REPORT 4 | FINDINGS FROM THE STUDY OF DEEPER LEARNING
Opportunities and Outcomes

Deeper Learning and High School Graduation: Is There a Relationship?

AUGUST 2016

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The Research Alliance for New York City Schools

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Abstract

The *Study of Deeper Learning: Opportunities and Outcomes*—funded by the William and Flora Hewlett Foundation—aimed to determine whether students attending high schools with a mature and at least moderately well implemented approach to promoting *deeper learning* actually experienced greater deeper learning opportunities and outcomes than they would have had they not attended these schools. In this report, we extend the analyses from our original study to explore the connections between deeper learning opportunities, deeper learning competencies (in the interpersonal, intrapersonal, and cognitive domains), and high school graduation. The findings indicate that students' opportunities to engage in deeper learning and the deeper learning competencies they developed were positively associated with graduating from high school. The ways in which deeper learning opportunities and competencies were connected to graduation differed across study locations, however.

Key findings include the following:

1. Students' deeper learning competencies were positively associated with high school graduation, but the nature of the association differed between California and New York City.
    - A composite measure of *interpersonal and intrapersonal competencies* was significantly related to high school graduation for students in California but not for students in New York City: California students with a value on the composite measure one standard deviation above the average had graduation rates 5 percentage points higher than students with average values.
    - Conversely, a composite measure of *cognitive competencies* was significantly related with high school graduation for students in New York City but not for students in California: New York City students with a value on the composite measure one standard deviation above the average had graduation rates 14 percentage points higher than students with average values.
2. Four of the nine individual deeper learning opportunity measures (opportunities for collaboration, learning how to learn, receiving feedback, and real-world connections) were positively associated with high school graduation in California, but none of the measures were significantly associated with graduation in New York City.
    - In California, students with an opportunity measure score one standard deviation above average had graduation rates approximately 4 to 5 percentage points higher than students with average scores.
3. Some, but not all, of the interpersonal and intrapersonal competencies were positively associated with high school graduation, with differences evident between students in California and New York City.
    - In California, six of the eight competency measures (collaboration skills, academic engagement, motivation to learn, self-efficacy, locus of control, and perseverance) were significantly related to graduation: students with a score one standard deviation above average had graduation rates approximately 4 to 5 percentage points higher than students with average scores.
    - In New York City, two of the eight competency measures (self-efficacy and perseverance) were significantly related to graduation: students with a score one standard deviation above average had graduation rates approximately 6 to 7 percentage points higher than students with average scores.
4. Two of the three cognitive competency measures were positively associated with high school graduation in New York City, but none of the competency measures were associated with graduation in California.
    - In New York City, students with a reading or mathematics score one standard deviation above average had graduation rates approximately 13 percentage points higher than students with average scores.

The general pattern of results supports the idea that there is a connection between students' deeper learning competencies and graduation from high school. The different findings for California and New York City, however, raise questions about how state and local contexts may hinder or promote the connection between deeper learning and graduation. In particular, differences in high school graduation requirements between the two states may explain why cognitive competencies had a stronger relationship with graduation in New York City (where students must pass multiple Regents exams) than in California (where most students in our sample already passed the state's exit exam).

Introduction

Over the past few years, a groundswell of interest among practitioners, policy makers, and researchers has culminated in promoting "deeper learning" as a way to improve college, career, and civic readiness beyond traditional academic content knowledge. The term *deeper learning* refers to a process whereby individuals develop skills needed to apply learning in one content area to new and different situations (National Research Council [NRC], 2012). This deeper learning process is associated with six interconnected competencies or goals for students that many argue are prerequisites for success in college, career, and civic life (Chow, 2010; Trilling, 2010; William and Flora Hewlett Foundation, 2013). These competencies, which the NRC groups into three domains, are presented in Exhibit 1. Throughout this report, we refer to these three domains collectively as *deeper learning competencies,* and we use the more general term *deeper learning* to describe the process of developing these competencies.[1]

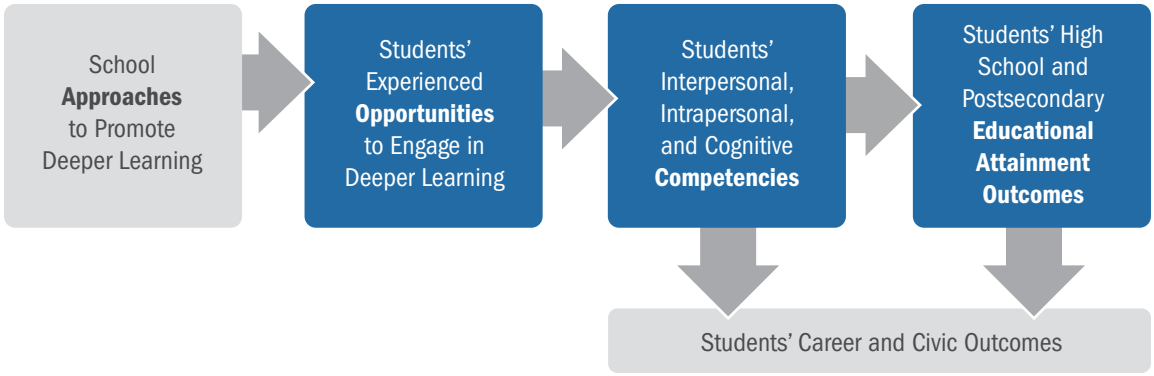
Exhibit 1. Competency Domains for Deeper Learning (Hewlett Foundation and NRC Frameworks)

Cognitive Domain	Deep content knowledge
	Critical thinking and complex problem solving
Interpersonal Domain	Collaboration
	Communication
Intrapersonal Domain	Learning-to-learn competencies
	Academic mindsets

The call for high schools to develop students' deeper learning competencies rests on several fundamental assumptions about how educational approaches are related to desired student outcomes. The theorized relationships, depicted in Exhibit 2, begin with the assumption that educators can design instruction, school structure, and school culture to focus explicitly on deeper learning—and that these approaches will be somewhat distinct from those common to traditional schools. Then, as a result of these approaches, students in schools that promote deeper learning will be exposed to more opportunities to engage in deeper learning than they would be in a more traditional setting. Finally, given these opportunities, students will develop transferable deeper learning competencies, which in turn will translate into success in high school and college. This success will then lead to better career and civic outcomes.

[1] Consistent with a recent National Research Council report (NRC, 2012), we use *deeper learning* to refer to the process through which students learn these competencies in ways that allow their transfer to novel situations and problems. We use *deeper learning competencies* to refer to the results of this learning process. We also refer to *opportunities for deeper learning* or *deeper learning opportunities* to refer to specific aspects of the learning environment believed to foster deeper learning competencies.

Exhibit 2. Abbreviated Theory of Action



In 2014, American Institutes for Research (AIR) completed *The Study of Deeper Learning: Opportunities and Outcomes,* which provided evidence that promoting deeper learning has potential merit as a means for educational improvement. The study found that, compared to similar students in comparison high schools, students in high schools with a mature and at least moderately well implemented approach to promoting deeper learning reported experiencing more opportunities to engage in deeper learning (Bitter, Taylor, Zeiser, & Rickles, 2014); demonstrated higher scores on measures of cognitive, interpersonal, and intrapersonal competencies; and were more likely to graduate from high school on time (i.e., within four years of high school entry) and enroll in four-year postsecondary institutions (Zeiser, Taylor, Rickles, Garet, & Segeritz, 2014).

In addition, *The Study of Deeper Learning* found that individual students' exposure to deeper learning opportunities was positively associated with their interpersonal and intrapersonal competencies (Bitter et al., 2014). However, the relationships between opportunities for deeper learning and cognitive competencies were less pronounced—only students' opportunities for complex problem solving had a significant positive relationship with students' cognitive competencies.[2]

The research reported here extends the results in these three earlier reports by examining the assumed relationships highlighted in the theory of action, with a focus on whether students' deeper learning opportunities and competencies are associated with graduating on time from high school. This report examines these relationships in two ways. First, the report focuses on the relationships between a composite measure of students' opportunities for deeper learning and two composite measures of deeper learning competencies. Using structural equation modeling (SEM), we combine multiple measures of deeper learning opportunities into a single opportunity composite score and multiple measures of deeper learning competencies into two competency composite scores. The analysis addresses the following research question:

[2] Because the OECD PISA-Based Test for Schools aims to measure problem-solving and critical thinking skills, students' cognitive competencies were expected to be related to students' opportunities for complex problem solving but not necessarily to the other deeper learning opportunities (e.g., collaboration, communication).

1. Are the relationships between students' opportunity for deeper learning composite score, deeper learning competency composite scores, and on-time graduation consistent with the deeper learning theory of action?

Second, the report provides a more detailed look at how specific types of deeper learning opportunities and competencies are related to students' probability of graduating from high school on time. The more detailed examination addresses the following two research questions:

2. Are some types of opportunities for deeper learning more strongly associated with on-time high school graduation than others?
3. Are some types of deeper learning competencies more strongly associated with on-time high school graduation than others?

Addressing these three research questions helps us understand whether the experiences of students in *The Study of Deeper Learning* support the theorized connections between deeper learning and high school graduation.

Study Design

This section provides an overview of the sample and measures we used for this report, which were all derived from the larger *Study of Deeper Learning: Opportunities and Outcomes.* Although the original study measured outcomes for a total of 18,436 students from 28 high schools who entered ninth grade between the 2007–08 and 2011–12 academic years, only students who participated in both the student survey and the cognitive assessment in spring 2013 have the data necessary to answer the research questions for this report. (See *The Study of Deeper Learning: Technical Appendix* [Zeiser, Rickles, Taylor, & Garet, 2014] for details about the sample and data for the original study.)

Sample

For the analyses reported here, we examined student survey data, test score data, and high school graduation records for 473 students (in 18 schools) who participated in *The Study of Deeper Learning* and in all three forms of data collection. The sample schools are located in New York City and in five districts in California. Although the main analyses in *The Study of Deeper Learning* compared outcomes for students attending deeper learning network schools[3] and students attending comparison schools, this report examines students' opportunities for deeper learning and measures of deeper learning competencies regardless of whether students attended a network or comparison school. Looking at relationships within both deeper learning

[3] For *The Study of Deeper Learning,* we defined *network schools* as high schools that focus on the development of deeper learning competencies and are associated with a school network that was a member of the Deeper Learning Community of Practice.

network schools and comparison schools allows us to examine the relationships between deeper learning opportunities, competencies, and high school graduation among a more general sample of students and schools. The sample does not include students who left the study schools or dropped out of school prior to the spring of their third year of high school, because students had to be enrolled in the study schools when the survey and cognitive assessment were administered.[4]

A description of the student sample is provided in Exhibit B1 in Appendix B. To determine whether our sample of third-year high school students who participated in all three forms of data collection represented a selective subset of all students who entered the study schools in the same cohort, we examined the demographic and eighth-grade performance characteristics for both groups. Exhibit B1 presents this information separately for the California and New York City schools. In California, students in the analytic sample had characteristics similar to the full cohort of students who started high school in the same year. In New York City, students in the analytic sample were less likely to be Hispanic, English language learners, or eligible for free or reduced-price lunch than the full cohort of entering ninth graders. Students in the New York City analytic sample also had higher mathematics and English language arts test scores in eighth grade compared to the full cohort of entering ninth graders. These differences suggest that, within New York City schools, disadvantaged students were more likely to leave the school prior to the third year of high school and/or were less likely to consent to participate in the study, and results in New York City are, therefore, based on a more-advantaged subgroup of entering Grade 9 students.

Because the analytic sample is based on students who were still enrolled in study schools in their third year of high school (11th grade for most students), the sample excludes students who dropped out or transferred between entry to ninth grade and the spring of 11th grade. Thus, the on-time graduation rate for the sample is higher than the on-time graduation rate for all students in the same cohort and higher than schools' officially reported graduation rates. In California, 90 percent of students in the analytic sample graduated within four years, compared to 66 percent of students in the entering high school cohort. Similarly, in New York City, 89 percent of the analytic sample and 61 percent of the entire ninth-grade cohort graduated on time. Therefore, the analyses presented in this report capture dynamics related to students successfully progressing from their third year of high school to graduation, which may not fully reflect the dynamics that influence students' progression from their first year of high school (ninth grade) to graduation.

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[4] Although *The Study of Deeper Learning* collected survey and cognitive assessment data for students in their third and fourth years of high school (11th and 12th grade for most students), we restricted the analysis for this report to students who were in their third year of high school when they took the student survey and cognitive assessment in 2013. We did not include fourth-year students in the analysis because these students were too close to graduation to provide a meaningful measure of high school graduation.

Measures

Measures of Opportunities for Deeper Learning: Analyses are based on nine measures of opportunities for deeper learning that were part of *The Study of Deeper Learning* student survey, as shown in Box 1. We measured the level of each opportunity by asking students to report the frequency with which they engaged in specific activities related to each of the identified opportunities in the current school year. (See the second report from *The Study of Deeper Learning* [Bitter et al., 2014] for more details about the measures.)

Box 1: Opportunities for Deeper Learning—Student Survey Measures

1. **Opportunities for complex problem solving:** The degree to which students engage in complex problem solving by analyzing ideas, judging the value and reliability of an idea or source, constructing new ideas, and applying knowledge to solve new problems
2. **Opportunities for creative thinking:** The extent to which students have the opportunity to engage in creative thinking in their core academic classes, such as thinking of original solutions to problems and new ways to do things, creating new ideas, and using their imagination
3. **Opportunities to communicate:** The extent to which students have the opportunity to practice written and oral communication skills
4. **Opportunities to collaborate:** The degree to which students collaborate on assignments, provide feedback on each other's work, and collaborate in other ways
5. **Opportunities to learn how to learn:** The degree to which students practice monitoring and directing their own work and learning
6. **Opportunities to receive feedback:** The degree to which students receive written and oral feedback on their work from teachers, peers, or others.
7. **Assessments aligned with deeper learning:** The extent to which students engage in various forms of assessment including assessments of problem solving, communication, and collaboration
8. **Opportunities for interdisciplinary learning:** The degree to which students engage in interdisciplinary learning, where two or more disciplines are combined to enhance inquiry and knowledge generation
9. **Opportunities for real-world connections:** The degree to which students engage in instructional activities that emphasize real-world connections

Students were asked to respond to a set of items asking about the number of core content classes (including English, mathematics, science, and social studies) in which they engaged in activities relevant to the opportunity measure. Responses options included: 0 = *none of my classes;* 1 = *one of my classes;* 2 = *two of my classes;* 3 = *three or more of my classes.* Opportunities for interdisciplinary learning were measured on the response scale 0 = *never,* 1 = *some of the time,* 2 = *most of the time,* 3 = *all of the time.* We used Rasch modeling to create scale scores from the survey items for each measure, and the scale scores were standardized to have a mean of zero and standard deviation of one in the full analytic sample of surveyed students that were part of *The Study of Deeper Learning.*

Measures of Interpersonal and Intrapersonal Competencies: Analyses also are based on eight measures aligned with the interpersonal and intrapersonal competencies, as shown in Box 2. The measures are based on items in *The Study of Deeper Learning* student survey and are, therefore, students' self-reports of their skills. (See the third report from *The Study of Deeper Learning* [Zeiser, Rickles et al., 2014] for more details about these measures.)

Box 2: Interpersonal and Intrapersonal Competencies—Student Survey Measures

1. **Creative thinking skills:** The extent to which a student perceives that he or she can think of original ideas and solutions
2. **Collaboration skills:** The extent to which a student perceives that he or she works well in a group (e.g., positive personal interactions; the ability to pay attention, share ideas, be prepared, and do his or her part) and cooperates to identify or create solutions
3. **Academic engagement:** The degree to which a student agrees that he or she has "interest and engagement in learning" and participates actively in classroom learning activities
4. **Motivation to learn:** The degree to which a student is motivated to do well academically and to become more knowledgeable, measured by a student's "perceived importance of coursework as well as preference for challenge and mastery goals"
5. **Self-efficacy:** The degree to which a student tends to view himself or herself "as capable of meeting task demands in a broad array of contexts"
6. **Locus of control:** The extent to which a student feels he or she has control over what happens to them, rather than their circumstances being controlled by chance or fate
7. **Perseverance:** The degree to which a student agrees that he or she maintains effort and interest despite failure, adversity, and plateaus in progress
8. **Self-management:** The extent to which a student feels he or she is able to independently manage his or her work and schedules to meet goals

Students were asked to respond to a set of items that asked about the extent to which they agreed with different statements. Response options ranged from 0 (*strongly disagree* or *never* or *almost never true*) to 3 (*strongly agree* or *always* or *almost always true*). To create scales from the survey items for each measure, we used the same Rasch modeling approach that was used to measure opportunities for deeper learning.

Measures of Cognitive Competencies: Students' critical thinking skills and mastery of content knowledge were measured based on data from the Organisation for Economic Co-operation and Development (OECD) PISA-Based Test for Schools (PBTS) that was administered to students in *The Study of Deeper Learning*. Using the PBTS, students were tested in mathematics, reading, and science. (See the third report from *The Study of Deeper Learning* [Zeiser, Rickles et al., 2014] for more details about the PBTS measures.)

Measure of On-Time High School Graduation: We defined students as "on-time graduates" if they had a graduation record in the district data system within four years of entering ninth grade, including the summer after their fourth year of high school. Any students who did not have a graduation record (including students who dropped out, students who took longer than four years to graduate, and students who transferred outside the district or to a private school) were classified as "not on-time graduates." We counted students who transferred outside the participating districts as "not on-time graduates" because some of the district data systems did not reliably distinguish students who transferred from those who dropped out. Due to our focus on students who were still enrolled in the same school in the third year of high school and our inclusion of transfer students as "not on-time graduates," the graduation rates presented in this report do not reflect official graduation rates for the schools included in the study.

Analytic Methods

To address the first research question about relationships among the composite scores and high school graduation, we used SEM. SEM allows us to synthesize the individual opportunity and competency measures into composite scores and examine how the composite scores are related to each other and to high school graduation. We used the measurement model aspect of SEM to create three deeper learning composite scores:[5]

- Opportunity for deeper learning (ODL) composite score: combines information about students' reports of the nine specific opportunities for deeper learning that are listed in Box 1
- Interpersonal and intrapersonal competency (IIC) composite score:[6] combines information about the eight individual competency measures in Box 2
- Cognitive competency (COG) composite score: combines students' mathematics, reading, and science scores on the PBTS

For the second and third research questions, we dig deeper into the data to examine how specific types of opportunities and competencies relate to high school graduation. For these two research questions, we used linear regression models to examine the relationships between the specific measures of deeper learning opportunities and competencies and high school graduation, taking into account factors such as eighth-grade student achievement and student background characteristics.[7]

We conducted separate analyses for students who attended California schools and students who attended New York City schools.[8] All measures of deeper learning opportunities and competencies were standardized. Thus, results of models predicting on-time high school graduation can be interpreted as percentage point differences in the probability of graduating associated with a one-standard-deviation difference in the opportunity or competency under investigation.

The analytic methods for this report are descriptive in nature, and one should not interpret the estimated relationships as evidence that one factor necessarily causes another. The results speak to the existence or absence of connections among deeper learning opportunities, deeper learning competencies, and high school graduation, but other factors not captured in the analysis may explain these connections. Details about the analytic methods are provided in Appendix A.

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[5] For more information about the creation of composite measures, including coefficients from the measurement model, see Appendix A.

[6] The decision to combine the interpersonal and intrapersonal competencies into one composite score was informed by an exploratory factor analysis and the limited number of observed measures directly aligned with the interpersonal competency.

[7] For the second and third research questions, we ran separate linear regression models for each opportunity and competency measure. Each model included controls for prior student achievement and student background characteristics as well as school fixed effects.

[8] Differences in high school graduation requirements between California and New York provide a substantive rationale for conducting separate analyses. Furthermore, data confidentiality requirements precluded us from combining the California and New York City data into one analytic file.

Findings

Are the relationships between students' opportunity for deeper learning composite score, deeper learning competency composite scores, and on-time graduation consistent with the deeper learning theory of action?

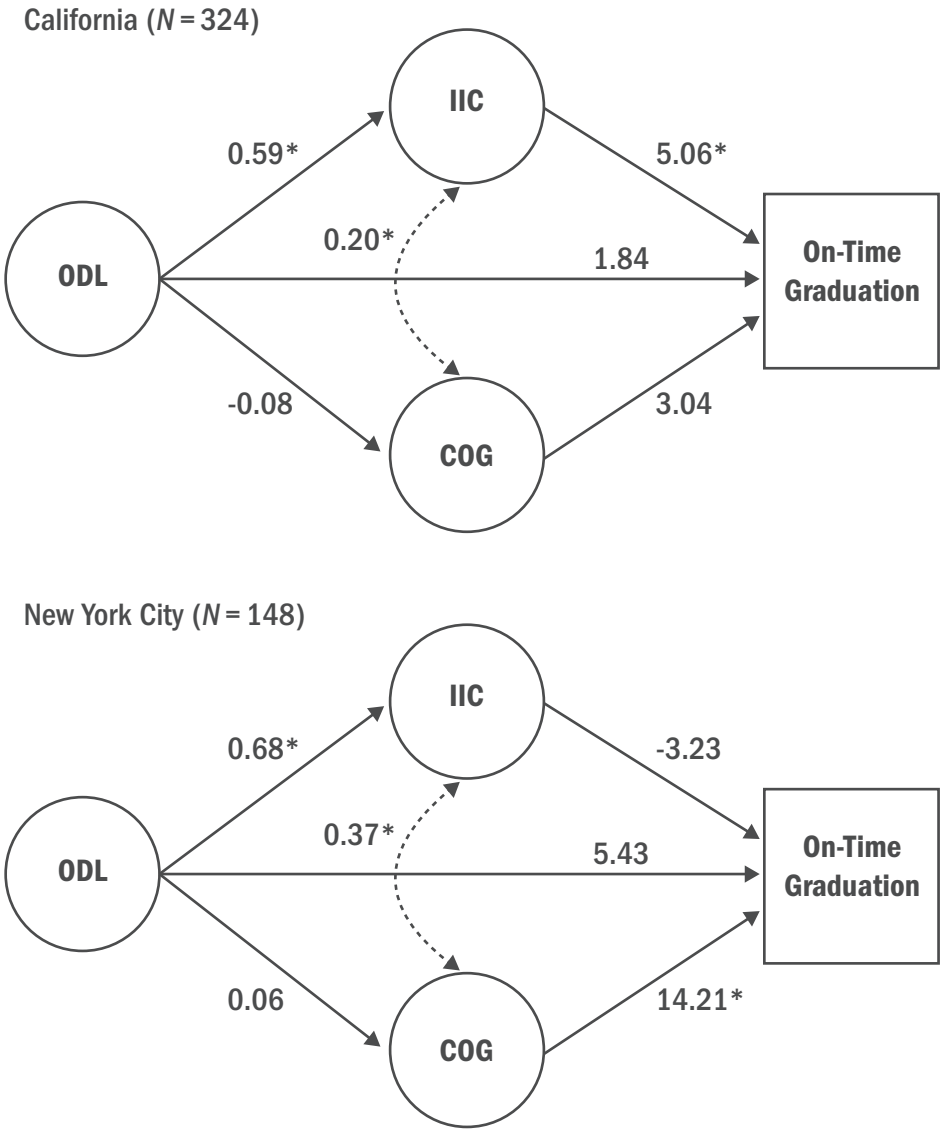
In addressing this first question, we provide a broad overview of the relationships among deeper learning opportunities, competencies, and high school graduation. We present the main results of SEM analyses as separate path diagrams for students attending California and New York City schools (see Exhibit 3). In these diagrams, the estimated magnitude of each relationship is reported on the path that represents the theorized relationship. The circles represent the composite measures for deeper learning opportunities and competencies, and the square represents on-time high school graduation.

Students' opportunity for deeper learning composite score was positively associated with students' interpersonal and intrapersonal competency composite score but not with students' cognitive competency composite score. In both California and New York City, the results indicate that students with more opportunities for deeper learning had significantly higher scores on measures of interpersonal and intrapersonal competencies:

- In California, a student with an opportunity for deeper learning composite score that was one standard deviation above average had an interpersonal and intrapersonal competency composite score that was 0.59 standard deviation above average.
- In New York City, a student with an opportunity for deeper learning composite score that was one standard deviation above average had an interpersonal and intrapersonal competency composite score that was 0.68 standard deviation above average.

The relationships between students' opportunity for deeper learning composite score and students' interpersonal and intrapersonal competency composite score are consistent with findings about the relationships between the individual opportunity and competency measures from *The Study of Deeper Learning* (Bitter et al., 2014). In addition, the SEM results suggest that the opportunity for deeper learning composite score was not significantly related to the cognitive competency composite score. This result is consistent with the earlier finding from *The Study of Deeper Learning* that, of the nine measures of opportunity for deeper learning, only the opportunity for complex problem solving measure was related to measures of cognitive competency (Bitter et al., 2014).

Exhibit 3. Relationships Between Opportunity for Deeper Learning Composite Score, Deeper Learning Competency Composite Scores, and On-Time High School Graduation in California and New York City



Notes: ODL = opportunity for deeper learning composite score; IIC = interpersonal and intrapersonal competency composite score; COG = cognitive competency composite score. Coefficients from ODL to IIC and COG represent changes in IIC and COG values in standard deviations per one standard deviation change in the value of ODL. Coefficients between the composite measures (circles) and graduation represent percentage point changes in the probability of graduating on time per one standard deviation change in the composite measure. Dashed curves with double-headed arrows represent correlations between IIC and COG. The direct path from ODL to graduation is not an explicit path in the theory of action, but it represents the extent to which ODL was related to graduation beyond the competency measures included in the analysis.

* $p < .05$

In addition, the SEM results indicate that, overall, students with greater interpersonal and intrapersonal competency had greater cognitive competency. This positive association is depicted in Exhibit 3 with the dashed curves with double-headed arrows.[9]

Students' deeper learning competency composite scores were positively associated with high school graduation, but the nature of the associations differed between California and New York City.

- In California (but not New York City), students with an interpersonal and intrapersonal competency score one standard deviation above average had graduation rates 5 percentage points higher than students with an average composite score, after accounting for the students' opportunity for deeper learning composite score and cognitive competency composite score.
- In New York City (but not California), students with a value on the composite measure of cognitive competencies one standard deviation above average had graduation rates 14 percentage points higher than students with average values, after accounting for opportunities for deeper learning and interpersonal and intrapersonal competencies.[10]

One potential explanation for why the relationships between deeper learning competencies and graduation differ between the California and New York City samples is that the high school graduation requirements differ in these two locations. We discuss this issue in more detail in the Conclusions section.

To further test the theory of action, we also examined whether there was a direct connection between students' opportunity for deeper learning composite score and graduation after accounting for students' deeper learning competency composite scores. In both California and New York City, the opportunity for deeper learning composite score was not directly related to graduation. This finding suggests that opportunities for deeper learning improve on-time graduation primarily by improving students' deeper learning competencies, which is consistent with the theory of action.

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[9] The estimated correlations between the composite measure of interpersonal and intrapersonal competencies and the composite measure of cognitive competencies were sensitive to the inclusion of students' prior (eighth-grade) achievement in the model. When prior achievement was added to the model, the correlations became nonsignificant, which suggests that the two measures were associated primarily because they were both associated with prior achievement (i.e., students with higher prior achievement tended to have higher values of both composite measures).

[10] The percentage point differences reported here are based on the assumption that the associations between the composite measures and graduation are linear. We conducted a sensitivity analysis using a logistic function and obtained similar results. In addition, when prior achievement was included in the model, the overall conclusions about the direction and statistical significance of the relationships did not change, but the magnitude of the relationship between cognitive competency and graduation was difficult to interpret because prior achievement was strongly correlated with cognitive competency. This situation was particularly true in New York City, where the correlation between prior achievement and cognitive competency was about 0.90, and the estimated relationship between cognitive competency and graduation increased to about 40 percentage points when prior achievement was included in the model. This is an implausibly strong relationship that most likely reflects limitations with the highly correlated data and the statistical model and should not be interpreted as a true relationship.

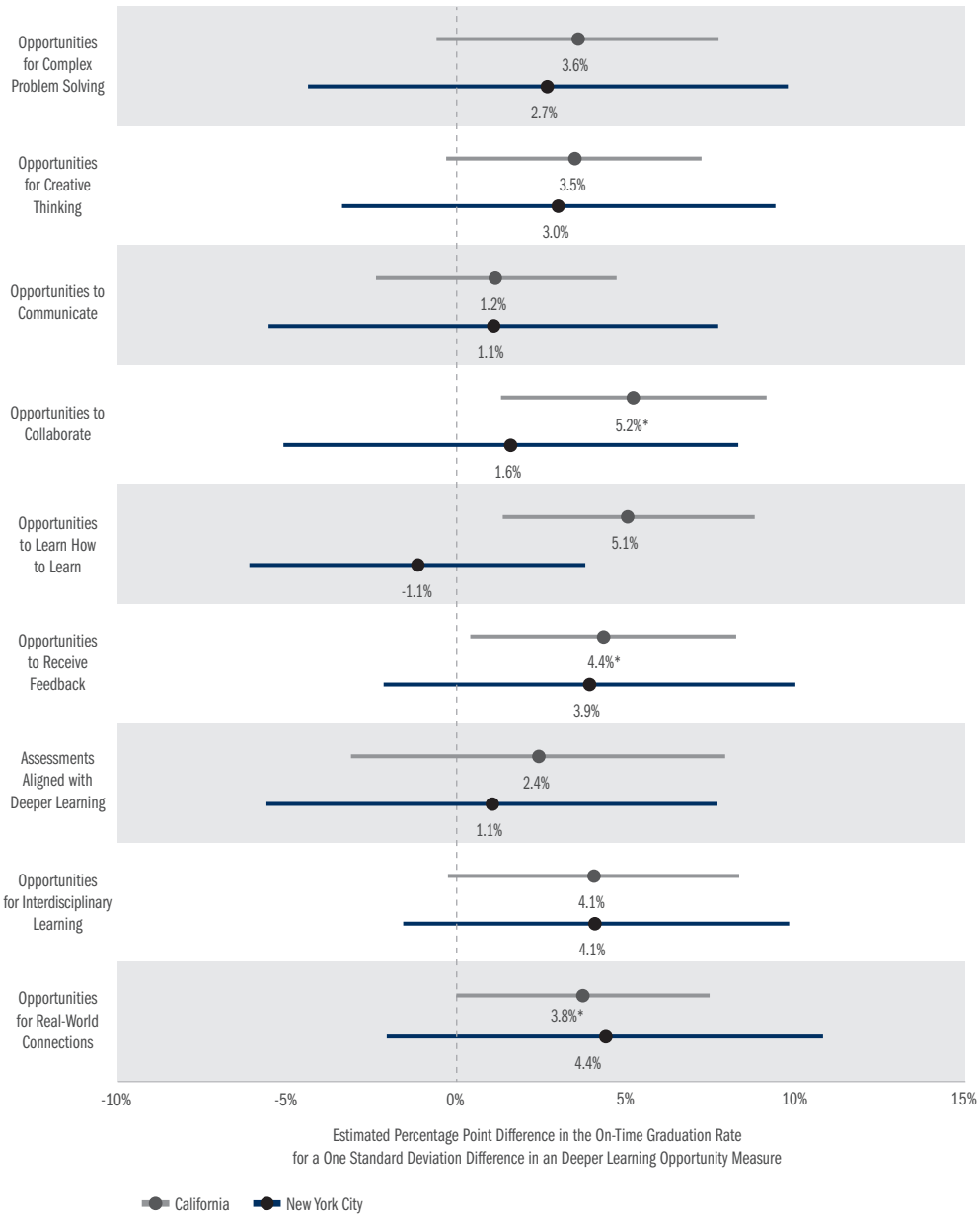
Are some types of opportunities for deeper learning more strongly associated with on-time high school graduation than others?

Although the SEM analysis indicated that there was not a significant, direct relationship between the composite measure of opportunities for deeper learning and graduation, this finding does not take into account how opportunities can be indirectly connected to graduation through their association with deeper learning competencies. For example, as shown in Exhibit 3, the opportunity for deeper learning composite score was positively related to the interpersonal and intrapersonal competency composite score, which was in turn positively related to graduation (in California). In addition, the focus on composite measures in the SEM model might mask ways in which individual opportunity measures are related to graduation. Therefore, we also examined whether there were relationships between individual opportunity measures and graduation by estimating separate linear regression models for each opportunity measure (see Appendix A for more details). The results are presented in Exhibit 4.

Four of the nine deeper learning opportunity measures were positively associated with high school graduation in California, but none of the measures were significantly associated with graduation in New York City.[11] In California, opportunities to collaborate, opportunities to learn how to learn, opportunities to receive feedback, and opportunities for real-world connections were significantly related to on-time graduation. The estimated relationships indicate that a student with a value of the opportunity measure that was one standard deviation above average was approximately 4 to 5 percentage points more likely to graduate than a student with an average value.

[11] In New York City, none of the opportunity measures were significantly related to graduation, but for many of the opportunity measures, the magnitude of the relationship with high school graduation was similar for students in California and New York City. The nonsignificant results in New York City may be due to the fact that the New York City student sample was too small to detect significant relationships.

Exhibit 4. Estimated Associations Between Opportunities for Deeper Learning and On-Time High School Graduation in California and New York City



Notes: Plotted points indicate the point estimate for the relationship between each opportunity measure and on-time high school graduation. The magnitude of the relationship (as percentage points) is provided directly under each plotted point. The horizontal bars represent the 95 percent confidence interval for each point estimate. Estimates are significant and positive when the full confidence interval lies to the right of the zero line. California N = 295 to 323 students depending on the measure; New York City N = 147 to 148 students depending on the measure.

* $p < .05$

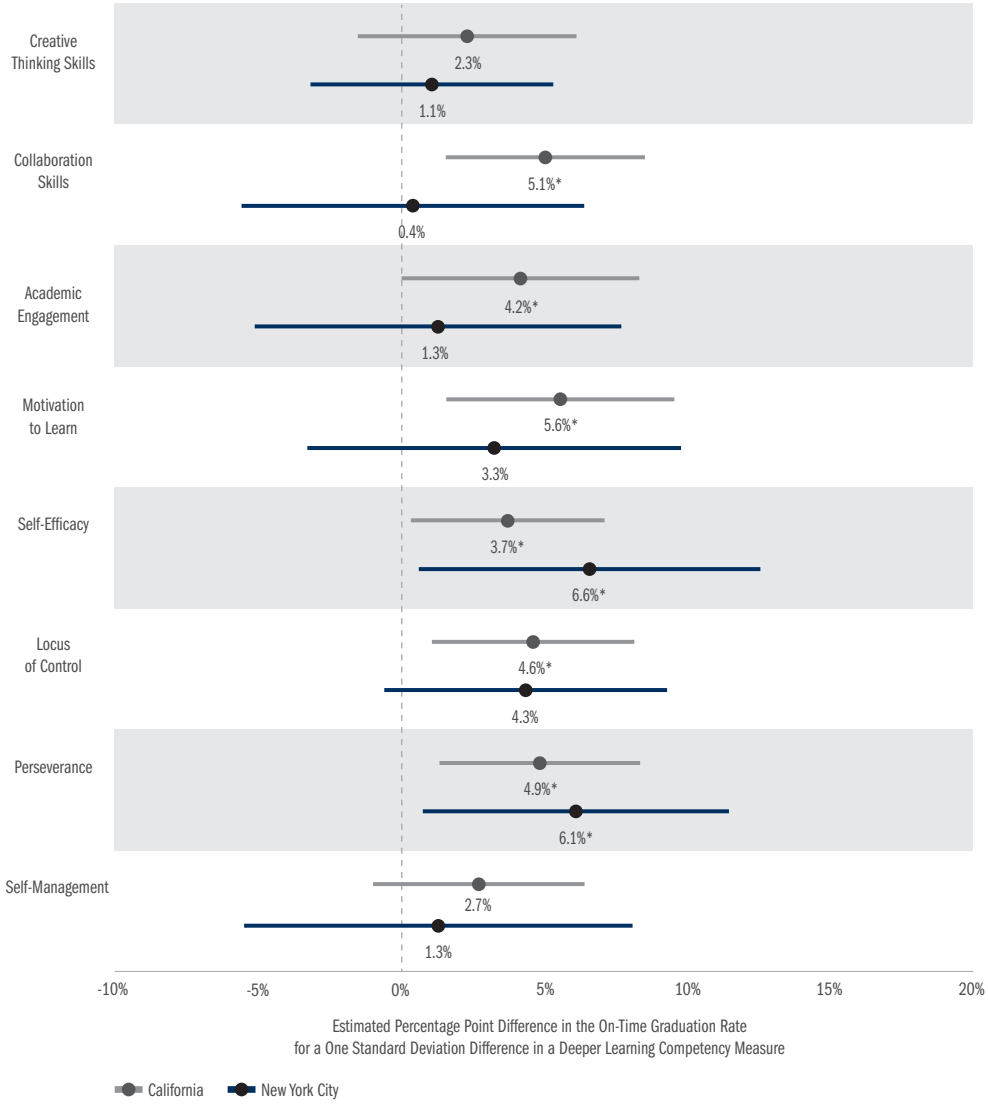
Are some types of deeper learning competencies more strongly associated with on-time high school graduation than others?

The SEM analyses indicated that there was a significant relationship between the interpersonal and intrapersonal competency composite score and graduation in California and that there was a significant relationship between the cognitive competency composite score and graduation in New York City. However, the use of composite measures might mask ways in which individual competency measures are related to graduation. Therefore, we also examined relationships between individual competency measures and on-time high school graduation using a separate linear regression model for each competency measure.

Some, but not all, of the interpersonal and intrapersonal competencies were positively associated with high school graduation, with differences evident between students in California and New York City. The estimated relationships between each of the interpersonal and intrapersonal competency measures and on-time high school graduation are presented in Exhibit 5. In California, six of the eight competency measures were significantly related to graduation. The two measures that were not significantly related to on-time graduation were creative thinking skills and self-management. For the other competency measures, the estimated relationships indicate that a student with a value on the measure one standard deviation above average was approximately 4 to 5 percentage points more likely to graduate than a student with the average value on the measure. In New York City, two of the eight competency measures were significantly related to graduation: self-efficacy and perseverance. A student with a value of self-efficacy or perseverance that was one standard deviation above average was approximately 6 to 7 percentage points more likely to graduate than a student with the average value on the measure.[12]

[12] We also examined the relationships between the interpersonal and intrapersonal competency measures and the cognitive competency measures. The results, presented in Appendix B (Exhibit B2 for California and Exhibit B3 for New York City), indicate that there were some significant relationships in New York City, particularly for mathematics achievement, but not in California.

Exhibit 5. Estimated Associations Between Interpersonal and Intrapersonal Competencies and On-Time High School Graduation in California and New York City

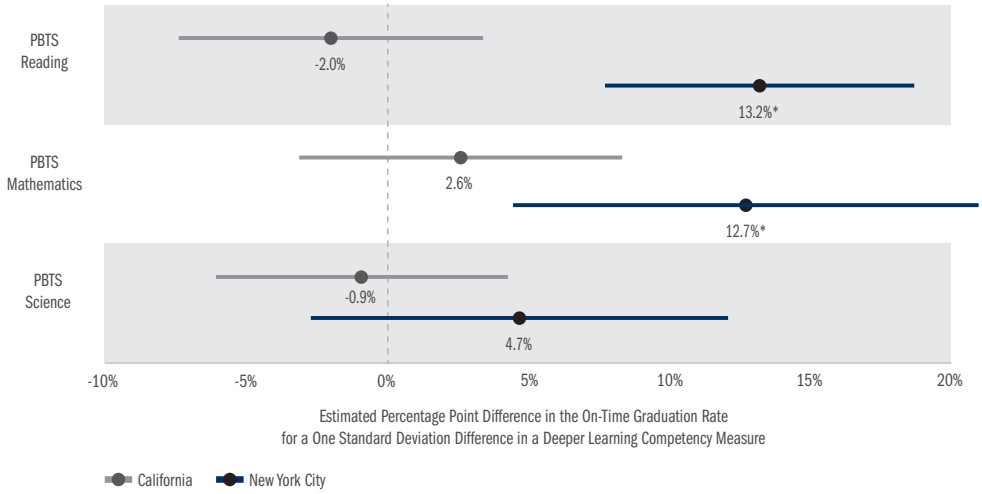


Notes: Plotted points indicate the point estimate for the relationship between each competency measure and on-time high school graduation. The magnitude of the relationship (as percentage points) is provided directly under each plotted point. The horizontal bars represent the 95 percent confidence interval for each point estimate. Estimates are significant and positive when the full confidence interval lies to the right of the zero line. California *N* = 294 to 321 students depending on the measure; New York City *N* = 147 to 148 students depending on the measure.

* $p < .05$

Two of the three cognitive competency measures were positively associated with high school graduation in New York City, but none of the competency measures were associated with graduation in California. The estimated relationship between each of the cognitive measures (i.e., PBTS subject scores) and on-time high school graduation is presented in Exhibit 6. In New York City, students with a reading or mathematics score that was one standard deviation above average had graduation rates approximately 13 percentage points higher than students with an average score.

Exhibit 6. Estimated Associations Between Cognitive Competencies and On-Time High School Graduation in California and New York City



Notes: Plotted points indicate the point estimate for the relationship between each cognitive competency measure and on-time high school graduation. The magnitude of the relationship (as percentage points) is provided directly under each plotted point. The horizontal bars represent the 95 percent confidence interval for each point estimate. Estimates are significant and positive when the full confidence interval lies to the right of the zero line. California N = 274 to 283 students depending on the measure; New York City N = 122 to 128 students depending on the measure.

* $p < .05$

Conclusions

Overall, the findings presented in this report support theorized relationships among opportunities for deeper learning, deeper learning competencies, and high school graduation. In particular, opportunities for deeper learning were positively related to interpersonal and intrapersonal competencies, but their connection to cognitive competencies was not well established in our sample of students. We also found positive relationships between deeper learning competencies and high school graduation; however, such relationships were not consistent across the two geographic locations in our study. Interpersonal and intrapersonal competencies were positively associated with on-time high school graduation in California but not in New York City. Conversely, cognitive competencies were positively associated with on-time high school graduation in New York City but not in California. The different patterns of findings suggest that the relationships between opportunities for deeper learning, deeper learning competencies, and on-time high school graduation may be sensitive to the educational context.

Our study design does not allow us to determine exactly why the interpersonal and intrapersonal, but not cognitive, competencies were significantly related to high school graduation in California, while cognitive, but not interpersonal or intrapersonal, competencies were significantly related to high school graduation in New York City. One hypothesis is that these differences may be attributed to the different high school graduation requirements in the two locations. In California, students

had to pass the California High School Exit Examination (CAHSEE), which focused on English/language arts content through 10th grade and mathematics content typically taught in Grades 9 and below. Most California students took the CAHSEE for the first time in 10th grade and could retake the exam as many times as necessary. In New York City, students were required to pass multiple Regents exams that were aligned to specific courses in English/language arts, mathematics, science, and social studies. New York City students took the Regents exams throughout their time in high school. Because the findings in this report are based on students who were in their third year of high school, it is likely that most students in the California sample had already passed the CAHSEE and most students in the New York City sample still needed to pass some of their Regents exams. As a result, the additional, and arguably more rigorous, testing requirements in New York City may have placed added emphasis on students' cognitive competencies compared to California. This possibility raises questions about how different high school graduation requirements across the country can influence the impact that deeper learning competencies can have on students' likelihood of graduating on time.

An important limitation of the analyses presented in this report is that they are based on a sample of students who agreed to participate in the student survey and PBTS and were third-year high school students at the time of data collection. These students were much more likely to graduate from high school than other students who entered the ninth grade during the same school year but were not attending the school (or did not consent to participate in data collection) during the third year of high school. The fact that all the students in our analysis had persisted to the spring of their third year of high school may have caused the relationship between deeper learning and high school graduation to be underestimated because it does not reflect possible connections between deeper learning and progression from a student's first year of high school to the third year.

Despite this limitation, the findings indicate that deeper learning competencies are positively correlated with students' probability of on-time graduation. Future research should examine the role of deeper learning opportunities and competencies during the first two years of high school. In addition, the contrasting findings across California and New York City highlight the need for future research to focus on schools located in a variety of educational contexts, because differences in local and state educational policies may hinder or promote the connections between deeper learning and high school success.

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Appendix A: Details of the Analytic Approaches

This appendix provides a more detailed description of the analytic approaches used for this report.

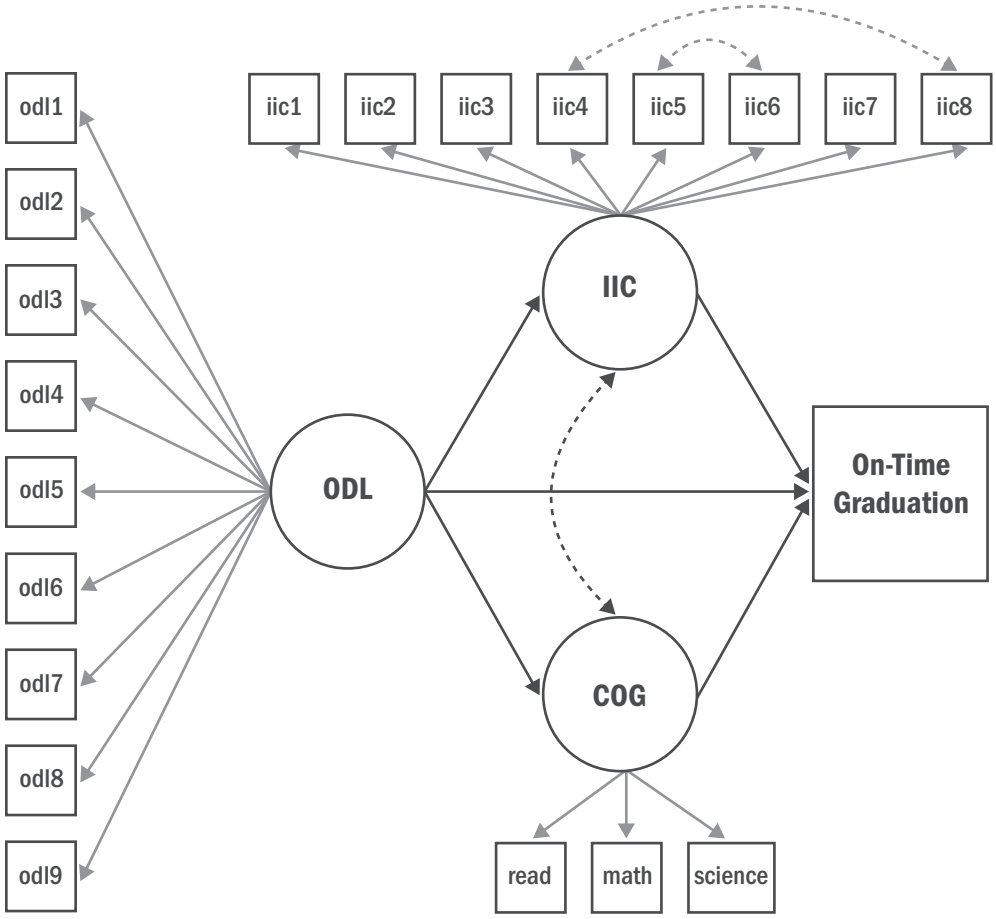
Structural Equation Model: SEM is a flexible statistical modeling approach that allows us to examine statistical relationships between two types of measures: observed (or manifest) measures and unobserved (or latent) constructs. Observed measures are characteristics that can be directly observed and measured using available data, such as graduation status. Unobserved or latent constructs are characteristics that cannot be observed directly and can be measured only indirectly, often with items on a survey or test. SEM typically involves two parts: a measurement model that estimates the unobserved constructs based on the observed measures, and a structural model (or path model) that tests the relationships among different observed and unobserved constructs. For this report, we consider the individual opportunity and competency measures from *The Study of Deeper Learning* as observed measures and consider the composite measures of opportunities for deeper learning and deeper learning competencies as unobserved or latent constructs that are measured based on the individual observed measures.

To get an overall picture of how the opportunities for deeper learning and deeper learning competencies are connected to on-time high school graduation, we estimated the SEM depicted in Exhibit A1. In the exhibit, observed measures are represented by boxes and unobserved constructs (i.e., composite measures) are represented by circles. Solid lines with a single arrow indicate hypothesized directional relationships, and dashed curves with double-headed arrows indicate hypothesized correlations. Relationships that are part of the measurement model portion of the SEM are represented by gray lines, and relationships that are part of the structural model are represented by black lines.

For the SEM measurement model, we used the student survey and PBTS measures from *The Study of Deeper Learning* to create three deeper learning composite measures: opportunity for deeper learning (ODL), interpersonal and intrapersonal competency (IIC), and cognitive competency (COG). In addition, for the IIC measurement model, preliminary analyses indicated that some measures were strongly correlated above and beyond their shared connection with the IIC construct (e.g., self-efficacy and locus of control). These correlations are incorporated into the SEM, as the dashed curves with double-headed arrows indicate in Exhibit A1. Results from the measurement model portion of the SEM analysis are presented in Exhibit A2.

For the structural model portion of the analysis, following the deeper learning theory of action, we hypothesized that ODL could influence IIC and COG and that all three constructs could influence on-time high school graduation. In addition, we hypothesized that IIC and COG could be correlated for reasons other than their relationship with students' ODL. The direct path from ODL to graduation is not an explicit path in the theory of action, but it represents the extent to which ODL was related to graduation beyond the competency measures included in the analysis.

Exhibit A1. Structural Equation Model Design



Notes: ODL = opportunity for deeper learning composite score; IIC = interpersonal and intrapersonal competency composite score; COG = cognitive competency composite score. Observed measures are represented by boxes, and unobserved constructs are represented by circles. Solid lines with a single arrow indicate hypothesized directional relationships, and dashed lines with double-headed arrows indicate hypothesized correlations. Relationships that are part of the measurement model portion of the SEM are represented by gray lines, and relationships that are part of the structural model are represented by black lines. For simplicity, error or residual variances are not shown.

To estimate the structural equation models, we standardized each observed measure to have a mean of zero and standard deviation of one within the full sample of students with non-missing values in *The Study of Deeper Learning*. Then, to focus the analysis on relationships that occurred among students within schools, each observed measure was centered on the school mean for that measure (i.e., school-mean centering). To facilitate model convergence and interpretation of results, the SEM did not include student prior achievement or background characteristics. In addition, all relationships in the models were estimated as linear relationships based on full information maximum likelihood (FIML) estimation, which allowed us to include students with missing data on individual observed measures. To determine whether the results are sensitive to these modeling decisions, we reanalyzed the data with alternative modeling options. More specifically, we tested the model with prior achievement, with a logistic link function for relationships with graduation, with imputed missing values and maximum likelihood estimation rather than FIML, and with and without school-mean centering. When presenting the findings in the report, we noted instances where the findings were sensitive to modeling specifications.

Exhibit A2. Results From the SEM Measurement Models

Measure	California Schools		New York City Schools	
	Loading	Residual	Loading	Residual
Opportunity for Deeper Learning Composite Measure				
(odl1) Opportunities for complex problem solving	0.637	0.595	0.701	0.509
(odl2) Opportunities for creative thinking	0.774	0.401	0.804	0.354
(odl3) Opportunities to communicate	0.542	0.706	0.619	0.617
(odl4) Opportunities to collaborate	0.745	0.445	0.766	0.413
(odl5) Opportunities to learn how to learn	0.592	0.650	0.539	0.709
(odl6) Opportunities to receive feedback	0.825	0.319	0.845	0.287
(odl7) Assessments aligned with deeper learning	0.756	0.428	0.720	0.482
(odl8) Opportunities for interdisciplinary learning	0.665	0.558	0.466	0.782
(odl9) Opportunities for real-world connections	0.855	0.269	0.886	0.214
Interpersonal and Intrapersonal Competency Composite Measure				
(iic1) Creative thinking skills	0.733	0.462	0.640	0.590
(iic2) Collaboration skills	0.708	0.499	0.702	0.507
(iic3) Academic engagement	0.523	0.726	0.672	0.549
(iic4) Motivation to learn	0.731	0.466	0.846	0.284
(iic5) Self-efficacy	0.767	0.411	0.745	0.445
(iic6) Locus of control	0.678	0.540	0.710	0.496
(iic7) Perseverance	0.863	0.256	0.835	0.302
(iic8) Self-management	0.739	0.454	0.768	0.411
cov (iic4, iic8)	N/A	0.446	N/A	0.139
cov (iic5, iic6)	N/A	0.478	N/A	0.433
Cognitive Competency Composite Measure				
Reading	0.785	0.384	0.697	0.514
Mathematics	0.781	0.390	0.677	0.542
Science	0.730	0.467	0.593	0.649

N/A = not applicable

Individual Regression Models: For the second and third research questions, we used linear regression models to estimate the extent to which the individual measures of opportunities for deeper learning and deeper learning competencies were related to on-time high school graduation. To examine relationships for the individual measures, rather than the overall patterns examined with the SEM analysis, we estimated a separate model for each measure. The models controlled for students' prior achievement and background characteristics so that the estimated relationships between individual measures and graduation could not be attributed to these factors. In addition, the models included school fixed effects so that the estimated relationships between individual measures and graduation could not be attributed to school factors.

To estimate the relationships between individual measures of deeper learning opportunities and competencies and graduation, we used a linear regression model of the following general form for students *(i)* in schools *(j)*:

$$Y_i = \beta_0 + \beta_1 Z_i + \boldsymbol{\beta_2 X_i} + \boldsymbol{\gamma}_j + e_i$$

where $\boldsymbol{Y}$ is a binary indicator for graduation (1 = graduated within the district in four years, 0 = did not graduate within the district in four years). $\boldsymbol{Z}$ is one of nine measures of opportunities for deeper learning, one of eight interpersonal or intrapersonal competency measures, or one of three cognitive competency measures (i.e., subject-specific PBTS scores). $\boldsymbol{X}$ is a set of student demographic characteristics and prior achievement,[13] and $\boldsymbol{\gamma}$ is a vector of school fixed effects. Robust standard errors were estimated using the Huber-White sandwich estimator.

The following student-level characteristics were included in the model for California students:

- Sex (male/female)
- Race/Ethnicity
- Individualized Education Plan (IEP) status
- English language learner (ELL) status
- Eighth-grade mathematics test taken (above Algebra I or not)
- Eighth-grade ELA state test score
- Eighth-grade mathematics state test score
- Eighth-grade science state test score
- Indicator for missing state test scores

The following student-level characteristics were included in the model for New York City students:

- Sex (male/female)
- Race/Ethnicity
- ELL status
- Free or reduced-price lunch (FRPL) status
- Age at Grade 9 entry
- Eighth-grade attendance rate
- Eighth-grade ELA state test score
- Eighth-grade mathematics state test score
- Indicator for missing state test scores

[13] Less than 5 percent of students in the sample were missing prior achievement. For these students, missing values were imputed using the mean value of other students within the school, grade level, gender, and racial/ethnic group.

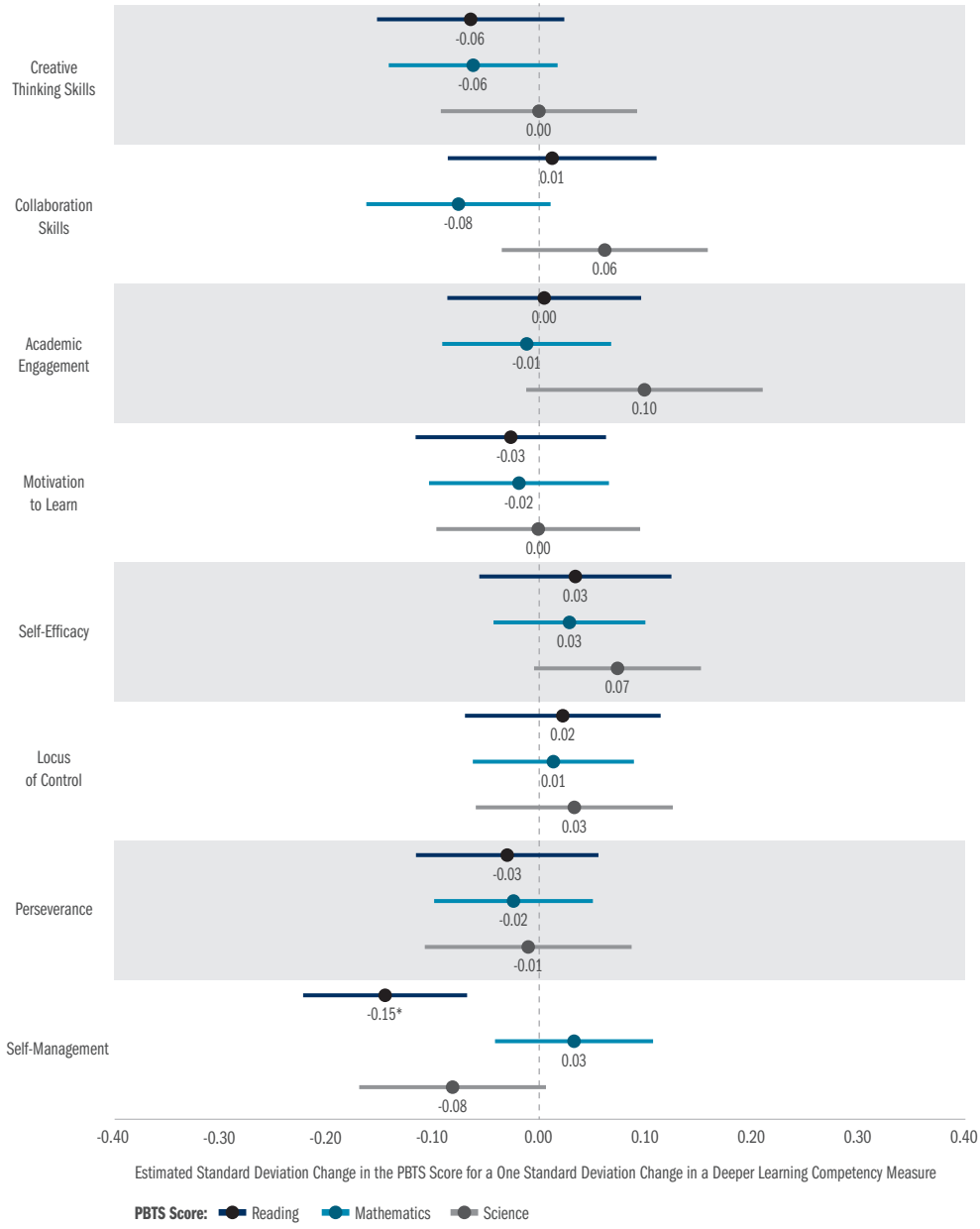
Appendix B: Supplemental Exhibits

Exhibit B1. Comparison of Student Characteristics for All Students in Entering Ninth-Grade Cohort and Students Included in Analysis in California and New York City

	California Schools (*N* = 10)		New York City Schools (*N* = 8)	
	All Cohort Students	**Students in Analysis**	**All Cohort Students**	**Students in Analysis**
Number of Students	3,231	324	1,002	148
Sex (%)				
Female	50	52	56	61
Race/Ethnicity (%)				
White	28	25	13	28
Black	14	13	16	16
Hispanic	40	49	69	49
Asian/Other	17	13	3	7
Parental Education (%)				
Less Than High School	15	14	NA	NA
High School Diploma	19	20	NA	NA
Some College	19	24	NA	NA
College Degree	23	24	NA	NA
Declined/Missing	23	18	NA	NA
Socioeconomic Status (%)				
Eligible for Free or Reduced-Price Lunch	NA	NA	69	57
Language Status (%)				
English Language Learner	21	22	48	35
Average Prior Test Scores				
Grade 8 Mathematics (*z* score)	0.32	0.33	-0.26	0.19
Grade 8 ELA (*z* score)	0.05	0.16	-0.30	0.16
High School Attainment (%)				
Graduated On Time	66	90	61	89

Note: NA = data not available.

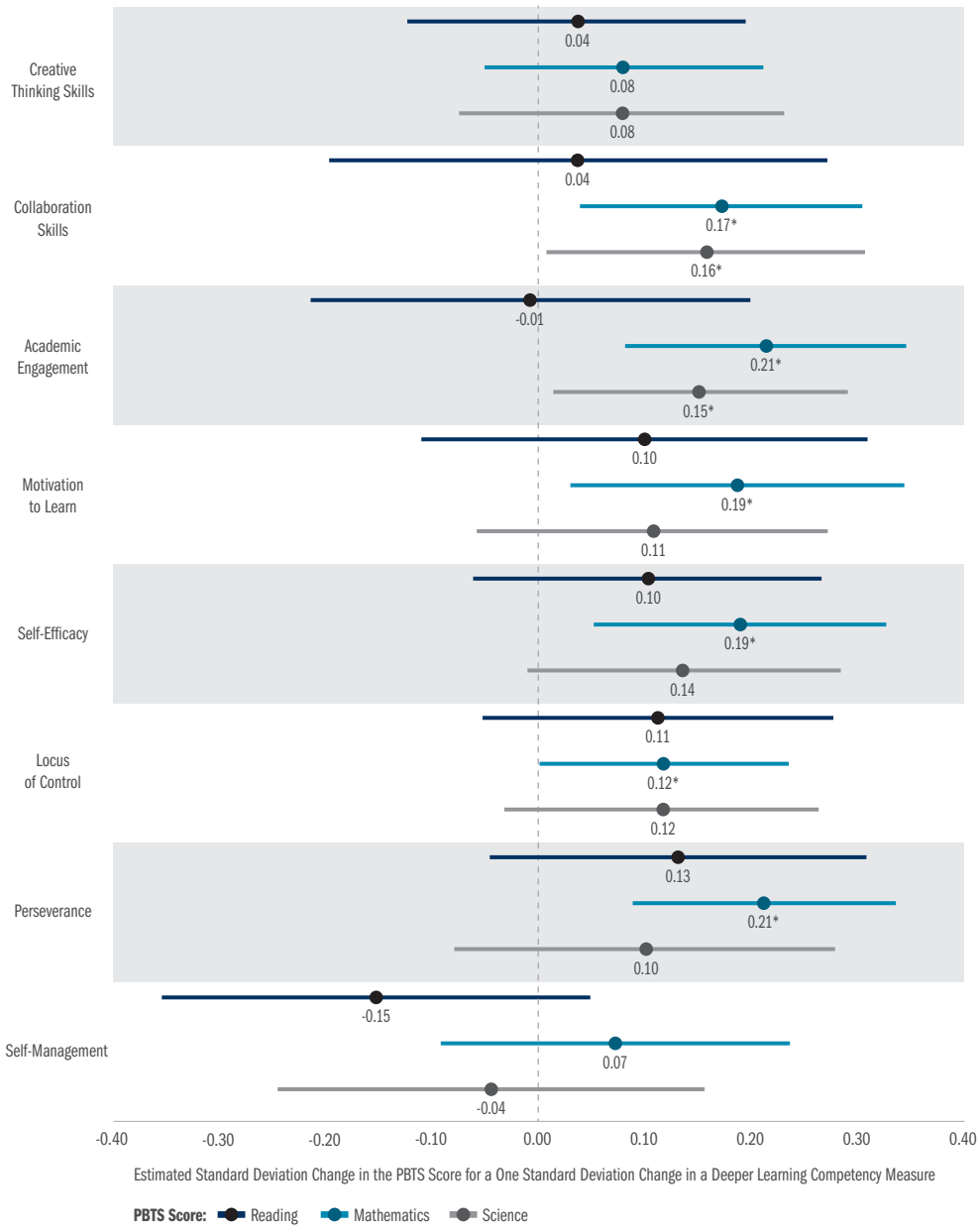
Exhibit B2. Estimated Associations Between Interpersonal and Intrapersonal Competencies and Cognitive Competencies: California



Notes: Plotted points indicate the point estimate for the relationship. The magnitude of the relationship (in standard deviation units) is provided directly under each plotted point. The horizontal bars represent the 95 percent confidence interval for each point estimate. Estimates are significant and positive when the full confidence interval lies to the right of the zero line, and they are significant and negative when the full confidence interval lies to the left of the zero line. N = 247 to 280 students depending on the measure.

* $p < .05$

Exhibit B3. Estimated Associations Between Interpersonal and Intrapersonal Competencies and Cognitive Competencies: New York City



Notes: Plotted points indicate the point estimate for the relationship. The magnitude of the relationship (in standard deviation units) is provided directly under each plotted point. The horizontal bars represent the 95 percent confidence interval for each point estimate. Estimates are significant and positive when the full confidence interval lies to the right of the zero line, and they are significant and negative when the full confidence interval lies to the left of the zero line. N = 121 to 128 students depending on the measure.

* $p < .05$

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