/certification-requirements.

value of uploading documents into OPTIC. ConnectEd had originally planned to use the OPTIC tool as part of the academy development process. However, as this tool was largely framed as a process to walk academies through to certification, ConnectEd also chose to eschew its use within the district. In its place, the district largely relied on self-assessment using a district-developed rubric. This self-assessment laid out criteria but did not require evidence or an external validation of the assessment, as certification would have (see Appendix A for SBCUSD's academy rating system.)

Research Design

To solve the issue of evaluating a program that does not emerge fully formed, the research team designed two impact studies. The Intensive, Longitudinal design follows a single cohort of students through the preexisting CPAs during the time ConnectEd partnered with the district. This design will capture more academies that begin with the basic structural pieces intact as ConnectEd works to fully develop them and evaluate longitudinal effects on students. The Exploratory design evaluates outcomes for students in newly developed pathways. We treat the CPAs as Linked Learning academies from inception, given the number of structural similarities between the two programs. Newly developed academies will be eligible to be evaluated as Linked Learning academies the year after the academy team self-assess as a five or six on the district's Academy Development rubric. For the purposes of this study, we can think of entering an academy as student self-selection into treatment, and entering into the traditional high school program as self-selection into control or "business as usual."

The student outcomes evaluation will therefore have two different designs:

- The Intensive, Longitudinal design's treatment group are drawn from the three CPAs that begin in the 10th grade (Exhibit 4). It follows a single cohort of students longitudinally from 10th grade in 2014–15 through what would be their 12th-grade year in 2016–17. The comparison group of students are those 10th-grade students at these same two high schools who enrolled in the traditional high school program in the 2014–15 school year. Baseline data are drawn from the 2012–13 and 2013–14 school years, when the students were in 8th and 9th grade. Outcome data are drawn from the 2014–15 through 2016–17 school years, when the students were in 10th-12th grades. In addition to the extant data collected by the district, researchers administered a student survey in 9th and 12th grades, which we linked to district data. This survey both decreases the selection bias inherent in many quasi-experimental designs (QEDs) due to unmeasured differences in students and provides data on what are traditionally thought of as "noncognitive" outcomes (e.g., engagement, self-efficacy). Our only confirmatory contrasts will be from this Intensive, Longitudinal design.

- The Exploratory design draws its students from the newly developed academies rated by the district as a five or six on their Academy Development rubric (Exhibit 5). This included nearly all 9th-grade students in Pacific and San Gorgonio High Schools during the 2016–17 school year. Comparison students are drawn from 9th-grade students in a traditional high school programs at Arroyo Valley and San Bernardino High schools in this same year. Baseline data are from the 2015–16 school year, when students were in the 8th grade, and outcome data are from the 2016–17 school year, when students were in 9th grade. This design only draws from district data; no additional student survey data were collected.

Exhibit 4. Treatment and Control Conditions for the Intensive, Longitudinal Design

School	2013-14, 9th grade	2014–15, 10th grade	2015–16, 11th grade	2016–17, 12th grade	Included in Intensive, Longitudinal Design Study
Arroyo Valley High School	Traditional HS	Teaching CPA	Teaching CPA	Teaching CPA	Treatment (Grades 10-12, Class of 2017)
		Traditional HS	Traditional HS	Traditional HS	Control (Grades 10-12, Class of 2017)
San Bernardino High School	Traditional HS	eBusiness CPA	eBusiness CPA	eBusiness CPA	Treatment (Grades 10-12, Class of 2017)
		Public Safety CPA	Public Safety CPA	Public Safety CPA	Treatment (Grades 10-12, Class of 2017)
		Traditional HS	Traditional HS	Traditional HS	Control (Grades 10-12, Class of 2017)

Note: The Intensive, Longitudinal design uses an intent-to-treat analysis, which assigns treatment status according to students 10th-grade enrollment. As such, beginning in the 11th grade, treatment students may transfer out of a CPA, and control students may transfer into a CPA. These students are analyzed according to their originally assigned treatment status.

Exhibit 5. Treatment and Control Conditions for the Exploratory Design

School	Year 4 2016–17 9th-grade students	Included in Exploratory Design Study
Pacific High School	Academy of Digital Design and Communication	Exploratory Design Treatment
	Academy of PLTW Biomedical	Exploratory Design Treatment
San Gorgonio High School	NAF Academy of Finance and Business	Exploratory Design Treatment
	NAF Academy of Information Technology	
	NAF Academy of Hospitality and Tourism	
	NAF/PLTW Academy of Design and Engineering	
	NAF Academy of Arts, Media, and Entertainment	
	NAF/PLTW Academy of Health Sciences	
Arroyo Valley High School	Traditional HS	Exploratory Design Control
San Bernardino High School	Traditional HS	Exploratory Design Control

Note: Project Lead the Way (PLTW); NAF (previously the National Academy Foundation)

Our primary research questions were:

- Was ConnectEd San Bernardino implemented with fidelity?
- What was the effect of enrolling in one of San Bernardino's CPAs on students' math and English Language Arts (ELA) achievement, credit accumulation, college readiness, attendance, noncognitive outcomes, retention in the district through 12th grade, and graduation?
- What was the effect of newly developed academies on students' attendance, credit accumulation, and college readiness?

Student Samples, Attrition, and Crossover

Academies implemented within traditional high schools can have somewhat porous boundaries (i.e., academy students will take nonacademy classes and vice versa; students who initially enroll in academies may leave that program for the traditional high school program and vice versa). These two issues create some unique challenges to evaluating academies. To solve the issue of porous boundaries, we use an intent-to-treat analysis, wherein students will be analyzed according to the enrollment decision they make when first given an option to enroll in academies. Those students that initially select to enroll in a Linked Learning academy will be treated as pathway/treatment students, and those that do not enroll in an academy we treat as comparison students, experiencing a "traditional high school" program. We describe attrition from the district and crossover in treatment condition for the Intensive, Longitudinal design in Exhibit 6. By 12th grade, only 57% of CPA students and 55% of comparison students remained in their original program. As such, measured impacts of the CPAs may tend to understate the true effects of an academy on student outcomes, as just over half of the treated students remained in the program.

Exhibit 6. Student Attrition from District and Crossover in Treatment Status for the Intensive, Longitudinal Design

	11th Grade		12th Grade	
	CPAs	*Comparison*	*CPAs*	*Comparison*
Remained in original program	65%	63%	57%	55%
Left program, stayed in SBCUSD	27%	30%	29%	34%
Left SBCUSD	8%	7%	14%	12%

Data and Methods

The SRI evaluation team collected data from multiple sources to understand program implementation and assess outcomes. We examined program implementation across the district, collected district student data for both the Intensive, Longitudinal design and the Exploratory design, and collected student survey data for the Intensive, Longitudinal design.

Program implementation

We examined program implementation across the four high schools as well as at the district and pathway levels, measured teacher practice through a survey, and assessed student learning with extant data and student noncognitive outcomes with a survey.[7]

To properly measure every component listed in the implementation and outcomes plan (as well as provide annual formative feedback), SRI and ConnectEd worked with the district and pathway staff to provide SRI with the necessary data for every year of the evaluation. The table below summarizes the data sources, data collection schedule, responsible party, and the number of times the data were collected. Following the table, we provide a brief description of each data source.

Exhibit 7: Data Collection Plan for Linked Learning: San Bernardino

Source	Schedule of Data Collection	Organization Responsible for Gathering Data
Documents	Annually	ConnectEd
Coaching and/or contact logs	Biannually, Winter and Summer in Years 2-4	ConnectEd
Attendance records	Biannually, Winter and Summer in Years 2-4	ConnectEd
Interviews and site visits	Annually	SRI International

SRI collected records from ConnectEd and district staff on both the dosage and topics of support provided to assist teachers as well as school and district leadership in pathway development. Data collected primarily for measuring implementation fidelity were expected to include the following:

- **Document collection and review**: SRI collected data on district-level efforts (e.g., conducting the District Needs and Capacity Assessment and writing an implementation plan in response to this document) in order to verify whether this work was completed. Data sources included interviews, document reviews, and communication with ConnectEd.
- **Coaching and/or contact logs**: For the purposes of measuring implementation fidelity, the coaching and contact logs identified the coach, the recipient of the coaching, as well as the focus and duration of the coaching. Contact or management logs provided a means for tracking pathway team progress through the pathway development series of modules.
- **Attendance records**: SRI collected rosters of attendees and itemized agendas for all district and pathway leadership institutes in order to understand who attended these meetings and what content was covered. We looked for both the appropriate number and roles of participants (e.g., pathway leads, CTE teachers, and non-CTE teachers within each pathway).
- **Interviews and site visits:** The SRI team also visited the district and each study school at baseline and outcome and gathered qualitative data through annual phone interviews. We

[7] The SRI team also surveyed teachers each year and visited each school and several academies; gathered qualitative data through interviews with professional development providers, district and school leaders, teachers, and students; and conducted an observation of professional development. But we did not draw on the teacher survey, interviews, and observations in this report.

did not draw on this data collection in this technical report outside of what is used to understand implementation fidelity.

Program implementation

SRI worked with ConnectEd leaders to identify the key program components and established multiple indicators for each component. To assess whether the program was implemented with fidelity across the sites, we identified how each indicator would be measured and indicated the level of measurement, including district (e.g., district staff), school (e.g., school leaders), and pathway (e.g., pathway teams, leads, teachers). As described, the four key components are:

- Quality review and certification process
- Coaching and support tailored to the district
- Pathway development
- District and school partnership and structural changes

To assess the fidelity of implementation, SRI collected information from ConnectEd coaches and SBCUSD leaders on district, school, and pathway staff participation in professional development, established a tracking system, and examined results against predetermined thresholds for each indicator. Data from this tracking system enabled SRI analysts to calculate whether staff at the right level attended a sufficient number of events to meet the agreed-on thresholds. We also reviewed other data sources that represented the output of work that fulfilled an indicator's requirements (e.g., district needs and capacity assessment).

Student outcomes

The student data used in each design is summarized in exhibits 8 and 9. More detail on the district extant and survey data collected is provided below.

Exhibit 8. Baseline and Outcome Data Used for Intensive, Longitudinal Design

Time	Cohort grade level	Data
Baseline data		
Spring 2013	8th	8th-grade math and ELA CST scores
Spring 2014	9th	School and CPA enrollment, demographics, credits completed, completion of freshman college-preparatory requirements, attendance, student survey data
Outcome data		
2014–15	10th	School and CPA enrollment, attendance, credits completed, college prep requirements completed, college-prep grade-point average
2015–16	11th	School and CPA enrollment, attendance, credits completed, college-prep requirements completed, college-prep grade-point average, math and ELA Smarter Balanced assessment scores
2016–17	12th	School and CPA enrollment, attendance, credits completed, college-prep requirements completed, graduation, survey data (noncognitive measures)

Exhibit 9. Baseline and Outcome Data Used for Exploratory Design

Time	Cohort grade level	Data
Baseline data		
2015–16	8th	Math and ELA Smarter Balanced assessment scores, demographics
Outcome data		
2016–17	9th	School and CPA enrollment, credits completed, completion of freshman college-prep requirements, attendance

Extant data

As part of the grant activity, the Institute for Evidence-Based Change (IEBC) worked with SBCUSD to collect data on student pathway enrollment. As part of this work, IEBC linked these pathway enrollment data with the SBCUSD extant data and provided SRI with a complete data file. SRI verified these pathway enrollment data using student course files.

SBCUSD district data used as baseline (BL) for the Intensive, Longitudinal design are:

- English Learner status—We constructed indicator variables equal to 1 if a student was either an English Learner or Reclassified Fluent English Proficient in the 9th grade. The reference group was students who were classified as either English Only or Initially Fluent English Proficient in the 9th grade (i.e., students who were never classified as an English Learner). We provide descriptives on all four categories.
- Gender—We constructed an indicator variable equal to 1 if a student was female and zero if the student was not female and the data were nonmissing.
- Latino—We constructed an indicator variable equal to 1 if the student was Latino/a and zero if the student was not female and the data were nonmissing. We provide descriptives on all racial and ethnic categories.
- Socioeconomic status—We constructed an indicator variable equal to 1 if the student was eligible for free or reduced-price lunch (FRPL) in the 9th grade and zero if the student was not eligible for free or reduced-price lunch in the 9th grade and the data were nonmissing.
- Special education status—We constructed an indicator variable equal to 1 if the student was classified as special education in the 9th grade and zero if the student was not classified as special education in the 9th grade and the data were nonmissing.
- Attended San Bernardino High School (SBHS)—We constructed indicator variables equal to 1 if a student attended San Bernardino High School in the 9th grade. The reference group was students who attended Arroyo Valley High School in the 9th grade.
- Attendance—We used the percent of days in the 9th grade that students attended.
- Course completion—We constructed an indicator variable equal to 1 if a student completed the recommended 9th-grade college-preparatory classes. We used the grade-level classes suggested by the University of California's Transcript Evaluation Service to determine what coursework students should have completed by the end of 9th grade: this means two semesters each of an English (b) and math (c) class and four other semesters of a-g–approved classes. Students must earn a grade of C or higher in each semester for

the class to count toward a-g completion. Our a-g on-track indicator does not include courses above the number required for UC admission (e.g., more than two semesters of "g" courses). We also used a continuous variable for the number of credits accumulated in the 9th grade.

- Academic achievement—We used students' 8th-grade math and English Language Arts (ELA) California Standards Test (CST) scores as a continuous variable. We also constructed an indicator variable equal to 1 if the student took the Algebra 1 CST in the 8th grade and 0 if the student took the 8th-Grade Math CST.

Baseline descriptive statistics for the overall analytic sample for the Intensive, Longitudinal design are provided in Exhibit 10 and 11 below.

Exhibit 10: Binary Baseline Descriptives for Students in the Intensive, Longitudinal Design

	Group	%	N
African American			
	CPAs	8.3%	133
	Comparison	6.7%	611
	Overall	7.0%	744
Asian			
	CPAs	0.8%	133
	Comparison	1.8%	611
	Overall	1.6%	744
White			
	CPAs	3.8%	133
	Comparison	2.6%	611
	Overall	2.8%	744
Other Ethnicity			
	CPAs	2.3%	133
	Comparison	0.8%	611
	Overall	1.1%	744
Latino/a			
	CPAs	85.7%	133
	Comparison	88.1%	611
	Overall	87.6%	744
Female			
	CPAs	65.4%	133
	Comparison	46.5%	611
	Overall	49.9%	744
Receives Free or Reduced-Price Lunch			
	CPAs	98.5%	133
	Comparison	96.2%	611
	Overall	96.6%	744
Special Education			
	CPAs	7.5%	133
	Comparison	11.1%	611
	Overall	10.5%	744
English Learner			
	CPAs	10.5%	133
	Comparison	21.1%	611
	Overall	19.2%	744

	Group	%	N
Reclassified Fluent English Proficient			
	CPAs	54.9%	133
	Comparison	47.6%	611
	Overall	48.9%	744
Took Algebra 1 8th-Grade CST Exam			
	CPAs	91.0%	133
	Comparison	84.3%	611
	Overall	85.5%	744
Attends SBHS			
	CPAs	67.7%	133
	Comparison	33.7%	611
	Overall	39.8%	744
On Track to Complete a-g in 9th grade			
	CPAs	37.6%	133
	Comparison	25.2%	611
	Overall	27.4%	744
Less than 95% 9th-grade attendance			
	CPAs	24.1%	133
	Comparison	29.1%	611
	Overall	28.2%	744

Exhibit 11: Nonbinary Baseline (BL) Descriptives for Students in the Intensive, Longitudinal Design

	Group	Mean	SD	N
8th-Grade ELA CST Scale Score				
	CPAs	341.56	44.90	133
	Comparison	330.87	52.71	611
	Overall	332.78	51.54	744
8th-Grade Math CST Scale Score				
	CPAs	332.82	56.62	133
	Comparison	328.12	67.83	611
	Overall	328.96	65.96	744
Credits Earned in 9th grade				
	CPAs	54.77	11.41	133
	Comparison	49.43	17.99	611
	Overall	50.38	17.12	744
BL Survey: Level of support & expectations from teachers (factor)				
	CPAs	5.76	1.30	112
	Comparison	5.44	1.32	469
	Overall	5.50	1.32	581
BL Survey: Sense of belonging (factor)				
	CPAs	5.16	1.22	112
	Comparison	4.94	1.26	469
	Overall	4.98	1.26	581
BL Survey: Conscientiousness (factor)				
	CPAs	4.82	0.80	112
	Comparison	4.65	0.96	469
	Overall	4.68	0.93	581
BL Survey: School relevance (factor)				
	CPAs	4.96	1.15	112
	Comparison	4.90	1.31	469
	Overall	4.91	1.28	581
BL Survey: Self-efficacy (factor)				
	CPAs	4.37	1.35	112
	Comparison	4.28	1.35	469
	Overall	4.30	1.35	581
BL Survey: Growth mindset (factor)				
	CPAs	2.96	1.32	112
	Comparison	3.10	1.25	469
	Overall	3.08	1.27	581
BL Survey: How often late to school? (item)				
	CPAs	3.12	1.37	112
	Comparison	2.93	1.34	469
	Overall	2.96	1.35	581

SBCUSD district data used as outcomes for the Intensive, Longitudinal design are:

- Academic achievement—We use 11th-grade math and ELA Smarter Balanced Assessment Consortium (SBAC) data as a measure of academic achievement.
- Attendance—SBCUSD provided data on the percent of days students attended school in each year. We used this variable both as grade-level outcome (i.e., percent of days attended 10th grade).

- Credit accumulation—This was defined as the number of course credits passed. Schools typically award 5 credits per semester class. In California, students are required to complete 220 credits to be eligible to graduate from high school. We used this variable both as a grade-level outcome (i.e., number of credits accumulated in 10th grade) and, for those students who remained in the district through 12th grade, a total across the 3 years.

- Completion of college-preparatory course requirements—To be admitted to a public 4-year university (UC or CSU) in California, students must complete a set number of designated college-preparatory courses across academic subjects and earn a grade of C or better in each course—these courses are collectively referred to as the a–g requirements. We defined this outcome in two ways for the Intensive, Longitudinal design. First, we looked at the total number of a–g requirements completed in the 10th–12th grades to determine the extent to which certified pathway students were making greater progress toward meeting those requirements. We also constructed a binary outcome equal to 1 if students completed all a–g requirements and zero if not, to understand whether academy students were more likely than comparison students to complete all college preparatory requirements via school curriculum. These variables are only calculated for students who remain in the district through 12th grade.

- Left the district—We classified students as having left the district (inclusive of both dropping out and transferring) if they were not enrolled in a district school through their 12th-grade year.

- Graduation—We classified students as having graduated from high school if they earned a traditional high school diploma within 4 years of beginning high school. Students did not earn a diploma if they were classified as neither having graduated nor transferred. The research team assumes that students with missing data on this variable transferred to another district.

Outcome descriptive statistics for the overall analytic sample for the Intensive, Longitudinal design are provided in Exhibit 12 and 13.

Exhibit 12: Binary Outcome Descriptives for Students in the Intensive, Longitudinal Design

	Group	%	N
Graduation			
	CPAs	95.0%	101
	Comparison	97.2%	430
	Overall	96.8%	531
Left SBCUSD before 12th Grade			
	CPAs	14.3%	133
	Comparison	13.6%	611
	Overall	13.7%	744
Completed All a-g Requirements			
	CPAs	21.1%	114
	Comparison	16.4%	525
	Overall	17.2%	639

Exhibit 13: Nonbinary Outcome Descriptives for Students in the Intensive, Longitudinal Design

	Group	Mean	SD	N
% Days Attended in 10th Grade				
	CPAs	0.97	0.06	133
	Comparison	0.95	0.06	611
	Overall	0.95	0.06	744
% Days Attended in 11th Grade				
	CPAs	0.96	0.05	112
	Comparison	0.95	0.08	489
	Overall	0.95	0.07	601
% Days Attended in 12th Grade				
	CPAs	0.94	0.08	114
	Comparison	0.92	0.11	525
	Overall	0.92	0.11	639
UC/CSU GPA in 10th-12th Grade				
	CPAs	1.63	0.52	114
	Comparison	1.49	0.82	525
	Overall	1.52	0.78	639
11th-Grade Math SBAC Scale Score				
	CPAs	2534.79	98.84	120
	Comparison	2505.95	111.12	531
	Overall	2511.27	109.46	651
11th-Grade ELA SBAC Scale Score				
	CPAs	2582.92	86.79	120
	Comparison	2549.69	108.07	533
	Overall	2555.80	105.22	653
Total Credits Earned in 10th-12th Grade				
	CPAs	176.21	31.90	114
	Comparison	155.01	41.65	525
	Overall	158.79	40.87	639

	Group	Mean	SD	N
Credits Earned in 10th Grade				
	CPAs	58.65	15.97	133
	Comparison	50.16	19.46	611
	Overall	51.67	19.16	744
Credits Earned in 11th Grade				
	CPAs	62.57	15.56	122
	Comparison	54.30	20.65	569
	Overall	55.76	20.08	691
Credits Earned in 12th Grade				
	CPAs	57.19	13.58	114
	Comparison	51.15	17.78	525
	Overall	52.23	17.26	639
Total a-g Requirements Completed in 10th-12th Grade				
	CPAs	9.81	3.02	114
	Comparison	8.25	4.22	525
	Overall	8.53	4.08	639
Outcome Survey: Level of support & expectations from teachers (factor)				
	CPAs	6.23	0.81	77
	Comparison	5.58	1.19	245
	Overall	5.73	1.14	322
Outcome Survey: Sense of belonging (factor)				
	CPAs	5.30	1.02	77
	Comparison	4.75	1.26	245
	Overall	4.88	1.23	322
Outcome Survey: Conscientiousness (factor)				
	CPAs	4.90	0.78	77
	Comparison	4.80	0.81	245
	Overall	4.82	0.80	322
Outcome Survey: School relevance (factor)				
	CPAs	4.72	1.33	77
	Comparison	4.65	1.36	245
	Overall	4.66	1.35	322
Outcome Survey: Self-efficacy (factor)				
	CPAs	4.75	1.40	77
	Comparison	4.65	1.29	245
	Overall	4.67	1.32	322
Outcome Survey: Growth mindset (factor)				
	CPAs	3.18	1.51	77
	Comparison	3.48	1.52	245
	Overall	3.41	1.52	322
Outcome Survey: Late to school (item)				
	CPAs	3.38	1.34	77
	Comparison	3.45	1.29	245
	Overall	3.43	1.30	322

SBCUSD district data used as baseline for the Exploratory design are:

- English Learner status—We constructed indicator variables equal to 1 if a student was either an English Learner or Reclassified Fluent English Proficent in the 9th grade. The reference group was students who were classified as either English Only or Initially Fluent English Proficient in the 9th grade (i.e., students who were never classified as an English Learner). We provide descriptives on all four categories.
- Gender—We constructed an indicator variable equal to 1 if a student was female and zero if the student was not female and the data were nonmissing.
- Latino—We constructed an indicator variable equal to 1 if the student was Latino/a and zero if the student was not female and the data were nonmissing. We provide descriptives on all racial and ethnic categories.
- Socioeconomic status—We constructed an indicator variable equal to 1 if the student was eligible for free or reduced-price lunch in the 9th grade and zero if the student was not eligible for free or reduced-price lunch in the 9th grade and the data were nonmissing.
- Special education status—We constructed an indicator variable equal to 1 if the student was classified as special education in the 9th grade and zero if the student was not classified as special education in the 9th grade and the data were nonmissing.
- Academic achievement—We used students' 8th-grade math and ELA Smarter Balanced scores as a continuous variable.

Baseline descriptive statistics for the overall analytic sample for the Exploratory design are provided in Exhibit 14 and 15.

Exhibit 14: Binary Baseline Descriptives for Students in the Exploratory Design

	Group	%	N
African American			
	Academies	17.8%	822
	Comparison	11.9%	877
	Overall	14.7%	1699
Asian			
	Academies	3.5%	822
	Comparison	1.6%	877
	Overall	2.5%	1699
Latino/a			
	Academies	68.4%	822
	Comparison	83.2%	877
	Overall	76.0%	1699
White			
	Academies	9.5%	822
	Comparison	2.5%	877
	Overall	5.9%	1699
Other Ethnicity			
	Academies	0.9%	822
	Comparison	0.8%	877
	Overall	0.8%	1699
Female			
	Academies	46.7%	825
	Comparison	47.8%	899
	Overall	47.3%	1724
Receives Free or Reduced-Price Lunch			
	Academies	82.7%	825
	Comparison	82.0%	899
	Overall	82.3%	1724
Special Education			
	Academies	10.7%	825
	Comparison	13.8%	899
	Overall	12.3%	1724
English Learner			
	Academies	12.4%	822
	Comparison	21.3%	892
	Overall	17.0%	1714
Reclassified Fluent English Proficient			
	Academies	34.5%	822
	Comparison	37.2%	892
	Overall	35.9%	1714

Exhibit 15: Nonbinary Baseline Descriptives for Students in the Exploratory Design

	Group	Mean	SD	N
8th-Grade ELA SBAC Scale Score				
	Academies	2539.31	85.52	664
	Comparison	2522.02	84.37	744
	Overall	2530.17	85.32	1408
8th-Grade Math SBAC Scale Score				
	Academies	2500.73	95.97	667
	Comparison	2494.86	95.38	748
	Overall	2497.63	95.67	1415

SBCUSD district data used as outcomes for the Exploratory design are:

- 9th-grade attendance—SBCUSD provided data on the percent of days students attended school.
- 9th-grade credit accumulation—This was defined as the number of course credits passed.
- Completion of recommended 9th-grade college preparatory course requirements—We constructed an indicator variable equal to 1 if a student completed the recommended 9th grade college-prep classes. We use the grade-level classes suggested by the University of California's Transcript Evaluation Service to determine what coursework students should have completed by the end of 9th grade: this means two semesters each of an English (b) and math (c) class and four other semesters of a-g–approved classes. Students must earn a grade of C or higher in each semester for the class to count toward a-g completion. Our a-g on-track indicator does not include courses above the number required for UC admission (e.g., more than two semesters of "g" courses). We also constructed a continuous variable containing the total number of college-preparatory requirements a student completed.

Outcome descriptive statistics for the overall analytic sample for the Exploratory design are provided in Exhibit 16 and 17.

Exhibit 16: Binary Outcome Descriptives for Students in the Exploratory Design

	Group	%	N
Completed All 9th-Grade a-g Requirements (1=Yes 0=No)			
	Academies	31.9%	825
	Comparison	26.1%	899
	Overall	28.9%	1724

Exhibit 17: Nonbinary Outcome Descriptives for Students in the Exploratory Design

	Group	Mean	SD	N
% Days Attended 9th Grade				
	Academies	0.94	0.09	825
	Comparison	0.94	0.08	899
	Overall	0.94	0.09	1724
	Academies	1.31	0.92	821
	Comparison	1.23	0.86	876
	Overall	1.26	0.89	1697
Credits Earned in 9th grade				
	Academies	49.47	22.46	825
	Comparison	49.79	21.05	899
	Overall	49.64	21.73	1724
	Academies	2.12	1.93	825
	Comparison	1.97	1.87	899
	Overall	2.04	1.90	1724

Student survey

SRI developed a student survey to model selection into CPAs and important noncognitive outcomes (e.g., academic engagement), drawing from well-validated instruments wherever possible. SRI worked with both IEBC and SBCUSD to ensure that student survey data was accurately linked to extant student data.

It is important to note the difficulty of measuring these noncognitive outcomes. For many of these outcomes, we must rely on student self-report, which may be biased by social-desirability, self-deception, the inaccuracy of human memory, or the reference group to which an individual compares oneself (Paulhus & Vazire, 2009). We supplemented survey data with results from the district data where possible, though these kinds of outcomes (e.g., attendance, graduation) have their own limitations: namely, they may include factors outside of the control of Linked Learning (e.g., illness, mobility).

There exist other noncognitive factors not discussed above that influence student success. Two of the most widely studied are conscientiousness and growth mindset. We included these in our survey as measures of interest in order to explore them further, as well as to improve our matching estimation and increase the causal validity of our estimated outcomes. However, we did not include them in the framework because we did not expect them to be affected by Linked Learning. In the case of conscientiousness, there exists widespread debate over whether these traits are even malleable (Srivastava, John, Gosling, & Potter, 2003; Duckworth & Quinn, 2009; Farrington et al., 2013). Growth mindset is not a fixed trait; however, research shows that it is affected uniquely by targeted growth mindset interventions (Wilson & Linville, 1982; Blackwell, Trzesniewski, & Dweck, 2007; Farrington et al., 2012). We therefore did not expect Linked Learning to move measurements of student conscientiousness or growth mindset as a method to improving academic success; however, given the widespread interest in these noncognitive factors, we examine them in our survey.

To develop a baseline survey, SRI drew on existing, validated surveys used by researchers in the field of education and psychology to measure noncognitive factors, such as students' affects

and behaviors of interest (exhibit 18). We adapted these survey items only where necessary to suit our student sample or to change to measurements of interest (e.g., frequency or extent of agreement).

Exhibit 18. Student Survey Scales and Sources

Factor	Chrombach's alpha Baseline	Chrombach's alpha Outcome	Explanation of Item(s)	Source of Item(s)
Relevance	0.88	0.92	Items provided by the 2013 Becoming Effective Learners Survey by the Consortium on Chicago School Research (CCCSR) which explored how students think about studying and learning as well as the	2013 Becoming Effective Learners Survey by the Consortium on Chicago School Research (CCCSR)
Belonging	0.72	0.83		
Self-efficacy	0.88	0.91		
Student supports	0.88	0.88	High School Longitudinal Study of 2009 produced by the National Center for Educational Statistics (NCES) that followed students throughout secondary and postsecondary years.	High School Longitudinal Study of 2009 produced by the National Center for Educational Statistics (NCES)
Conscien-tiousness	0.75	0.77	The five-item measurement for conscientiousness comes from the Big-Five Inventory (BFI), a commonly used set of 100 questions that place people along a personality continuum on measures of Extraversion, Agreeableness, Emotional Stability and Intellect, and Conscientiousness (Goldberg, 1993; John, 2009). Of these, conscientiousness is the personality trait most closely related to achievement (John & Srivastava, 1999).	Big Five Inventory, copyright Oliver P. John, Berkeley Personality Lab, 2009 <http://www.ocf.berkeley.edu/~johnlab/index.htm>
Growth Mindset	0.86	0.90	Carol Dweck's growth mindset scale is widely accepted as the validated measurement of the degree to which a student believes that his or her intelligence is changeable as opposed to a fixed trait (Dweck, 2006).	Growth Mindset, copyright Carol Dweck, 2006 <http://mindsetonline.com/testyourmindset/step1.php>

Intensive, Longitudinal student impact model

Prior to data collection, we registered the Intensive, Longitudinal design and two outcomes--credits accumulated by the end of 12th grade and number of college preparatory requirements--as confirmatory contrasts with the National Evaluation of Investing in Innovation (i3).

To estimate the effect of enrollment in the SBCUSD CPAs that began in 10th grade, we used inverse propensity weighting with regression adjustment, a doubly robust estimator that is less sensitive to issues of functional form than either inverse propensity weighting or regression adjustment alone (Bang & Robins, 2005; Tan, 2010; Wooldridge, 2010). These models have two stages: the first determines the predication of selection into treatment, the second uses the predicted selection into treatment and additional covariates to predict the students' outcomes and, in doing so, estimates the effect of treatment on these outcomes. All models were estimated using Stata version 14.2's *teffects ipwra* command.

We used an iterative process to determine the predictor variables and functional form. First, we chose the variables for which we prioritized baseline equivalence: prior achievement, gender, ethnicity, socioeconomic status (as measured by receipt of free or reduced-price lunch), and English Language Learner status. Given that the confirmatory outcomes are related to successful completion of coursework, in particular college preparatory coursework, we also thought it important to demonstrate equivalence on a measure of students' 9th-grade coursework. Other covariates were thought to be of secondary importance and were therefore included in the models as predictors of the outcome variable, but not of treatment status. We iterated several versions of the functional form until we found one that provided baseline equivalence (i.e., weighted standardized differences of .05 or below for all variables) when predicting the confirmatory outcomes (see findings section for baseline equivalence results).

We first use a logistic regression to predict a student's propensity to enter a CPA, conditional on a vector of student pretreatment characteristics. The vector of predictor variables includes student prior achievement scores (8th-grade math and ELA CST scores, including the indicator for the math exam taken), gender, English Learner status, ethnicity, free lunch status, and the indicator for a student being on-track to complete their college preparatory requirements at the end of 9th grade. It also includes interactions between gender and both ethnicity and English Learner status. We then estimate a student's predicted outcomes. In this model predicting outcomes, students are inversely weighted by their predicted propensity to enter treatment, as predicted in the prior estimation. The model also adjusts for a vector of control variables, which includes 8th-grade achievement, 9th-grade credit accumulation and attendance, the indicator for attending San Bernardino High School, and all demographic variables (gender, ethnicity, English Learner status, special education status, and free or reduced-price lunch). The models use a logistic model to predict treatment status and an Ordinary Least Squares (OLS) model to predict outcome data.[8] As the two confirmatory variables are closely related, we interpret these two impact models' statistical significance using a Benjamini-Hockberg multiple comparison correction.

[8] Logistic models predicting binary outcomes did not converge when using the same predictors that provided balance on baseline covariates for our confirmatory contrasts. We ran specification checks using logistic models and dropping free or reduced-price lunch status, which converged. We discuss the findings from these specification checks at the end of the results section if they diverge from the reported findings in statistical significance.

We also ran specification checks using baseline student survey data as a predictor. These specification checks included two models. First, we ran the main impact models, described above, with the sample of students for whom survey data are available and compared these results (in sign and significance) to the main impact models. This check allowed us to verify that the estimated treatment effects remained the same with the smaller sample (i.e., any differences in estimated impacts using the survey data as baseline would be driven by the data, and not the differences in samples). Then, we ran the main student impact models including the survey data as covariates in both the prediction of treatment status and outcome variables. These survey data allow for a check that any estimated treatment effects are driven by unobserved student characteristics.

Exploratory student impact model

To estimate the effect of enrollment in the SBCUSD academies that developed during the course of the grant period, we again used inverse propensity weighting with regression adjustment. For the exploratory analysis, both the vector predicting selection into an academy and vector predicting outcome variables include student prior achievement scores (8th-grade math and ELA Smarter Balanced scores), gender, English learner status, ethnicity, and free lunch status. Models used similar estimation procedures (e.g., Stata's *teffects ipwra* command).[9]

Findings

Here we describe our findings on program implementation and student outcomes.

Fidelity of program implementation

The Linked Learning San Bernardino project was implemented with adequate fidelity, although participation across the district, school, and pathway staff fell short of predetermined thresholds on some indicators in some years.

Component 1: Quality Review and Certification Process

For the quality review and certification process component, fidelity of implementation was measured with two indicators, both at the district level, in Year 1 only. The first indicator (1.1) was defined as ConnectEd and District leadership completing a District Needs and Capacity Assessment, and the second indicator (1.2) was the completion of an Implementation Plan. ConnectEd and SBCUSD met the threshold for fidelity with adequate implementation.

Changes to indicators. At the outset of the study we established a third indicator (1.3) for this component that would measure academies progress toward establishing a continuous improvement cycle and chart their progress toward achieving Linked Learning certification. Beginning in Year 2, this indicator required a new academy to complete one iteration of the OPTIC tool and identify action steps; in later years the academy was required to reassess their progress. While the certification process was on hiatus as the responsibility for certifying pathways shifted between organizations, the impetus for uploading data into the OPTIC Tool was negated. Because ConnectEd and SBCUSD could provide the pathway support and assessment without the use of the online tool, we chose to omit this indicator.

[9] As described above, we estimated binary variables using an OLS predictor model and ran a specification check using logistic models but without the socioeconomic status indicator.

Component 2: Coaching and Training Tailored to the District

The coaching and training tailored to the district component was measured with two indicators in Years 2, 3, and 4. The first criteria, (2.1) internal coach training, involved intensive training for internal school-level coaches, called Site Linked Learning Program Specialists (Program Specialists), and established a minimum number of Program Specialists to complete training toward certification each year as well as a minimum number of schools with certified coaches. The number of Program Specialists was expected to increase over time until each of the four schools in the study had a certified Program Specialist.

Changes to criteria for an indicator. While the Program Specialists were engaged in and completing their training, ConnectEd and SBCUSD agreed that the Program Specialists would not be granted a certificate and we removed this aspect of the criteria from the indicator. Typically ConnectEd gives these certificates to staff who are full-time school-level coaches focused on pathway development. As the SBCUSD Site Linked Learning Program Specialist positions were not full-time release from classroom teaching, they were not granted the certificate.

This revised threshold for the first indicator (2.1) was met each year.

The goal of the second criteria (2.2) was to develop a district-level community of practice and involved school and district staff participation in ConnectEd facilitated conversations quarterly during the school year beginning in Year 2. The criteria for the second indicator was met at both the school and district levels in Year 2 but fell short of participation requirements in Years 3 and 4.

Component 3: Academy Development

Fidelity of implementation for the academy development component was measured with two indicators in Years 2, 3, and 4. The first criteria, (3.1) Linked Learning Development and Networking, involved ConnectEd providing two 2-day trainings throughout the year to district, school, and academy staff beginning in Year 2. The purpose of these trainings was to provide both development and networking opportunities. We established thresholds for participation at the academy, school, and district levels requiring at least one representative attend each session.

Changes to the criteria for an indicator. As the work of the LLSB project unfolded, ConnectEd provided more than two 2-day sessions each year. We revised the wording of the criteria from requiring at least one participant from each level (academy, school, and district) attend *each* session to *two* sessions as that was in keeping with the original level of participation.

The threshold for the first indicator (3.1) was met for each of the three levels (academy, school, and district) in Years 2 and 3 but fell short on school-level participation in Year 4.

The second criteria involved ConnectEd providing 20 hours of support to the District LL Director and supports the Director in training the internal coaches (the Site Linked Learning Program Specialists). The threshold for this district-level indicator was met In Years 2 and 3 but was not met in Year 4.

Changes to indicators. Initially this component had a third indicator, (3.2) Academy Development Series, that involved academy teams completing a series of sequenced training modules beginning in Year 2. The professional development represented in this indicator was tied to the use of the OPTIC Tool in indicator 1.3. This indicator was cancelled in Year 3 along with the indicator of the OPTIC Tool.

Component 4: District and School Partnership and Structural Changes

The district and school partnership and structural changes component was measured with five indicators. Over the course of the study we revised the criteria for meeting fidelity for 1 indicator. The first indicator, (4.1) district vision, was met and involved district leaders writing a graduate profile in Year 3.

The second indicator, (4.2) district staffing, required the district to appoint staff in specific positions to lead the implementation of Linked Learning. In Year 1, SBCUSD was required to appoint a District Linked Learning Director. Although the Director was technically appointed 2 months after Year 1 ended, we consider the criteria met because the Director was in place and functioning in that capacity but without the title throughout Year 1. In Year 2, the district was required to appoint Work-based Learning Coordinators at either the district or school. These positions were not filled until Year 3 so this criteria was not met in Year 2.

The third indicator, (4.3) district-provided training to academy leads or school administrators, involved the district providing 30 hours of training and support to an increasing number of academy leads and/or school administrators annually, beginning in Year 2. In Year 2, the baseline was that four academy leads and/or school administrators attend 30 hours of training. Three academy leads attended more than 30 hours of training and two fell just short of the 30 hours (reaching a full 29 and 28 hours). We determined that the district met the goal for participation in Year 2.

Revision to criteria for an indicator. In Years 3 and 4 the district shifted its training strategy from having the District Linked Learning Director provide training directly to the pathway leads and/or school administrators to a train-the-trainer model in which the Linked Learning Director provided training to the Site Linked Learning Program Specialists who were then charged with training the pathway leads at their school site. We revised this criteria to match the district's training strategy and shifted the target participant from "academy leads and/or school leader" to "Site Linked Learning Program Specialist, academy lead, or school leader" and left the number of participants constant at four participants instead of increasing the number of academies represented. While the Program Specialists reported meeting regularly with their academy leads, they did not document their training time with sign-in sheets and we did not incorporate their school-based training into the criteria for this indicator. With the revised criteria, the threshold for fidelity of implementation was met in Years 3 and 4 as each of the four Program Specialist participated in over 30 hours of training each year.

The goal of the fourth indicator, (4.4) school scheduling, was to have schools adapt the master schedules to support cohort scheduling beginning in Year 2. At the academy level, fidelity of implementation was measured by the number of academy teams that had schedules that allowed for them to meet at least twice per week. At the school level, fidelity of implementation was measured by a 7-period day master schedule and/or the provision of opportunities for students to take courses outside the 6-period day. For the indicator to meet its threshold overall, the thresholds for both the academy and school levels had to be met. The overall threshold for the fourth indicator was not met in any year although it was met at either the academy or school level each year.

The fifth indicator, (4.5) school and academy staffing, involved an increasing number of pathway leads having one release period each day dedicated to pathway activities beginning in Year 3. The fifth indicator was not met in Year 3 and was met in Year 4.

The Linked Learning San Bernardino project leaders established a threshold for the program-level scores for fidelity of implementation at the sample level for each component for each year that required each of the indicators to be met for the component to be considered implemented with fidelity that year.[10] We present the scores in Appendix B. The table below represents a summary of the key components and indicates if the component met the threshold for adequate implementation each year. The recently published report on the Investing in Innovation Fund established a threshold for intervention-level fidelity of implementation: "The intervention was considered to have been implemented with adequate fidelity if the implementation of the majority of the intervention's key components met the specified fidelity threshold in at least 50 percent of the years of measurement" (Boulay et al., 2018, p. 33). In keeping with this definition, the Linked Learning San Bernardino: Accelerating College and Career Readiness in Low-Performing Schools i3 development grant was implemented with adequate fidelity.

[10] Linked Learning San Bernardino: Accelerating College and Career Readiness in Low-Performing Schools i3 Study Design. Submitted to Abt Associates in October 2014.

Exhibit 19: LLSB Implementation Fidelity by Component by Year

	Key Indicators of Component (Level)	Year 1 (2013–14)	Year 2 (2014–15)	Year 3 (2015–16)	Year 4 (2016–17)
Component 1: Quality Review and Certification Process					
1.1	District Needs & Capacity Assessment (District)	Met	n/a	n/a	n/a
1.2	Implementation Plan (District)	Met	n/a	n/a	n/a
Implemented with Adequate Fidelity?		Yes	n/a	n/a	n/a
Component 2: Coaching and Support Tailored to the District					
2.1	Internal coach training (School)	n/a	Met	Met	Met
2.2	Development of a district-level community of practice (School & District)	n/a	Met (School & District)	Not met (School & District)	Not met (School & District)
Implemented with Adequate Fidelity?		n/a	Yes	No	No
Component 3: Academy Development					
3.1	Linked Learning development and networking (Academy, School, & District)	n/a	Met (Academy, School, & District)	Met (Academy, School, & District)	Not met (Met at Academy & District, Not met at School)
3.3	District Linked Learning Director coaching (District)	n/a	Met	Met	Not met
Implemented with Adequate Fidelity?		n/a	Yes	Yes	No

Exhibit 20: LLSB Implementation Fidelity by Component by Year (concluded)

	Key Indicators of Component (Level)	Year 1 (2013–14)	Year 2 (2014–15)	Year 3 (2015–16)	Year 4 (2016–17)
Component 4: District and School Partnership and Structural Changes					
4.1	District vision (District)	n/a	n/a	Met	n/a
4.2	District staffing (District)	Met	Not met	n/a	n/a
4.3	District-provided training to pathway leads or ACIIs (Academy)	n/a	Met	Met	Met
4.4	School scheduling (Academy & School)	n/a	Not met (not met at School but met at Academy)	Not met (not met at Academy but met at School)	Not met (not met at Academy but met at School)
4.5	School and Academy Staffing (Academy)	n/a	n/a	Not met	Met
Implemented with Adequate Fidelity?		Yes	No	No	No
How many of the key components that were measured with fidelity in each year were implemented with adequate fidelity?		**2/2: Met**	**2/3: Met**	**1/3: Not met**	**0/3: Not met**

Student outcomes

Here we present our findings on student outcomes for both research designs.

Intensive, Longitudinal Design

Estimated impacts of the CPAs on district-collected data are provided in exhibit 21. The CPAs had a positive and statistically significant effect on the two confirmatory outcomes: total number of credits accumulated and number of college preparatory requirements completed. As both outcomes are statistically significant, both remain statistically significant after the Benjimini-Hockberg multiple comparison correction. Exhibit 22 provides baseline data for the confirmatory outcome sample: both unweighted and weighted by the inverse propensity weights used to predict selection into treatment.

Exhibit 21: Estimated Impacts of CPAs on Student School Outcomes: Intensive, Longitudinal Design

	Point Estimate	s.e.		Student N
Academic Achievement (11th grade)				
Smarter Balanced math	8.85	(7.76)		651
Smarter Balanced ELA	20.84	(7.51)	**	653
Attendance				
10th grade attendance	0.8%	(0.00)	~	744
11th grade attendance	1.8%	(0.00)	***	601
12th grade attendance	1.1%	(0.01)		639
College preparatory grade point average				
10th-11th college preparatory GPA	-0.03	(0.06)		639
Credit completion				
Total credits, 10th-12th grade^	10.80	(3.82)	**	639
10th grade credits completed	4.55	(1.63)	**	744
11th grade credits completed	4.94	(1.75)	**	691
12th grade credits completed	1.36	(1.75)		639
College preparatory requirements				
Total college preparatory requirements met, 10th-12th grade^	0.70	(0.34)	*	639
Probability of meeting all preparatory requirements	-7.0%	(0.03)	*	639
School completion				
Graduation	-3.1%	(0.03)		531
Remaining in district	-1.7%	(0.04)		744

~ p < .1; *p < .05; **p < .01; ***p < .001

^Confirmatory contrast

Exhibit 22 provides the raw and weighted baseline data for the matching variables. These specific tables describe the analytic sample used to examine the impact of the program on credits accumulated by the end of 12th grade and number of college preparatory requirements, the two confirmatory contrasts registered with the National Evaluation of Investing in Innovation (i3) prior to data collection. These tables are extracted using the *teffects summarize* command in Stata version 14.2.

Exhibit 22: Weighted and Unweighted Baseline Data Used to Match the Intensive, Longitudinal Analysis Predicting Cumulative 10th–12th Grade Course Outcomes

	Standardized Difference, Unweighted	Standardized Difference, Weighted	Ratio, Unweighted	Ratio, Weighted
English Learner	-0.256	0.014	0.618	1.023
Female	0.342	-0.015	0.930	1.000
English Learner # Female	0.025	0.012	1.091	1.041
Reclassified Fluent English Proficient	0.113	0.011	0.992	0.999
Reclassified Fluent English Proficient # Female	0.205	-0.012	1.191	0.988
Latino/a	-0.009	0.023	1.027	0.946
Latino/a # Female	0.329	-0.015	1.022	0.996
8th-Grade ELA CST Scale Score	0.196	0.019	0.787	0.849
8th-Grade Math CST Scale Score	0.090	-0.001	0.669	0.656
Took Algebra 1 8th-Grade CST Exam	0.159	-0.008	0.694	1.016
On Track to Complete a-g in 9th grade	0.289	-0.037	1.220	0.966
Receives Free or Reduced-Price Lunch	0.115	-0.025	0.498	1.134

Exhibit 23 uses the weights used in the matching process to calculate weighted means of the baseline variables used to match the academy and comparison samples. As in Exhibit 22, we provide the results of the matching process for the analytic sample used in the confirmatory contrasts.

Exhibit 23: Weighted and Unweighted Mean Baseline Data Used to Match the Intensive, Longitudinal Analysis Predicting Cumulative 10th–12th Grade Course Outcomes, by Academy and Comparison Status

	Unweighted Academy	Unweighted Comparison	Unweighted Overall	Weighted Academy	Weighted Control
English Learner					
	11.4%	20.8%	19.1%	19.7%	19.1%
Female					
	64.0%	47.2%	50.2%	49.5%	50.2%
Reclassified Fluent English Proficient					
	56.1%	50.5%	51.5%	52.1%	51.6%
Latino/a					
	87.7%	88.0%	87.9%	88.7%	87.9%
8th-Grade ELA CST Scale Score					
Mean	342.19	332.58	334.30	335.35	334.43
SD	46.00	51.85	50.96		
8th-Grade Math CST Scale Score					
Mean	336.86	331.20	332.21	332.17	332.26
SD	56.42	69.00	66.92		
Took Algebra 1 8th-Grade CST Exam					
	90.4%	85.1%	86.1%	85.8%	86.1%
On Track to Complete a-g in 9th grade					
	41.2%	27.6%	30.0%	28.2%	29.9%
Receives Free or Reduced-Price Lunch					
	98.2%	96.4%	96.7%	96.2%	96.7%
N	114	525	639		

In addition to having impacts on the two confirmatory contrasts, CPAs also had positive and statistically significant impacts on student ELA achievement, as measured by the Smarter Balanced assessment, and attendance in the 11th grade. CPAs had an estimated negative impact on student completion of all college-preparatory requirements. While this negative outcome is worth district investigation, we caution that our data on this outcome has one significant flaw: namely, we do not know if students meet their college preparatory requirements through an alternative source (e.g., using home language fluency to circumvent the need for foreign language classes in high school).

Results are generally consistent in the robustness checks we ran, with a few exceptions:

- ELA achievement becomes nonsignificant when run with the smaller sample size. The point estimate drops from about 21 points to about 14 points. When including the survey data as baseline controls, the estimated impact becomes marginally significant.
- The estimated impact on completion of all college preparatory requirements retains a negative sign but is not significant in any of the robustness checks.
- When using a logistic model, the estimated impacts of CPAs on graduation become negative and statistically significant. However, given the small number of students in the sample who do not graduate (5 of 101 CPA students), we caution against over-interpretation of this finding, as a single clerical error in the data could potentially drive these results.

Estimated impacts of the CPAs on survey outcomes are provided in exhibit 24. The CPAs had a positive and statistically significant effect on student perceptions of teacher supports and feelings of belonging in school. Both factors ran on a 1 through 7 scale, with 1 equal to strongly disagree, 2 equal to disagree, 3 equal to mostly disagree, 4 equal to neither agree nor disagree, 5 equal to mostly agree, 6 equal to agree, and 7 equal to strongly agree. Comparison students' perceptions of teacher support averaged a score of 5.6—between "mostly agree" and "agree." CPA students averaged .6 higher, moving their score above the agreeing threshold and below "strongly agree." Comparison student averaged 4.8 on their sense of belonging—just below "mostly agree." CPA students answered an average of .6 higher—moving them to halfway between "mostly agree" and "agree." No other survey outcomes had a statistically significant finding. Models were robust to specification checks.

Exhibit 24: Estimated Impacts of CPAs on Student Survey Measures: Intensive, Longitudinal Design

	Point Estimate	s.e.		Student N
Student perception of teacher supports	0.66	(0.12)	***	322
Student feeling of belonging in school	0.61	(0.14)	***	322
Conscientiousness	0.15	(0.09)		322
Student perception of class relevance	0.14	(0.20)		322
Student self-efficacy	0.11	(0.18)		322
Growth mindset	-0.09	(0.20)		322
Frequency of being late for school	-0.17	(0.17)		322

~ p < .1; *p < .05; **p < .01; ***p < .001

Exploratory Design

Estimated impacts of the newly developed academies are provided in exhibit 25. There were no estimated impacts of these academies on student outcomes. Exhibit 26 provides raw and weighted baseline differences of the analytic sample for the Exploratory Design.

Exhibit 25: Estimated Impacts of Academies on 9th-Grade Outcomes: Exploratory Design

	Point Estimate	s.e.		Student N
Attendance	0.00	(0.00)		1,385
Credits completed	-1.69	(1.00)	~	1,385
Number of college preparatory requirements met	0.00	(0.08)		1,385
On track to complete all college preparatory requirements	0.04	(0.02)	~	1,385

~ p < .1; *p < .05; **p < .01; ***p < .001

Exhibit 26: Raw and Model-Adjusted Treatment-Control Baseline Differences for the Exploratory Design Estimating Impacts on Credit Accumulation

	Standardized Differences		Ratios	
	Raw	*Adjusted*	*Raw*	*Adjusted*
8th Grade ELA SBAC Scale Score	0.200	-0.000	1.020	1.073
8th Grade Math SBAC Scale Score	0.057	0.001	1.014	1.000
Latino/a	-0.374	-0.002	1.631	1.003
Female	0.017	-0.004	1.002	1.000
Receives Free or Reduced-Price Lunch	-0.034	-0.000	1.075	1.000
Special Education	-0.058	-0.001	0.874	0.999
English Learner	-0.244	0.001	0.634	1.001
Reclassified Fluent English Proficient	-0.072	-0.001	0.971	0.999

References

Bang, H., & Robins, J. M.. (2005). Doubly robust estimation in missing data and causal inference models. *Biometrics, 61*, 962–972.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across and adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246–263.

Boulay, B., Goodson, B., Olsen, R., McCormick, R., Darrow, C., Frye, M., et al. (2018). *The Investing in Innovation Fund: Summary of 67 Evaluations: Final Report* (NCEE 2018-4013). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Duckworth, A.L, & Quinn, P.D. (2009). Development and validation of the Short Grit Scale (Grit-s). *Journal of Personality Assessment, 91*, 166–174.

Farrington, C. A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., et al. (2012). *Teaching adolescents to become learners. The role of noncognitive factors in shaping school performance: A critical literature review.* Chicago: University of Chicago Consortium on Chicago School Research.

Fredricks, J., McColskey, W., Meli, J., Mordica, J., Montrosse, B., & Mooney, K. (2011). *Measuring student engagement in upper elementary through high school: A description of 21 instruments.* (Issues & Answers Report, REL 2011–No. 098). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast. Retrieved from http://ies.ed.gov/ncee/edlabs.

Goldberg, L.R. (1993) The Structure of Phenotypic Personality Traits. American Psychologist, 48, 26-34. http://dx.doi.org/10.1037/0003-066X.48.1.26

John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In L. A. Pervin, & O. P. John (Eds.), Handbook of personality: Theory and research (2nd ed., pp. 102-138). New York: Guilford.

Paulhus, D.L. & Vazire, S. (2009). The Self-Report Method. In Robins, R.W., Fraley, R.C., and Krueger, R.F. (Eds.), *Handbook of research methods in personality psychology* (pp. 224–239). New York: Guilford.

Srivastava, S., John, O. P., Gosling, S. D., & Potter, J. (2003). Development of personality in early and middle adulthood: Set like plaster or persistent change? *Journal of Personality and Social Psychology, 85*(4), 1041–1053.

Tan, Z. (2010). Bounded, efficient and doubly robust estimation with inverse weighting. *Biometrika, 97*, 661–682.

Wilson, T. D., & Linville, P. W. (1982). Improving the academic performance of college freshmen: Attribution therapy revisited. *Journal of Personality and Social Psychology, 42*, 367-376.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data.* 2nd ed. Cambridge, MA: MIT Press.

Appendix A: Linked Learning Academies and the SBCUSD Rating System

Exhibit A-1. Ratings of Linked Learning Academies as of Spring 2018

	Rating
Arroyo Valley High School	
Business & Logistics Academy	1
C.O.R.E. Academy	6
Digital Media Arts Academy	3
Global Leadership Academy	3
Local & National Security Academy	1
Teaching Academy	6
Visual & Performing Arts Academy	1
Pacific High School	
Academy of Digital Design and Communication	6
Academy of PLTW Biomedical	5
Heavy Diesel (Pilot Program)	None
San Bernardino High School	
Academy of Air Force ROTC	3
Academy of E-Business	6
Academy of Law and Society	5
Academy of PLTW Engineering	2
Academy of Public Safety	6
Academy of Sports Medicine	2
Academy of Visual and Performing Arts	4
San Gorgonio High School	
NAF Academy of Arts, Media & Entertainment	5
NAF Academy of Finance & Business	6
NAF Academy of Hospitality & Tourism	6
NAF Academy of Information Technology	6
NAF/PLTW Academy of Health Science	6

Exhibit A-2. San Bernardino City Unified School District's Academy Rating System

Stage	Steps and Process
Setting the Conditions	**Step 1: Vision Planning and Pathway Design** ☐ Forming a Design Team ☐ Establishing a pathway vision and mission ☐ Determining and/or refining a pathway theme ☐ Developing pathway-level college and career-ready student learning outcomes ☐ Forming a business and community Advisory Committee
	Step 2: Structures and Schedules ☐ Designing the Program of Study ☐ Beginning student recruitment and selection ☐ Creating a master schedule ☐ Making staff assignments
Transforming Teaching and Learning	**Step 3: Community of Practice, Performance-Based Assessments, and Curriculum** ☐ Building a collaborative, results-oriented culture ☐ Mapping student learning outcomes to Program of Study ☐ Creating benchmarks and assessments based on the outcomes ☐ Developing a curriculum sequence and courses, including single- and multi-disciplinary integrated projects
	Step 4: Engaged Learning and Teaching ☐ Aligning daily classroom instruction with the pathway experience ☐ Developing and strengthening instruction and assessment ☐ Functioning as a Community of Practice, pathway teachers agree to common and high expectations ☐ Engaging students through the integration of work-based learning ☐ Looking regularly at student work
	Step 5: Embedding Student Supports and Personalization ☐ Creating an atmosphere where support and engagement occur naturally ☐ Planning to provide academic interventions ☐ Providing counseling and guidance, plus career and college planning
Continuous Improvement	**Step 6: Continuous Improvement** ☐ Establishing indicators to facilitate data-driven decisions ☐ Making ongoing review and reflection part of practice ☐ Conduction peri8odic reviews to plan for improvement

Appendix B: Supplementary Tables for Implementation Fidelity

Exhibit B-1: LLSB Program Implementation Component Summary

	Key Indicators of Component	Operational Definition for Indicator	Levels at which the component is met
Component 1: Quality Review and Certification Process			
1.1	District Needs & Capacity Assessment	ConnectEd (CE) and Linked Learning (LL) director/other district leadership complete District Needs & Capacity Assessment once, at outset of project	District
1.2	Implementation plan	Completion of implementation plan, once at outset of project	District
Component 2: Coaching and Support Tailored to the District			
2.1	Internal coach training	ConnectEd provides a 5-6 day intensive training, followed by 6 months of apprenticeship. Begins in Year 2.	School
2.2	Development of a district-level community of practice	ConnectEd staff and affiliates facilitate conversations for district and school leaders once quarterly during the school year in each year beginning in Year 2.	School and District
Component 3: Academy Development			
3.1	Linked Learning development and networking	ConnectEd provides two 2-day trainings throughout the year to district, school, and academy staff. Training provided annually beginning in Year 2.	Academy, School, and District
3.3	District Linked Learning Director coaching	CE provides 20 hours of support to District LL Director; supports Director in training internal coaches. Begins in Year 2.	District
Component 4: District and School Partnership and Structural Changes			
4.1	District Vision	District writes a graduate profile in Year 3.	District
4.2	District Staffing	District appoints appropriate staff (LL director and WBL coordinator).	District
4.3	District-provided training to academy leads or ACIIs	District provides 30 hours of training and support to Site Linked Learning Program Specialists, pathway leads, and/or school administrators annually, beginning in Year 2.	Academy
4.4	School scheduling	Schools adapt master schedules to support cohort scheduling.	Academy and School
4.5	School and Academy Staffing	Academy leads have dedicated release time (1 period per day). Begins in Year 3.	Academy

The table below represents a summary of the key components of the LLSB study and indicates if the component met the threshold for adequate implementation each year. The recently published report on the Investing in Innovation Fund established a categorization scheme for the nature of the activities represented in each domain (Boulay et al., 2018, p. 8). Using that scheme, we categorized each of the four key components in the LLSB project into a domain. The report also established a threshold for intervention-level fidelity of implementation: "The intervention was considered to have been implemented with adequate fidelity if the implementation of the majority of the intervention's key components met the specified fidelity threshold in at least 50 percent of the years of measurement" (Boulay et al. 2018, p. 33). In keeping with this definition, the Linked Learning San Bernardino: Accelerating College and Career Readiness in Low Performing Schools i3 development grant was implemented with adequate fidelity.

Exhibit B-2. Summary of Key Components and Measures of Implementation Fidelity

Intervention Description	Key Component Name	Key Component Domain	Y1	Y2	Y3	Y4
The Linked Learning San Bernardino (LLSB) project was designed to create Linked Learning career-themed academies offering learning environments for students that support their success in school and improve their college and career readiness and postsecondary outcomes. Creating these learning environments includes changing teachers' instructional practices with the goal of improving students' cognitive and noncognitive outcomes. To achieve these outcomes, ConnectEd provides a system of supports designed to address the varied needs of actors in different organizational positions that was responsive to both their context and their individual knowledge, skills, and abilities. The system of supports are professional development events comprised of in-person trainings or workshops, online learning opportunities, as well as individual and group coaching.	Quality Review and Certification Process	Target Leadership Structures and Supports	Met	n/a	n/a	n/a
	Coaching and Support Tailored to the District	Provide Coaching	n/a	Met	Not met	Not met
	Academy Development	Provide Coaching	n/a	Met	Met	Not met
	District and School Partnership and Structural Changes	Institute Structural Changes	Met	Not met	Not met	Not met
How many of the key components that were measured with fidelity in each year were implemented with adequate fidelity?			**2/2: Met**	**2/3: Met**	**1/3: Not met**	**0/3: Not met**

Exhibit B-3: LLSB Implementation Fidelity Reporting Summary by Year for Each Component

Key Components (on logic model)	Definitions		Findings							
			Year 1 (2013-14)		Year 2 (2014-15)		Year 3 (2015-16)		Year 4 (2016-17)	
	Implementation Measure	Definition of "Implementation with fidelity" at sample level	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?
Intervention Components										
1) Quality Review and Certification Process	Calculation based on 2 quality review and certification indicators 1 indicator based on academies 0 indicators based on schools 2 indicators based on districts	***Academies***: Year 1: N/A ***Schools:*** *N/A* ***District***: Year 1: Met threshold for 2 district indicators (1.1 and 1.2) Years 2-4: N/A	Threshold met for 2 district indicators (1.1 and 1.2)	**Yes** Score = 2 = Implementation with fidelity	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Exhibit B-3: LLSB Implementation Fidelity Reporting Plan by Year for Each Component (continued)

Key Components (on logic model)	Definitions		Findings							
			Year 1 (2013-14)		Year 2 (2014-15)		Year 3 (2015-16)		Year 4 (2016-17)	
	Implementation Measure	Definition of "Implementation with Fidelity" at sample level	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?
Intervention Components										
2) Coaching and Support Tailored to the District	Calculation based on 2 coaching and support indicators 0 indicators based on academies 2 indicators based on schools 1 indicator based on district	***Academies*** : N/A ***Schools:*** Year 1: N/A Years 2, 3, & 4: Met threshold for 2 school indicators (2.1 and 2.2) ***District*** Year 1: N/A Years 2, 3, & 4: Met threshold for 1 district indicator (2.2)	N/A	N/A	Threshold met for 1 district indicator (2.2) Threshold met for 2 school indicators (2.1 or 2.2)	**Yes** Score = 2 = Implementation with Fidelity	Threshold met for 1 school indicator (2.1) Threshold not met for 1 school indicator (2.2) Threshold not met for 1 district indicator (2.2)	**No** Score = 1 = low implementation	Threshold met for 1 school indicator (2.1) Threshold not met for 1 school indicator (2.2) Threshold not met for 1 district indicator (2.2)	**No** Score = 1 = low implementation

Exhibit B-3: LLSB Implementation Fidelity Reporting Plan by Year for Each Component (continued)

Key Components (on logic model)	Definitions		Findings							
			Year 1 (2013-14)		Year 2 (2014-15)		Year 3 (2015-16)		Year 4 (2016-17)	
	Implementation Measure	Definition of "Implementation with Fidelity" at sample level	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?
Intervention Components										
3) Academy Development	Calculation based on 2 academy development support indicators 1 indicator based on academies (3.1) 1 indicator based on schools (3.1) 2 indicators based on district (3.1 and 3.2)	***Academies*** : Year 1: N/A Years 2, 3, & 4: Met threshold for 1 academy indicators (3.1) ***Schools:*** Year 1: N/A Years 2, 3, & 4: Met threshold for 1 school indicator (3.1) ***District*** Year 1: N/A Years 2, 3, & 4: Met threshold for 2 district indicators (3.1, 3.2)	N/A	N/A	Threshold met for: 1 academy indicators (3.1) AND 1 school indicator (3.1) AND 2 district indicators (3.1, 3.3)	**Yes** Score = 2 = Implementation with Fidelity	Threshold met for 1 academy indicators (3.1) AND 1 school indicator (3.1) AND 2 district indicators (3.1, 3.3)	**Yes** Score = 2 = Implementation with Fidelity	Threshold not met for 1 academy indicators (3.1) OR 1 school indicator (3.1) OR 2 district indicators (3.1, 3.3)	**No** Score = 0 = low implementation

Exhibit B-3: LLSB Implementation Fidelity Reporting Plan by Year for Each Component (concluded)

Key Components (on logic model)	Definitions		Findings							
			Year 1 (2013-14)		Year 2 (2014-15)		Year 3 (2015-16)		Year 4 (2016-17)	
	Implementation Measure	Definition of "Implementation with Fidelity" at sample level	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?	Implementation fidelity score	Implemented with Fidelity?
Intervention Components										
4) District and School Partnership and Structural Changes	Calculation based on 5 district and school change indicators 3 indicators based on academies 1 indicator based on schools 2 indicators based on districts	***Academies*** : Year 1: N/A Year 2: Met threshold for 2 academy indicators (4.3, 4.4) Years 3 & 4: Met threshold for 3 academy indicators (4.3, 4.4, 4.5) ***Schools:*** Year 1: N/A Years 2, 3, &4: Met threshold for 1 school indicator (4.4) ***District*** Years 1 & 2: Met threshold for 1 district indicator (4.2) Year 3: Met threshold for 1 district indicator (4.1) Year 4: N/A	Threshold met for 1 district indicator (4.2)	**Yes** Score = 1 = Implementation with Fidelity	Threshold met for 1 academy indicator (4.3) Threshold not met for 1 academy indicators (4.4) OR 1 school Indicator (4.4) OR 1 district indicator (4.2)	**No** Score = 0 = low implementation	Threshold met for 1 academy indicator (4.3) Threshold not met for 2 academy indicators (4.4, 4.5) OR 1 school Indicator (4.4) OR 1 district indicator (4.1)	**No** Score = 1 = low implementation	Threshold met for 1 academy indicator (4.3) Threshold not met for 2 academy indicators (4.4, 4.5) OR 1 school Indicator (4.4)	**No** Score = 0 = low implementation

References

Boulay, B., Goodson, B., Olsen, R., McCormick, R., Darrow, C., Frye, M., et al. (2018). *The Investing in Innovation Fund: Summary of 67 Evaluations: Final Report* (NCEE 2018-4013). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.