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Equitable Access to the Interpersonal and Intrapersonal Benefits of Deeper Learning

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Abstract

In previous work, researchers found that opportunities for deeper learning (e.g., collaborative group work, real-world connections, and interdisciplinary learning) were positively associated with students' interpersonal and intrapersonal competencies (e.g., collaboration skills, self-efficacy). In this brief, we use data from the Study of Deeper Learning: Opportunities and Outcomes to explore whether students' opportunities for deeper learning are similarly beneficial for different types of students (e.g., male and female students, English language learners and native English speakers). Overall, we found that positive relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies were similar in strength across different types of students. However, relationships were significantly stronger for male students than for female students. Because female students generally reported high levels of interpersonal and intrapersonal competencies, the weaker relationships for women indicate that other environmental factors (such as interactions with peers and families) may influence these competencies more than experiences in schools.

These findings contradict popular notions that deeper learning is an approach that generally benefits advantaged students or students who are already succeeding academically. In fact, our results suggest that opportunities for deeper learning are similarly beneficial for all students.

Introduction

Deeper learning is not just about improving learning in the short term, although many studies do find gains in students' grade point averages[1] and test scores.[2] In addition to these immediate academic outcomes, studies connect deeper learning exposure with improved college readiness and retention[3] as well as improved critical thinking and communication skills.[4] Recently, researchers at the American Institutes for Research (AIR) also found that students who attended schools that focused on deeper learning reported higher levels of collaboration skills, academic engagement, motivation to learn, and self-efficacy than similar students who attended comparison schools.[5] Furthermore, they found that student reports of opportunities for deeper learning were positively associated with these skills and competencies regardless of the type of schools students attended.[6] Finally, the research team found that students who attended schools with an explicit focus on deeper learning were more likely to graduate from high school within 4 years of Grade 9 entry (by about 8 percentage points) and were more likely to enroll in 4-year colleges (by about 4 percentage points) than were similar students who attended comparison schools.[7]

The William and Flora Hewlett Foundation—a leader in the national initiative to promote deeper learning in schools—has described how *deeper learning* fosters "a set of competencies students must master in order to develop a keen understanding of academic content and apply their knowledge to problems in the classroom and on the job."[8] These competencies can be classified as *cognitive* (e.g., critical thinking and complex problem-solving skills), *interpersonal* (e.g., collaboration and communication skills), or *intrapersonal* (e.g., academic mindset and understanding of how to learn).[9] Schools may adopt a range of strategies and structures to support the development of deeper learning.

In the Study of Deeper Learning, AIR researchers examined schools participating in national networks that promote deeper learning.[10] They found that the strategies that these schools commonly used to foster deeper learning included project-based learning, internship opportunities, collaborative group work, longer term cumulative assessments, and regular meetings between an advisor and a student or a group of students to provide academic and social support.[11] These deeper learning network high schools also tended to have leadership structures and practices that supported the schoolwide implementation of instruction focused on deeper learning, creating a culture in which teachers were more likely to adopt student-centered instructional practices and express greater belief in their ability to address the needs of all students in the school.[12]

What is not yet clear is whether instruction focused on deeper learning may help to improve educational equity by reducing gaps in student experiences and thereby increase the competencies of traditionally underserved students, giving them better skills for postsecondary life. If opportunities for deeper learning are similarly beneficial for all students, then the introduction of opportunities for deeper learning among traditionally underserved students who are less likely to be exposed to these experiences[13] (e.g., female students, students of color, English language learners [ELLs], low-income students, lower achieving students, and students with disabilities) may help to create more equitable student outcomes.

However, if we find that relationships between opportunities for deeper learning and students' interpersonal and intrapersonal competencies are stronger among students with relative social advantage, then opportunities for deeper learning may exacerbate existing gaps in educational outcomes.

In addition, research has not examined whether relationships between opportunities for deeper learning and student competencies are equitable across school contexts. In the United States, more than 500 schools are associated with formal school networks that promote deeper learning,[14] but most students attend schools that do not have an explicit focus on deeper learning. It may be argued that opportunities for deeper learning and students' interpersonal and intrapersonal competencies would not be as strongly related in traditional high schools, which lack a schoolwide culture focused on deeper learning.

In this brief, we examine whether relationships between opportunities for deeper learning and students' interpersonal and intrapersonal competencies differ across different subgroups of students. We also explore whether relationships between opportunities for deeper learning and students' interpersonal and intrapersonal competencies are similar for students who attended a school with an explicit focus on deeper learning (network schools) and students who attended similar traditional high schools (comparison schools).

Sample and Data

For the larger research project, the Study of Deeper Learning, we collected student survey data from students in Grades 10 through 12 at 13 deeper learning network high schools and 10 matched comparison schools in California and New York City. Table 1 presents information about the network and matched comparison schools included in this data collection and analyzed in the current brief.

Table 1. Characteristics of Network and Comparison High Schools Included in This Study

School characteristic	Network schools (13)	Comparison schools (10)
Enrollment	Average: 400	Average: 1,500
	Range: 300–600	Range: 400–2,600
Percentage female	Average: 53%	Average: 50%
	Range: 40%–70%	Range: 40%–60%
Percentage African American	Average: 12%	Average: 15%
	Range: 0%–40%	Range: 0%–40%
Percentage Hispanic	Average: 45%	Average: 48%
	Range: 10%–100%	Range: 20%–100%
Percentage eligible for free or reduced-price lunch	Average: 58%	Average: 57%
	Range: 30%–100%	Range: 20%–90%

Note. School demographics from the 2010–11 Common Core of Data (CCD).

In addition to matching network schools and comparison schools based on geography and school composition, students were purposefully selected to participate in the student survey so that samples of students were similar in terms of demographic characteristics and prior achievement between matched network and comparison schools. (For more information about the sample selection, see Appendix A.)

Student surveys included questions that were used to create nine measures of opportunities for deeper learning (see Box 1) that we combine into a single measure of opportunities for deeper learning for this study. The student surveys also included eight measures of interpersonal and intrapersonal competencies (see Box 2). The deeper learning opportunity measures directly addressed four of the six dimensions of deeper learning outlined by the Hewlett Foundation (opportunities for complex problem-solving, opportunities to collaborate, opportunities to communicate, and opportunities to learn how to learn) as well as additional opportunities that we expected would support the development of interpersonal and intrapersonal competencies (opportunities for creative thinking, opportunities to receive feedback, opportunities for assessments aligned with deeper learning, opportunities for interdisciplinary learning, and opportunities for real-world connections). The results presented in this brief are based on a sample of 2,298 students who took the student survey and for whom we were able to collect demographic information and prior achievement. The number of students included in each analysis varied depending on the availability of student background data. Details of the sample selection procedures and the creation of survey measures based on individual survey responses are provided in Appendix A.

Box 1. Measures of Opportunities for Deeper Learning Based on the Student Survey

1. ***Opportunities for complex problem-solving (22 items, α = 0.93):*** 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 (5 items, α = 0.88):*** The extent to which students have opportunities 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 (12 items, α = 0,90):*** The extent to which students have opportunities to practice written and oral communication skills
4. ***Opportunities to collaborate (9 items, α = 0.93):*** 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 (4 items, α = 0.78):*** The degree to which students practice monitoring and directing their own work and learning
6. ***Opportunities to receive feedback (6 items, α = 0.84):*** The degree to which students receive written and oral feedback on their work from teachers, peers, and others
7. ***Assessments aligned with deeper learning (9 items, α = 0.86):*** The extent to which students engage in various forms of assessment, including assessments of problem-solving, communication, and collaboration
8. ***Opportunities for interdisciplinary learning (4 items, α = 0.82):*** The degree to which students engage in interdisciplinary learning, in which two or more disciplines are combined to enhance inquiry and knowledge generation
9. ***Opportunities for real-world connections (9 items, α = 0.89):*** The degree to which students engage in instructional activities that emphasize real-world connections

We asked students to respond to a set of items 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. Response options were 0 (*none of my classes*), 1 (*one of my classes*), 2 (*two of my classes*), and 3 (*three or more of my classes*). Opportunities for interdisciplinary learning were measured on the following response scale: 0 (*none of the time*), 1 (*some of the time*), 2 (*most of the time*), and 3 (*all of the time*). We used Rasch modeling to create scale scores from the survey items for each measure. The scale scores were standardized to have a mean of 0 and a standard deviation of 1 in the full analytic sample of surveyed students.

Box 2. Measures of Interpersonal and Intrapersonal Competencies Based on the Student Survey

1. ***Creative thinking skills (5 items, α = 0.84):*** The extent to which a student perceives that he or she can think of original ideas and solutions
2. ***Collaboration skills (10 items, α = 0.91):*** The extent to which a student perceives that he or she works well in a group (e.g., positive personal interactions and 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 (10 items, α = 0.77):*** The degree to which a student agrees that he or she is interested and engaged in learning and participates actively in classroom learning activities
4. ***Motivation to learn (5 items, α = 0.81):*** The degree to which a student is motivated to do well academically and to become more knowledgeable, as measured by the student's perceived importance of coursework as well as preference for challenge and mastery goals
5. ***Self-efficacy (7 items, α = 0.91):*** The degree to which a student tends to view him- or herself as capable of meeting task demands in a broad array of contexts
6. ***Locus of control (5 items, α = 0.83):*** The extent to which a student feels that he or she has control over what happens to him or her rather than the student's circumstances being controlled by chance or fate
7. ***Perseverance (5 items, α = 0.88):*** 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 (10 items, α = 0.85):*** The extent to which a student feels that he or she is able to independently manage his or her work and schedules to meet goals

We asked students to respond to a set of items 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.

Methods

Our previous research revealed that students' opportunities for deeper learning did not occur in isolation; for example, students who reported greater frequency of opportunities to receive feedback also reported greater frequency of opportunities to learn how to learn, work in collaborative groups, etc.[15] Therefore, to avoid estimating relationships between each of the nine opportunity measures and each of the eight competency measures, we were able to create a single measure of opportunities for deeper learning that takes into account levels of and relationships between the nine opportunity survey measures. To examine the relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies, we estimated statistical models that allowed us to (a) combine information across survey

measures to create one overarching measure of opportunities for deeper learning and (b) compare the direction (negative or positive) and strength of the relationships between this measure of opportunities for deeper learning and competencies across student subgroups (see Appendix A for more details on the statistical analyses).[16] Analyses were conducted for the following subgroups:

- school type: students who attended deeper learning network high schools compared with students who attended traditional comparison high schools;
- gender: male students compared with female students;
- race/ethnicity: Black students compared with White students and Hispanic students compared with White students;
- English language learner (ELL) status: English language learners compared with native English speakers;
- disability status: students with an individualized education plan (IEP) compared with students without an IEP;
- low-income status: students who were eligible to receive free or reduced-price lunch (FRPL) compared with students who were not eligible; and
- prior achievement levels: students whose Grade 8 ELA test scores fell below the average within the sample compared with students whose scores fell above the average.[17]

Results

In general, we observed positive relationships between opportunities for deeper learning and each of the eight interpersonal and intrapersonal competency measures that ranged between moderate and large in strength.[18] In other words, for all groups of students, greater reported frequency of opportunities for deeper learning were related to higher reported levels for each of the interpersonal and intrapersonal competencies.

In addition, we found few consistent subgroup differences in the strength of the relationships. This means that, besides the few exceptions below, all students showed similar positive relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies. With eight student group comparisons and eight interpersonal and intrapersonal competencies, we examined a total of 64 pairs of relationships; less than one fifth of these comparisons showed significant differences in the relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies (see Table 2).

Table 2. Number of Significantly Different Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies Across Eight Survey Measures

Comparison	Number of significantly different relationships	Which competencies?
Students with below average prior achievement compared with students with above average prior achievement	0	N/A
Black students compared with White students	0	N/A
Students eligible for FRPL compared with students not eligible for FRPL	1	Perseverance
Students with IEPs compared with student without IEPs	1	Academic engagement
Network school students compared with comparison school students	1	Academic engagement
Hispanic students compared with White students	2	Academic engagement, motivation to learn
ELLs compared with native English speakers	2	Academic engagement, collaboration skills
Females compared with males	5	Academic engagement, creative thinking, perseverance, self-management, self-efficacy

Note. N/A = not applicable.

Although results of all of our analyses can be found in Appendix B, we describe main findings below.

For more than 80% of the comparisons we examined, relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies did not significantly differ.

Positive relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies did not significantly differ by levels of prior achievement or between Black and White students. For three of the subgroup comparisons, we observed a significant difference in the relationship between opportunities for deeper learning and one intrapersonal competency measure between groups: low-income status (perseverance, with a stronger relationship among students who were not eligible for FRPL), disability status (academic engagement, with a stronger relationship among students without IEPs), and school type (academic engagement, with a stronger relationship among network school students). For two of the subgroup comparisons, we observed two significant differences in the relationship between opportunities for deeper learning and one intrapersonal and interpersonal competency measure between groups: differences between Hispanic and White students (for academic

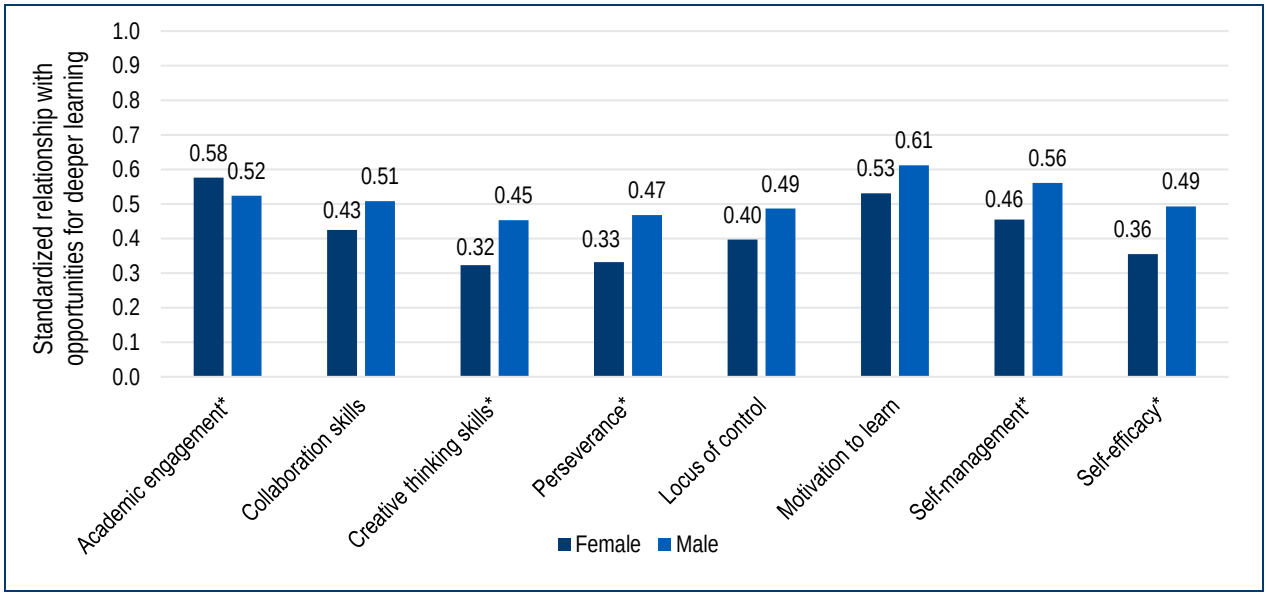
engagement and motivation to learn, with stronger relationships among White students) and differences between ELL students and native English speakers (for academic engagement and collaboration skills, with stronger relationships among ELL students). Therefore, for most of the subgroup comparisons, we did not find significant differences in relationships between opportunities for deeper learning and between six and eight of the interpersonal and intrapersonal competencies.

It is worth noting that nearly half of the of the significant differences between groups involved a single intrapersonal competency measure: academic engagement. We observed that the relationship between opportunities for deeper learning and academic engagement significantly differed by disability status, race/ethnicity (between Hispanic and White students), ELL status, gender, and school type. However, we also observed that, although the strength of the relationship significantly differed between groups, the size of the difference was generally small in magnitude. For example, the relationship between opportunities for deeper learning and academic engagement was 0.55 in network schools, 0.53 in comparison schools, 0.56 among ELL students, and 0.53 among non-ELL students (indicating that a one standard deviation difference in opportunities for deeper learning was related to a difference in academic engagement of about half of a standard deviation). Therefore, it is important to keep in mind that "statistically significant differences" in the relationship between opportunities for deeper learning and interpersonal and intrapersonal competencies did not necessarily indicate large differences between groups.

There were slightly stronger relationships between opportunities for deeper learning and intrapersonal competencies for male students, but female students reported stronger competencies.

We found several differences between males and females in the relationships between opportunities for deeper learning and intrapersonal outcomes (see Figure 1). Whereas the relationship between opportunities for deeper learning and academic engagement was significantly stronger among females than among males, relationships between opportunities for deeper learning and four other intrapersonal competencies were stronger among males: creative thinking skills, perseverance, self-management, and self-efficacy.[19] As described in our companion brief, "Equitable Opportunities for Deeper Learning,"[20] female students reported fewer opportunities for deeper learning than their male peers, particularly in traditional high schools. In contrast, as shown in Figure 2, female students' reports of interpersonal and intrapersonal competencies were similar to or higher than male students' reports of these competencies.

Figure 1. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Gender

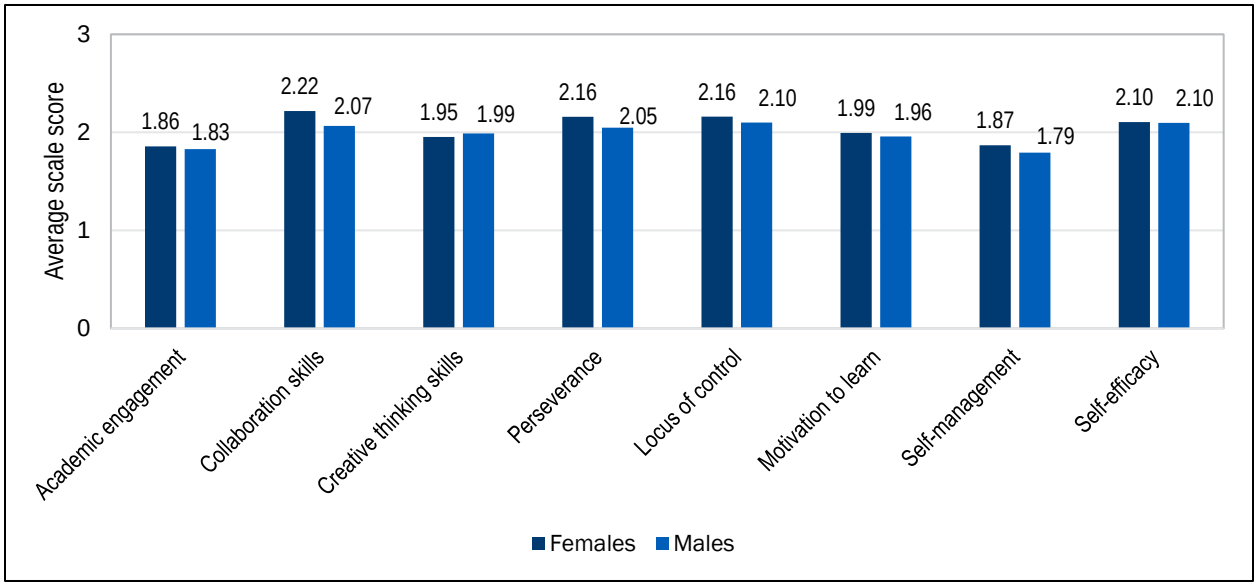


Note. The numbers in Figure 1 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.

Source. Secondary analysis of data from the Study of Deeper Learning.

*The difference between females and males is significant, $p < .05$.

Figure 2. Average Reports of Interpersonal and Intrapersonal Competencies by Gender



Note. The numbers in Figure 2 represent the average reported interpersonal and intrapersonal competency measure on a scale of 0 (*strongly disagree/never or almost never true*) to 3 (*strongly agree/always or almost always true*).

Source. Secondary analysis of data from the Study of Deeper Learning.

Taken together, these findings suggest that female students' interpersonal and intrapersonal competencies may not be as strongly related to their high school experiences and that other aspects of students' social lives (e.g., gender norms, peer groups, family situations) may play a larger role in the development of these skills for females than for males.

Conclusion

Our examination of relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies yielded few differences across student subgroups. In fact, for more than 80% of the comparisons we examined, relationships did not significantly differ between student subgroups. In addition, when we did find differences between subgroups, we found that these differences in the strength of the relationship were relatively small in magnitude.

We did find that the relationships between opportunities for deeper learning and creative thinking skills, perseverance, self-management, and self-efficacy were significantly stronger for male than for female students. However, because relationships were positive and moderate to large in size for both male and female students and also because reported interpersonal and intrapersonal competencies were similar for male and female students, these findings may indicate that factors external to the classroom (e.g., relationships with peers and parents' expectations) may be more influential in shaping intrapersonal competencies among female students than among male students.

What do these results mean for policy makers and practitioners? Deeper learning is a promising strategy for increasing interpersonal and intrapersonal competencies for many groups of students. The results in this brief do not demonstrate that opportunities for deeper learning *cause* differences in students' interpersonal and intrapersonal competencies, nor do they necessarily generalize to a larger population of schools. However, our findings do demonstrate that positive relationships between students' opportunities for deeper learning and interpersonal and intrapersonal competencies existed for all the student groups we examined. Furthermore, with a few exceptions, these positive relationships did not differ significantly in strength across different types of students in these schools. Therefore, increasing deeper learning opportunities for all types of students could potentially help all students develop interpersonal and intrapersonal competences.

Further, because traditionally underserved students are less likely to be exposed to these deeper learning opportunities in classrooms (see the companion brief, "Equitable Opportunities for Deeper Learning"),[21] providing them with these opportunities would be a departure from the status quo in many schools. Based on the analysis in this brief, this change to more equitable access to deeper learning might be an important step to improving interpersonal and intrapersonal competencies for these underserved students. This step could be key to ensuring positive life chances, since competences have been linked to positive academic and career outcomes.[22]

Appendix A. Technical Details

Study Sample Details

In 2011–12, the Hewlett Foundation selected 10 school networks to participate in what would become the "Deeper Learning Community of Practice." The purpose of this community of practice was to share strategies, tools, and lessons that both contribute to the work of the networks themselves and build the broader knowledge base of deeper learning. The 10 networks represented in this study have a well-established history of promoting deeper learning, and all share an emphasis on providing educational opportunities for minority students and students from low-income families to prepare them for college and careers. The network schools were drawn from 10 different networks, and the treatment evaluated in this study is therefore heterogeneous. As discussed in Huberman and colleagues,[23] although the networks' approaches varied, the approaches in the sampled high schools typically encompassed several common elements, including engagement in project-based learning involving collaboration and real-world experiences; use of authentic assessment (such as portfolios and exhibitions) to measure student achievement and progress; and development of personalized learning environments.

To select comparison schools, AIR researchers identified schools with a population of incoming Grade 9 students similar to the incoming Grade 9 students at the network schools. They identified eligible comparison schools located in the same school district as the network school (if the network school was operated by a school district) or within the surrounding school district of the network school (if the network school was operated by a charter school management organization).

Analyses in this brief are based on students who entered Grade 9 in 2009–10, 2010–11, or 2011–12 and consented to participate in study data collection during spring 2013. At that time, most students were in Grades 10 through 12. Within each school pair, we sampled all consented students from network schools. In addition, we sampled all consented students from small comparison schools (all New York City schools were small in size) and from one large comparison school in which a small number of students consented to participate in the study. In the remaining large comparison schools, we subsampled consented students by randomly selecting students based on propensity scores that were calculated based on students' Grade 8 demographic and test score data.[24] The results presented in this brief are based on a sample of 2,298 students who took the student survey and for whom we were able to collect demographic information and prior achievement.

Relationships were estimated for seven types of student subgroups (see Table A.1). Because we were not able to obtain each of the student background characteristics from all of the participating schools, students for whom we were unable to obtain the relevant student background information were excluded from the analyses. For example, as shown in Table A.1, analyses that focus on low-income status exclude about 54% of the sample because districts were unable to provide us with information on FRPL eligibility for these students.

Table A.1. Demographic and Achievement Information for Students in the Study Sample

Student subgroup	Categories	Number	Percentage
School type	Attended network school	1,077	46.9
	Attended comparison school	1,221	53.1
Gender	Female	1,245	54.2
	Male	1,053	45.8
Race/ethnicity	Hispanic	1,213	52.8
	Black	311	13.5
	White	527	22.9
	Other (not included in this brief)	247	10.8
Low-income status	Eligible for free or reduced-price lunch	647	28.2
	Not eligible for free or reduced-price lunch	416	18.1
	Missing (11 schools)	1,235	53.7
English learner status	English language learner	602	26.2
	Not an English language learner	1695	73.8
Grade 8 English language arts achievement	Above-average achievement	1,358	59.1
	Below-average achievement	697	30.3
	Missing (4 schools)	243	10.6
Disability status	Has an individualized education plan	118	5.1
	Does not have an individualized education plan	2,180	94.9

Rasch Modeling

We calculated Rasch scores using a one-parameter partial credit model, estimated with the Winsteps program. We chose a one-parameter model because it is simple to interpret, and, given that we do not have evidence that some items within the scale are more important than others, it assumes that all items contribute equally to the Rasch scores. In addition, in contrast to the rating scale model,[25] the partial credit model does not restrict the item structures to be the same across all items. Rasch scores and item threshold parameters were generated separately for each survey measure.

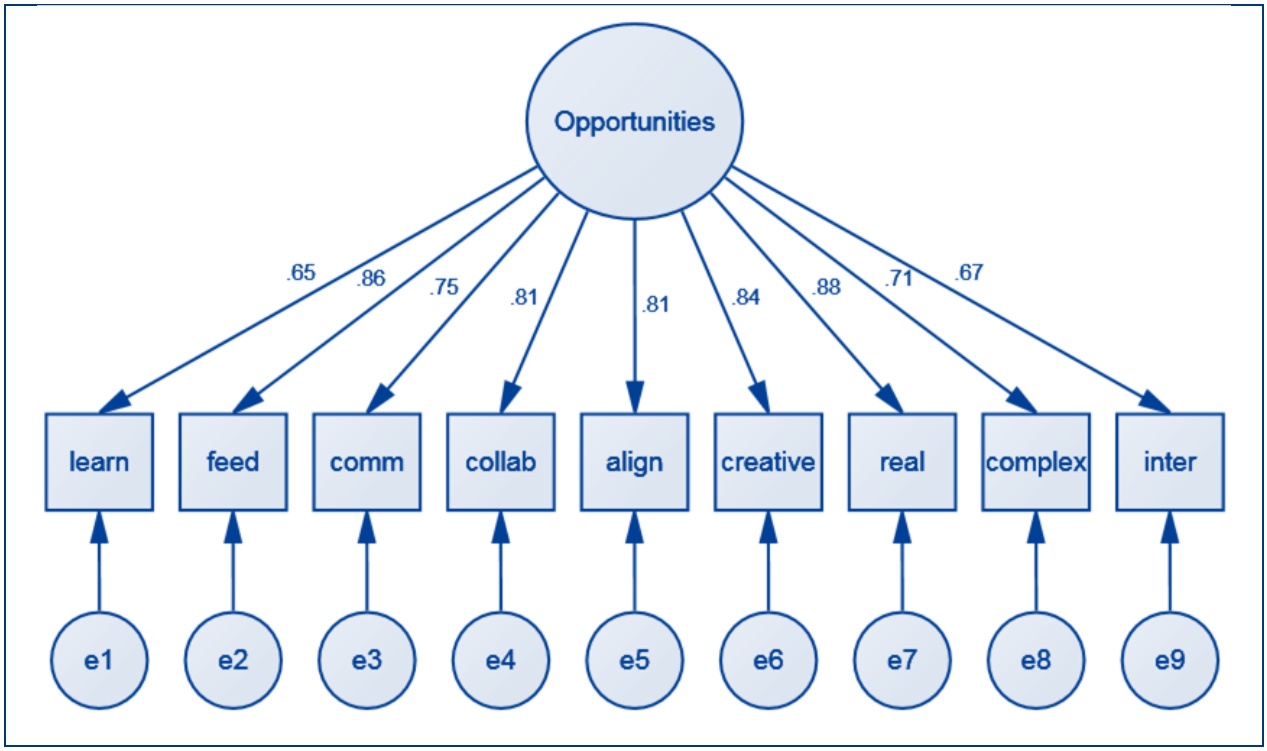
Structural Equation Modeling

To examine relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies, the AIR research team estimated structural equation models. We relied on structural equation modeling (SEM) because it allowed us to (a) use information from the nine opportunity measures to create a single latent "opportunities for deeper learning" measure and (b) estimate relationships between this latent measure and each of the eight interpersonal and intrapersonal competency measures. In this section, we discuss the creation of the latent measure of opportunities for deeper learning, tests of measurement invariance on this latent construct, and the path models in which

we estimate relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies.

Opportunities for Deeper Learning Latent Construct. Figure A.1 presents our latent measure of opportunities for deeper learning. This latent measure explains variation in the Rasch scores associated with the nine measures of opportunities for deeper learning.[26] Full information maximum likelihood was employed to handle missing data. This approach to missing data includes all students in analyses as long as they had at least one nonmissing scale score. All of the factor loadings, which can be interpreted as correlations between the individual opportunity measures and the latent opportunity measure, are greater than or equal to 0.65, indicating that all of the opportunity measures fit well together as a single latent opportunity construct.[27] Model fit indices show a relatively good fit to the data, with a confirmatory fit index (CFI) of .94 and a root mean square error of approximation (RMSEA) of .11. Normally, a CFI of .95 or higher and a RMSEA of .10 or lower indicate good fit to the data.

Figure A.1. Opportunities for Deeper Learning Measurement Model



Note. learn = Opportunities for Learning How to Learn, feed = Opportunities for Feedback, comm = Opportunities for Communication, collab = Opportunities for Collaboration, align = Opportunities for Assessments Aligned With Deeper Learning, creative = Opportunities for Creative Thinking, real = Opportunities for Real-World Connections, complex = Opportunities for Complex Problem-Solving, inter = Opportunities for Interdisciplinary Learning.

Tests for Measurement Invariance. Before examining subgroup differences in relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies, we tested for measurement invariance of the latent measure of opportunities for deeper learning. In other words, we examined whether the factor loadings capturing the relationships between the latent opportunity

construct and each of the opportunity measures were sufficiently similar between the two student subgroups under investigation. If the opportunity measure did not achieve measurement invariance, it would not be appropriate to make comparisons across subgroups, because this would indicate that subgroups derived substantively different meaning from the different components of the measure.

Measurement invariance was tested by estimating the SEM measurement model twice. In the first model, the factor loadings and intercepts are free to vary across subgroups, and in the second model, the factor loadings and intercepts are constrained to be equal across groups. By comparing the model fit statistics between these two models, we can determine whether allowing the model parameters to differ across groups significantly improves the fit of the model to the data.[28] Table A.2 presents the factor loadings for the student subgroups examined in this study.

Table A.2. Regression Weights From Measurement Models for the Opportunities for Deeper Learning Latent Construct by Student Subgroup

Subgroup	complex	real	creative	Align	collab	comm	feed	learn	inter
Network schools	0.71	0.87	0.84	0.78	0.78	0.73	0.83	0.62	0.60
Comparison schools	0.68	0.89	0.83	0.82	0.80	0.73	0.86	0.64	0.69
Female	0.71	0.87	0.83	0.80	0.79	0.75	0.84	0.67	0.67
Male	0.71	0.90	0.85	0.82	0.83	0.75	0.88	0.64	0.68
English language learner	0.75	0.89	0.84	0.84	0.83	0.78	0.87	0.60	0.65
Not English language learner	0.70	0.87	0.84	0.79	0.80	0.74	0.85	0.68	0.69
Eligible for free or reduced-price lunch	0.74	0.89	0.84	0.84	0.84	0.76	0.86	0.64	0.67
Not eligible for free or reduced-price lunch	0.74	0.89	0.84	0.84	0.84	0.76	0.86	0.64	0.67
White	0.68	0.88	0.81	0.83	0.81	0.73	0.86	0.65	0.72
Black	0.76	0.88	0.87	0.83	0.80	0.78	0.85	0.69	0.69
Hispanic	0.71	0.90	0.85	0.80	0.83	0.75	0.86	0.64	0.66
Has an individualized education plan	0.68	0.89	0.87	0.81	0.83	0.73	0.84	0.66	0.67
Does not have an individualized education plan	0.71	0.88	0.84	0.81	0.81	0.75	0.86	0.65	0.68
Below-average achievement	0.70	0.90	0.85	0.79	0.80	0.71	0.83	0.62	0.67
Above-average achievement	0.71	0.86	0.82	0.80	0.80	0.76	0.86	0.66	0.67

Note. learn = Opportunities for Learning How to Learn, feed = Opportunities for Feedback, comm = Opportunities for Communication, collab = Opportunities for Collaboration, align = Opportunities for Assessments Aligned With Deeper Learning, creative = Opportunities for Creative Thinking, real = Opportunities for Real-World Connections, complex = Opportunities for Complex Problem-Solving, inter = Opportunities for Interdisciplinary Learning

Differences in model fit statistics indicated that the latent measure of opportunities for deeper learning achieved invariance across groups (see Table A.3). In addition to examining differences in the chi-square model fit (in which a significant difference indicates a significant difference in model fit), we examined differences in CFI and RMSEA (in which a substantive difference in model fit is defined as 0.01 and 0.015, respectively).[29] Whereas the difference in the chi-square statistic achieved statistical significance in models comparing the measurement of opportunities of deeper learning by school type, ELL status, and prior achievement, the small differences in CFI and RMSEA indicated that the improvement in model fit was not substantive.

Table A.3. Model Fit Statistics From Measurement Invariance Models

		Network vs. comparison	Female vs. male	ELL vs. not ELL	FRPL vs. not FRPL	IEP vs. not IEP	Low ELA vs. higher ELA	Hispanic vs. White	Black vs. White
Chi-square	Unconstrained	807.388	802.330	752.605	584.125	806.904	704.482	679.330	361.706
	Constrained measurement weights	824.951	812.491	818.025	584.125	813.252	724.592	704.015	369.153
	Difference	*17.563*	*10.161*	*65.420*	*0.000*	*6.348*	*20.110*	*24.685*	*7.447*
	Significance	*0.025*	*0.254*	*0.000*	*1.000*	*0.608*	*0.010*	*0.002*	*0.489*
CFI	Unconstrained	0.934	0.938	0.938	0.932	0.938	0.936	0.934	0.929
	Constrained measurement weights	0.933	0.938	0.933	0.933	0.938	0.935	0.932	0.929
	Difference	*0.001*	*0.000*	*0.005*	*-0.001*	*0.000*	*0.001*	*0.002*	*0.000*
RMSEA	Unconstrained	0.078	0.078	0.078	0.087	0.078	0.077	0.082	0.083
	Constrained measurement weights	0.073	0.073	0.076	0.081	0.073	0.072	0.077	0.077
	Difference	*0.005*	*0.005*	*0.002*	*0.006*	*0.005*	*0.005*	*0.005*	*0.006*

Note. ELL = English language learner, FRPL = free or reduced-price lunch, IEP = individualized education plan, ELA = English language arts, CFI = confirmatory fit index, RMSEA = root mean square error of approximation.

Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies

We relied on SEM path models to estimate relationships between the latent opportunities for deeper learning construct and each of the eight interpersonal and intrapersonal competency outcome measures. Two types of models were used for each of the subgroup comparisons (e.g., male versus female students, Hispanic students versus White students). In the first model, we allowed the relationship between opportunities for deeper learning and the outcome measure to differ across groups. For the second model, we imposed a model constraint to force the relationship between deeper learning opportunities and the competency measure to be the same for both groups of students.[30] By comparing the model fit statistics between these two models (i.e., a model wherein the relationship is allowed to differ and a model wherein the relationship is constrained to be the same), we were able to test whether the relationships between deeper learning opportunities and competencies significantly differed between student subgroups.

Tables A.4 through A.11 provide the results of the model fit tests for each of the subgroup comparisons. While tests of measurement invariance required the examination of multiple measures of model fit (e.g., chi-square, CFI, RMSEA), comparisons of path model results across student subgroups relied exclusively on the significance of the chi-square test. We acknowledge that, with eight measures of interpersonal and intrapersonal competencies and eight different subgroup comparisons, a total of 64 significance tests are summarized in this report, and we do not adjust for multiple comparisons. Rather than focus on each individual model comparison, our findings focus on the patterns of differences between groups, and they should be interpreted as descriptive in nature.

Table A.4. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by School Type

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	1,052.999	1,061.977	8.978	0.003
Collaboration skills	1,116.549	1,118.209	1.660	0.198
Creative thinking skills	1,100.288	1,100.988	0.700	0.403
Perseverance	1,028.120	1,029.822	1.702	0.192
Locus of control	902.121	904.712	2.591	0.107
Motivation to learn	1,023.610	1,024.221	0.611	0.434
Self-management	1,026.602	1,027.966	1.364	0.243
Self-efficacy	986.427	989.309	2.882	0.090

Table A.5. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Gender

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	1,036.359	1,042.777	6.418	0.011
Collaboration skills	1,113.501	1,114.411	0.910	0.340
Creative thinking skills	1,062.027	1,068.999	6.972	0.008
Perseverance	1,017.831	1,024.001	6.170	0.013
Locus of control	904.939	905.633	0.694	0.405
Motivation to learn	1,018.142	1,019.939	1.797	0.180
Self-management	1,008.913	1,014.375	5.462	0.019
Self-efficacy	977.711	981.705	3.994	0.046

Table A.6. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by English Language Learner Status

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	1,049.238	1,062.190	12.952	0.000
Collaboration skills	1,170.220	1,177.826	7.606	0.006
Creative thinking skills	1,123.694	1,125.144	1.450	0.229
Perseverance	1,080.761	1,081.822	1.061	0.303
Locus of control	970.738	971.403	0.665	0.415
Motivation to learn	1,099.786	1,099.933	0.147	0.701
Self-management	1,064.969	1,067.456	2.487	0.115
Self-efficacy	1,058.693	1,058.729	0.036	0.850

Table A.7. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by FRPL Eligibility

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	657.952	658.080	0.128	0.721
Collaboration skills	704.723	704.725	0.002	0.972
Creative thinking skills	668.491	668.496	0.005	0.944
Perseverance	638.359	642.758	4.399	0.036
Locus of control	584.128	584.150	0.022	0.883
Motivation to learn	660.700	660.814	0.114	0.736
Self-management	621.625	621.631	0.006	0.938
Self-efficacy	602.877	602.878	0.001	0.984

Note. FRPL = free or reduced-price lunch.

Table A.8. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies for Hispanic Students and White Students

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	894.597	899.869	5.272	0.022
Collaboration skills	935.615	935.821	0.206	0.650
Creative thinking skills	942.091	942.275	0.184	0.668
Perseverance	854.382	857.440	3.058	0.080
Locus of control	751.544	752.408	0.864	0.353
Motivation to learn	883.289	892.432	9.143	0.002
Self-management	868.196	870.559	2.363	0.124
Self-efficacy	808.777	809.379	0.602	0.438

Table A.9. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies for Black Students and White Students

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	435.578	435.898	0.320	0.572
Collaboration skills	494.129	494.457	0.328	0.567
Creative thinking skills	432.615	432.870	0.255	0.613
Perseverance	417.315	418.162	0.847	0.357
Locus of control	422.443	424.305	1.862	0.172
Motivation to learn	434.877	435.527	0.650	0.420
Self-management	433.019	435.445	2.426	0.119
Self-efficacy	444.020	444.068	0.048	0.826

Table A.10. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Disability Status

Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	1,038.080	1,045.575	7.495	0.006
Collaboration skills	1,093.861	1,093.960	0.099	0.753
Creative thinking skills	1,062.672	1,064.603	1.931	0.165
Perseverance	1,013.634	1,014.691	1.057	0.304
Locus of control	894.065	895.351	1.286	0.257
Motivation to learn	1,029.478	1,029.931	0.453	0.501
Self-management	1,001.979	1,001.991	0.012	0.913
Self-efficacy	979.989	983.303	3.314	0.069

Table A.11. Chi-Square Model Fit Test Results From Path Models Estimating Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies, by Prior English Language Arts Achievement Level

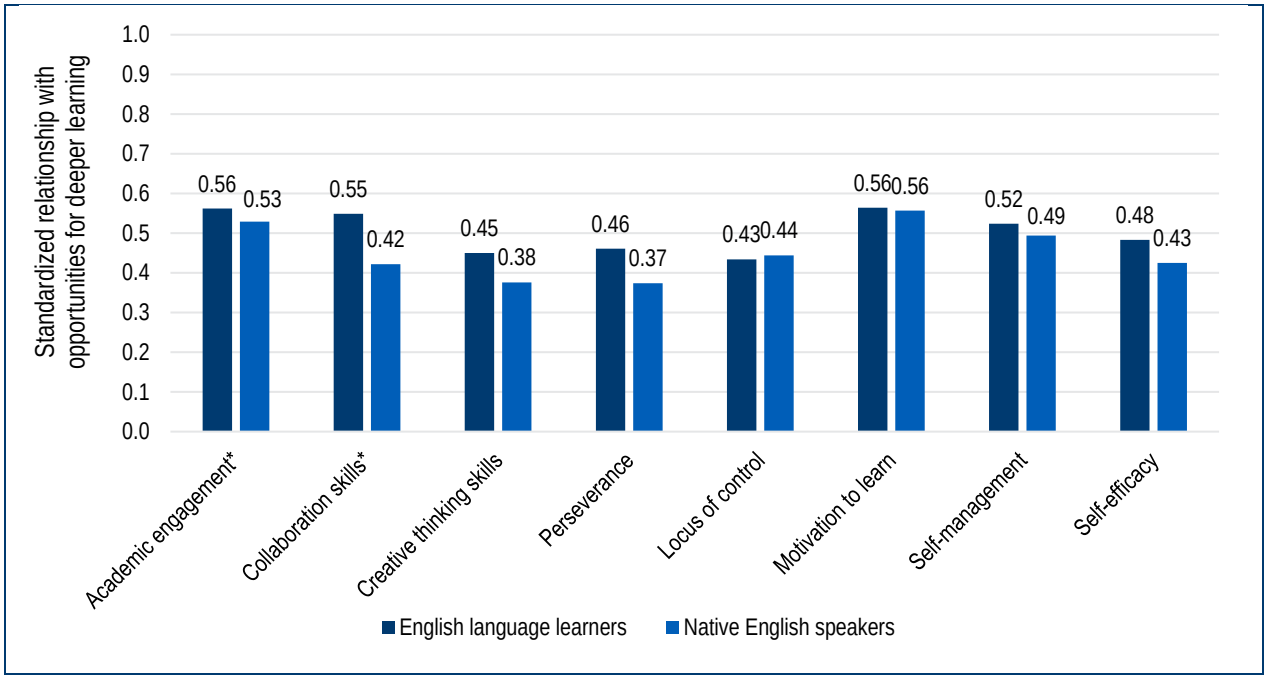
Interpersonal and intrapersonal competency outcome	Chi-square, unconstrained model	Chi-square, constrained model	Difference	Significance
Academic engagement	921.659	922.374	0.715	0.398
Collaboration skills	973.864	975.348	1.484	0.223
Creative thinking skills	946.397	946.400	0.003	0.958
Perseverance	886.420	886.427	0.007	0.933
Locus of control	803.788	804.027	0.239	0.624
Motivation to learn	902.966	902.976	0.010	0.918
Self-management	886.546	886.563	0.017	0.897
Self-efficacy	866.083	868.281	2.198	0.138

Appendix B. Detailed Findings

Detailed results for each of the subgroup comparisons are provided below.

ELL status. ELL students are traditionally disadvantaged in the school setting because of language barriers and the need to overcome social-cultural differences with peers and teachers within their schools. Because of the unique obstacles that ELL students face in their education, we were not sure whether to expect that the relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies would be similar for ELL students and their non-ELL peers. With two exceptions, we found that relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies did not differ between ELLs and native English speakers (see Figure B.1). Relationships were stronger among ELLs between opportunities for deeper learning and academic engagement (0.56 versus 0.53) and between opportunities for deeper learning and collaboration skills (0.55 versus 0.42). These findings suggest that opportunities for deeper learning may be particularly beneficial for ELLs, who typically face barriers to collaborating with their peers and becoming engaged in their education.

Figure B.1. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by English Language Learner Status

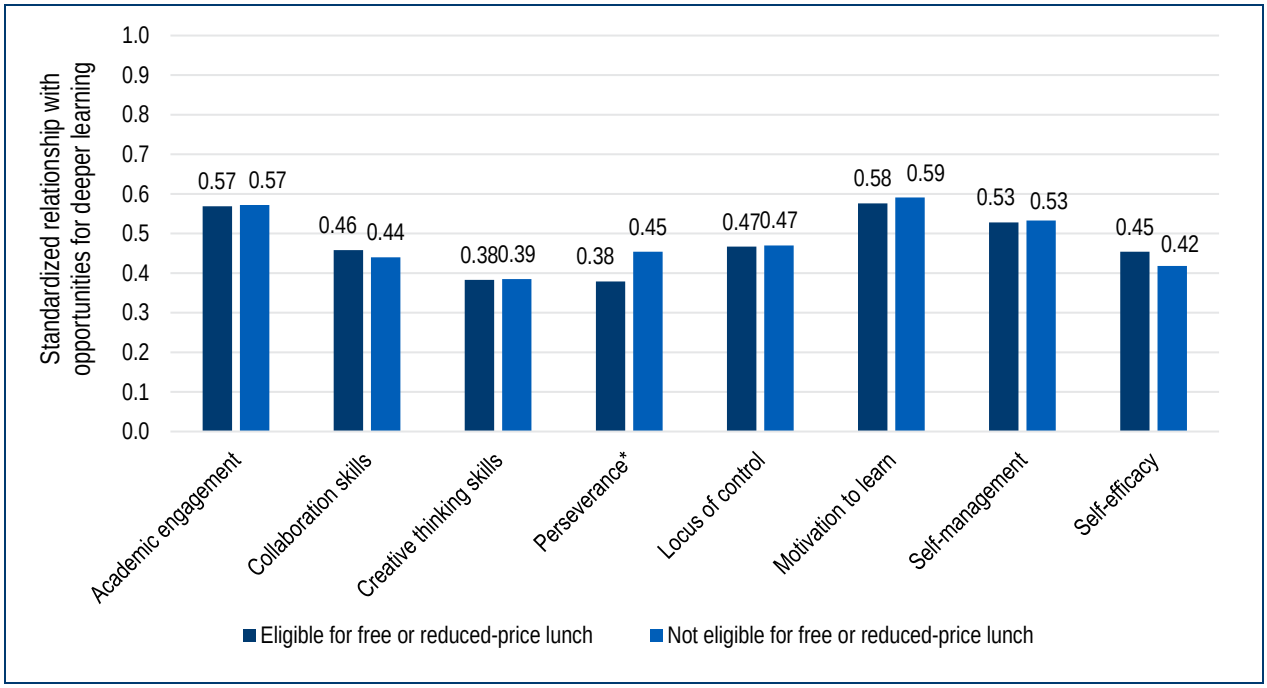


Note. The numbers in Figure B.1 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.
Source. Secondary analysis of data from the Study of Deeper Learning.
* The difference between English language learners and native English speakers is significant, $p < .05$.

Low-income status. Students who come from economically disadvantaged families may face obstacles that affect their interpersonal and intrapersonal outcomes, including issues related to family stress and

instability and limited financial resources for basic needs such as food and healthcare.[31] Therefore, we were not sure whether relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies would be similar for students with different income statuses. In general, these relationships did not significantly differ by low-income status, as defined by eligibility to receive free or reduced-price lunch (see Figure B.2). The single exception was the relationship between opportunities for deeper learning and perseverance, which was significantly weaker among students who were eligible for free or reduced-price lunch (0.38) than among students who were not eligible (0.45). Therefore, to the extent that low-income students generally receive fewer opportunities for deeper learning (see our companion brief, "Equitable Opportunities for Deeper Learning"),[33] increasing exposure to these opportunities has the potential to close economic gaps in competencies related to future academic and career success.

Figure B.2. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Eligibility for Free or Reduced-Price Lunch



Note. The numbers in Figure B.2 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.

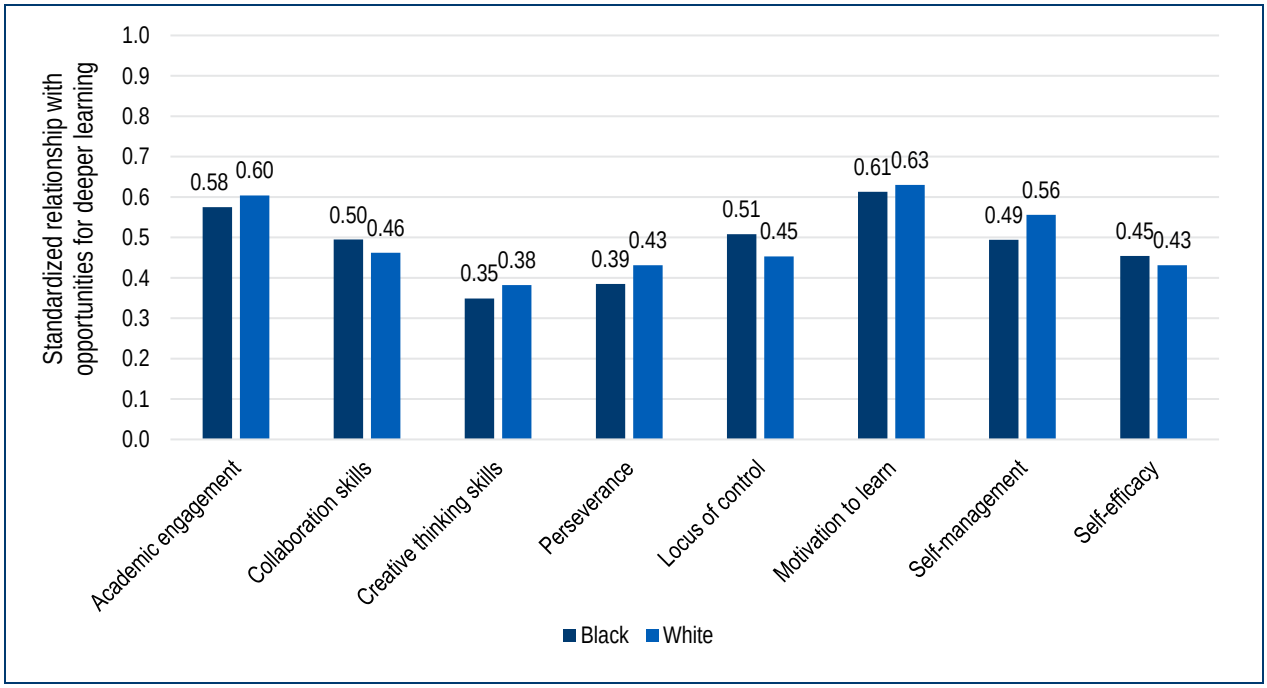
Source. Secondary analysis of data from the Study of Deeper Learning.

* The difference between students who are eligible for free or reduced-price lunch and students who are not eligible is significant, $p < .05$.

Race/ethnicity. Research has documented racial/ethnic gaps in academic achievement and attainment, with racial/ethnic minorities demonstrating lower levels of high school graduation, postsecondary enrollment, and degree attainment.[34] We found that relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies did not significantly differ between Black students and White students (see Figure B.3). Although several relationships between opportunities for

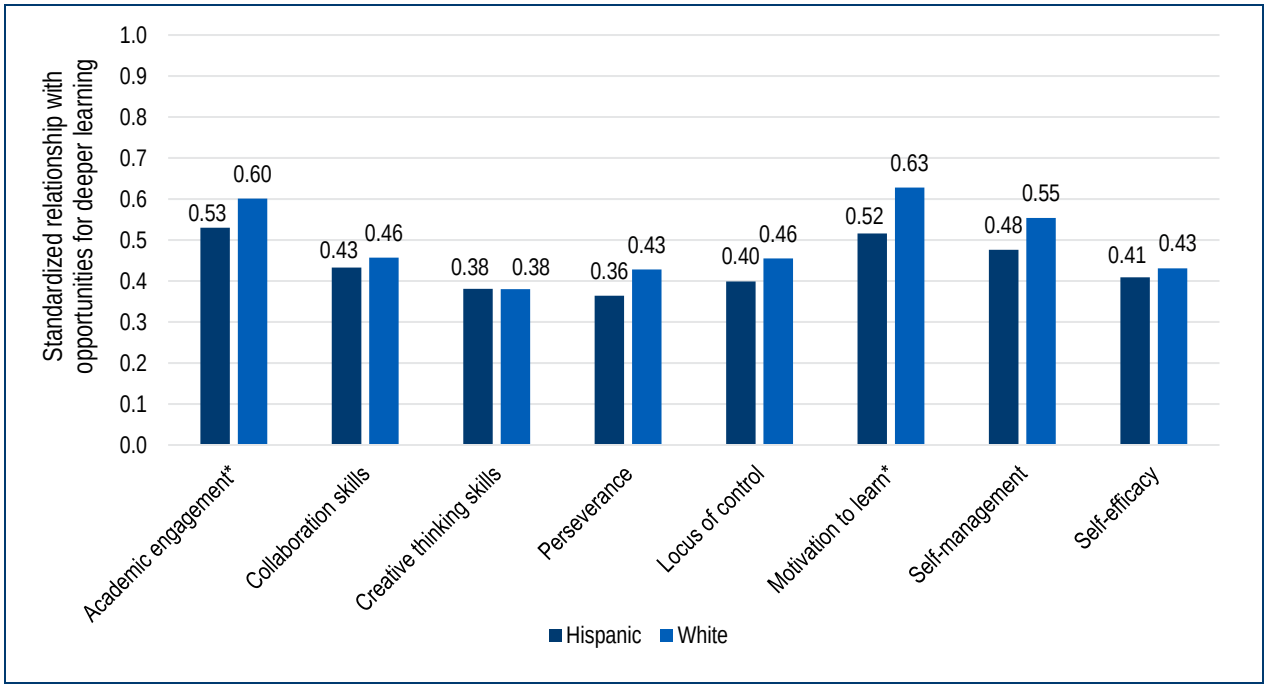
deeper learning and interpersonal and intrapersonal competencies appear to be weaker among Hispanic students than White students, only two relationships significantly differed between these subgroups (see Figure B.4). The relationships between opportunities for deeper learning and academic engagement (0.53 versus 0.60) and between opportunities for deeper learning and motivation to learn (0.52 versus 0.63) were significantly weaker among Hispanic students than among White students.[35]

Figure B.3. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies for Black Students and White Students



Note. The numbers in Figure B.3 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.
Source. Secondary analysis of data from the Study of Deeper Learning.

Figure B.4. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies for Hispanic Students and White Students



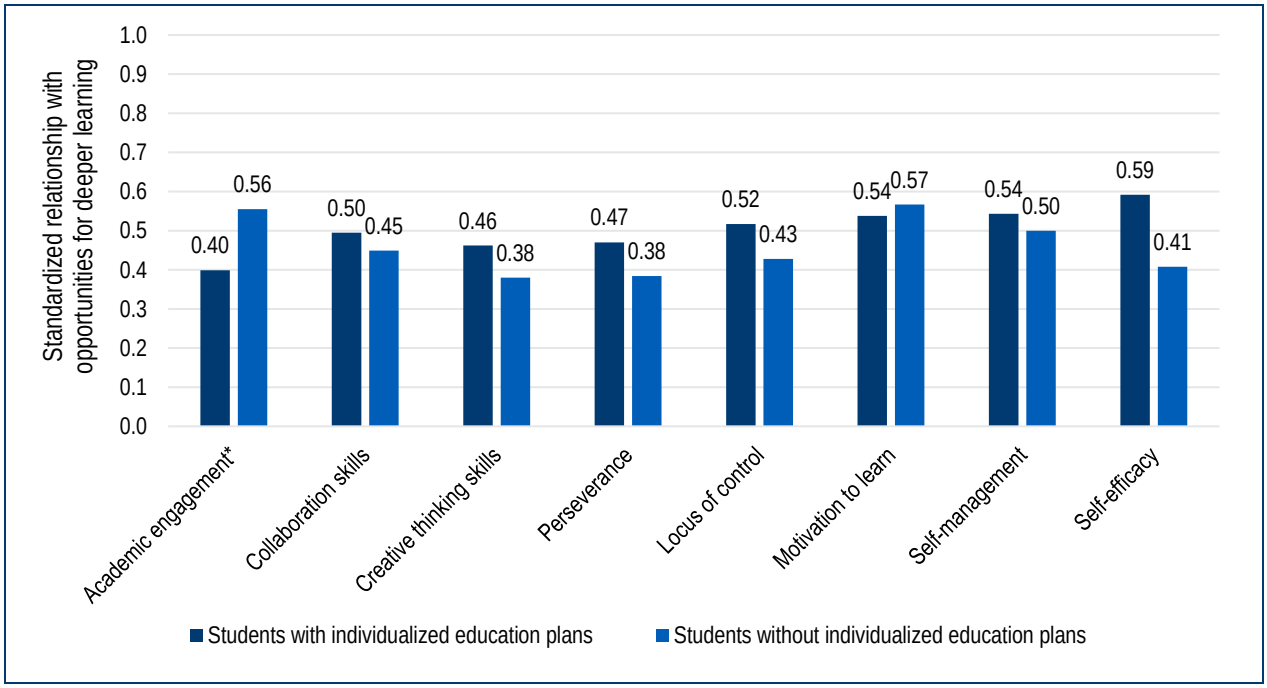
Note. The numbers in Figure B.4 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.

Source. Secondary analysis of data from the Study of Deeper Learning.

* The difference between Hispanic students and White students is significant, $p < .05$.

Disability status. Although several relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies appear to be stronger among special education students, who we define as students with individualized education plans (IEPs), than among students who did not have IEPs, these differences did not achieve statistical significance (see Figure B.5). It is possible that the lack of significant differences is due to the relatively small number of special education students in our sample (118). Only the relationship between opportunities for deeper learning and academic engagement significantly differed between groups, with a weaker relationship observed among students with an IEP (0.40) than among students without an IEP (0.56). Overall, these results indicate that opportunities for deeper learning are positively related to students' interpersonal and intrapersonal competencies regardless of disability status.

Figure B.5. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Disability Status



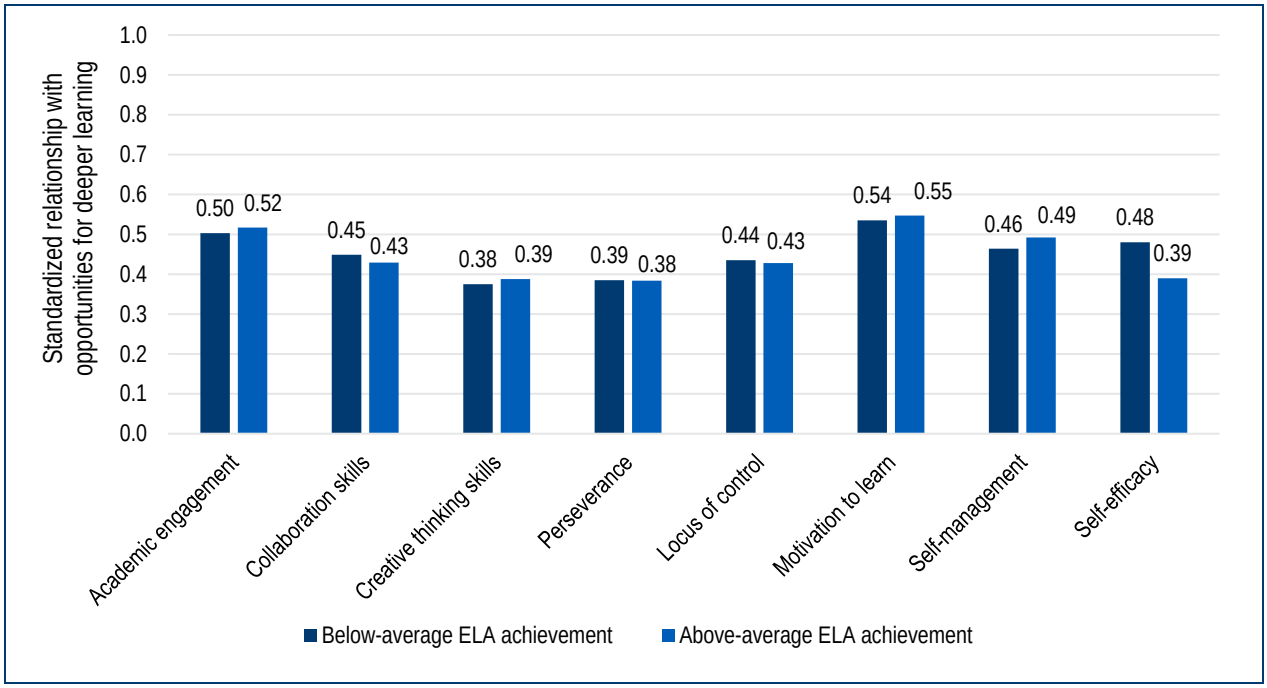
Note. The numbers in Figure B.5 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.

Source. Secondary analysis of data from the Study of Deeper Learning.

* The difference between students with an individualized education plan (IEP) and students without an IEP is significant, $p < .05$.

Prior achievement. In traditional high schools, opportunities for deeper learning (e.g., opportunities for collaboration, longer term assessments through projects, and learning in real-world settings) are often reserved for higher achieving students, because teachers tend not to be as concerned about their comprehension of academic content. In contrast, instruction for lower achieving students is more likely to involve teacher-led lectures and traditional testing techniques, with the focus on mastery of concepts rather than the development of interpersonal and intrapersonal skills. However, we found that relationships between opportunities for deeper learning and interpersonal and intrapersonal competencies did not significantly differ between students with below-average levels of Grade 8 English language arts (ELA) achievement and students with above-average levels of Grade 8 ELA achievement (see Figure B.6). This finding suggests that educational opportunities often reserved for higher achieving students are equally beneficial for students with lower levels of prior achievement; therefore, increasing exposure to these opportunities has the potential to reduce longer term gaps in educational and workforce outcomes.

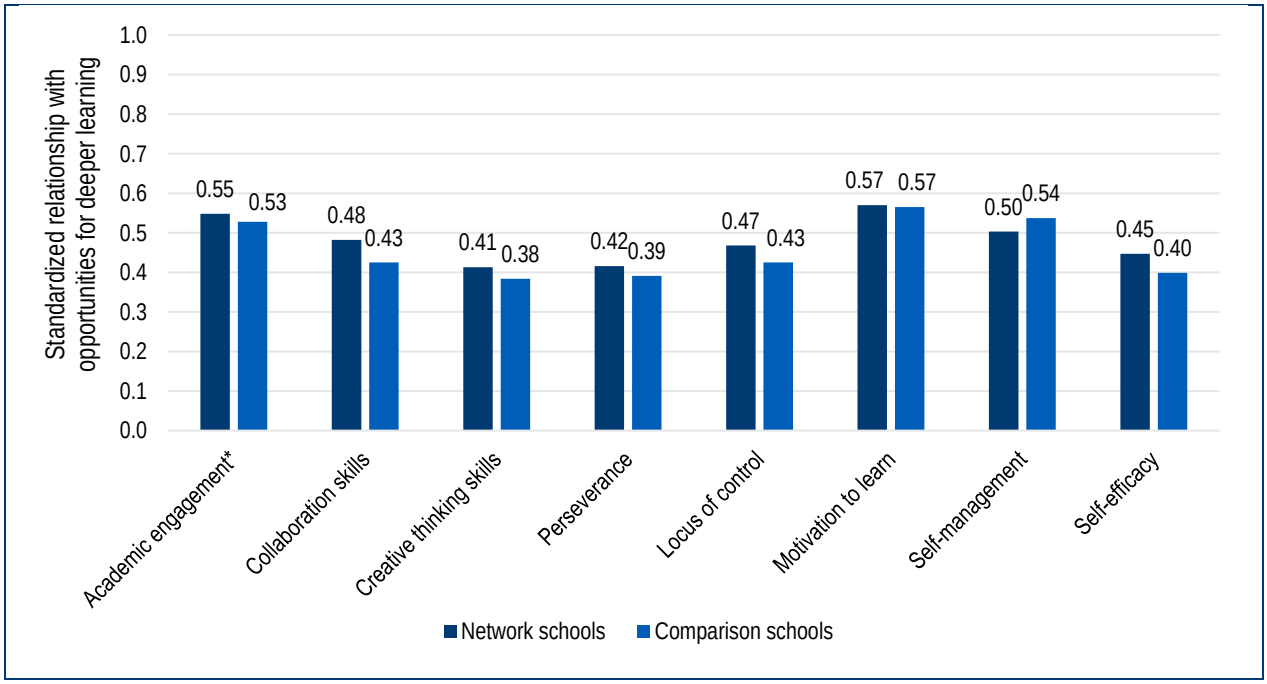
Figure B.6. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by Prior Achievement Level



Note. ELA = English language arts. The numbers in Figure B.6 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.
Source. Secondary analysis of data from the Study of Deeper Learning.

School type. Because the deeper learning network schools included in this study were founded on the principle that students' opportunities for deeper learning translate into improved interpersonal and intrapersonal competencies, it is possible that hard-to-measure school characteristics such as the school culture, leadership practices, and the structure of the school day may facilitate positive relationships between student opportunities and outcomes. It is less clear whether relationships between opportunities for deeper learning and competencies would be similarly positive in traditional high schools, where there is not a schoolwide push for deeper learning. Overall, we found that relationships between opportunities for deeper learning and interpersonal and intrapersonal outcomes were similar between students who attended deeper learning network schools and students who attended matched comparison schools (see Figure B.7). Although the magnitude of the relationships tended to be somewhat larger among students who attended deeper learning network schools, only the relationship between opportunities for deeper learning and academic engagement significantly differed by school type (0.55 among network school students and 0.53 among comparison school students). Overall, these findings demonstrate that positive relationships between opportunities for deeper learning and students' interpersonal and intrapersonal competencies are not limited to schools with an explicit focus on deeper learning.

Figure B.7. Relationships Between Opportunities for Deeper Learning and Interpersonal and Intrapersonal Competencies by School Type



Note. The numbers in Figure B.7 represent the standard deviation change in the competency measure given a one standard deviation change in the deeper learning opportunity latent measure.

Source. Secondary analysis of data from the Study of Deeper Learning.

* The difference between network schools and comparison schools is significant, $p < .05$.

Endnotes

[1] Collins, S., Davis-Molin, W., & Conley, D. (2013). *Journey toward deeper learning: An evaluation of the Roadtrip Nation Experience in the San Jose PLUS Academies*. Eugene, OR: Educational Policy Improvement Center.

[2] Nichols-Barrer, I., & Haimson, J. (2013). *Impacts of five Expeditionary Learning middle schools on academic achievement*. Cambridge, MA: Mathematica Policy Research.

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[6] Rickles, J., Zeiser, K. L., Mason, J., & Garet, M. S. (2016). *Deeper learning and graduation: Is there a relationship?* Washington, DC: American Institutes for Research.

[7] Rickles, J., Zeiser, K. L., Yang, R., O'Day, J., & Garet, M. (2019). Promoting deeper learning in high school: Evidence of opportunities and outcomes. *Educational Evaluation and Policy Analysis*, *41*(2), 214–234.

[8] William and Flora Hewlett Foundation. (2013). *Deeper learning defined*. Retrieved from https://www.hewlett.org/library/deeper-learning-defined/

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[10] Deeper learning network schools in this study were small in size (with an annual average enrollment ranging from 200 to 700 students), avoided the use of tracking, and provided opportunities for students to revise their work to demonstrate mastery of core content. Schools (and sometimes networks) provided both formal and informal opportunities for adult learning and collaboration, including instructional rounds where teachers observe and provide feedback to one another, regular grade-level and content area team

meetings, access to instructional coaching, and professional learning communities where teachers bring a problem of practice to the table for discussion among colleagues. All of these practices created a context for a more equitable distribution of student experiences and outcomes.

[11] Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). The shape of deeper learning: Strategies, structures, and cultures in deeper learning network high schools. *Report 1: Findings from the Study of Deeper Learning: Opportunities and outcomes*. Washington, DC: American Institutes for Research.

[12] Huberman, M., Duffy, H., Mason, J., Zeiser, K., & O'Day, J. (2016). *School features and student opportunities for deeper learning: What makes a difference?* Washington, DC: American Institutes for Research.

[13] Zeiser, K. L., Brodziak de los Reyes, I., & Yang, R. (2020). *Equitable opportunities for deeper learning: Exploring differences between traditional and network schools*. Washington, DC: American Institutes for Research. Retrieved from

[14] Alliance for Excellent Education. (2011). *A time for deeper learning: Preparing students for a changing world*. Washington, DC: Author. Retrieved from https://all4ed.org/wp-content/uploads/2013/06/DeeperLearning.pdf

[15] Rickles, J., Zeiser, K. L., Mason, J., & Garet, M. S. (2016). *Deeper learning and graduation: Is there a relationship?* Washington, DC: American Institutes for Research.

[16] We also ran alternative models in which we statistically controlled for student background characteristics. Results of these alternative models largely resemble the results presented in this brief unless otherwise noted.

[17] Average Grade 8 English language arts (ELA) test scores were calculated within grade level and separately for students in California and students in New York City.

[18] Though standards for the strength of relationships vary across disciplines, according to Cohen (1988), a moderate relationship is a standardized relationship that falls between about 0.3 and 0.5. Standardized relationships above 0.5 may be considered as large. Because this brief presents standardized relationships, the size of the relationship can be interpreted as the percentage of a standard deviation change in the interpersonal and intrapersonal competency outcome measure given a one standard deviation change in the measure of opportunities for deeper learning. See: Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

[19] Results of alternative models that controlled for student background characteristics largely resemble the results shown here; however, the gender difference in the relationship between opportunities for deeper learning and self-efficacy did not achieve statistical significance.

[20] Zeiser, K. L., Brodziak de los Reyes, I., & Yang, R. (2020). *Equitable opportunities for deeper learning: Exploring differences between traditional and network schools*. Washington, DC: American Institutes for Research. Retrieved from

[21] Zeiser, K. L., Brodziak de los Reyes, I., & Yang, R. (2020). *Equitable opportunities for deeper learning: Exploring differences between traditional and network schools*. Washington, DC: American Institutes for Research. Retrieved from

[22] National Research Council. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century.* Washington, DC: The National Academies Press.

[23] Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). The shape of deeper learning: Strategies, structures, and cultures in deeper learning network high schools. Report 1: Findings from the Study of Deeper Learning: Opportunities and outcomes. Washington, DC: American Institutes for Research.

[24] Propensity score weights are often used in quasi-experimental inferential statistics to estimate significant differences between groups who do or do not receive some sort of "treatment" or intervention. While the original Study of Deeper Learning applied propensity score weights to impact models, because the analyses in this brief are descriptive in nature and do not exclusively focus on differences between students in network and comparison schools, propensity score weights are not applied to analyses in this report. For more information on propensity score weights, see Hirano, K., Imbens, G. W., & Ridder, G. (2003). Efficient estimation of average treatment effects using the estimated propensity score. *Econometrica*, *71*(4), 1161–1189.

[25] Partial credit models and rating scale models are the two types of one-parameter IRT models. The rating scale model is a special case of partial credit model wherein the threshold parameters are the same across items when overall item difficulty is partialed out.

[26] We originally tried to fit joint models with nine first-order factors and one second-order factor using the 80 items associated with opportunities for deeper learning, but the program did not work due to computing power requirements. However, across the opportunity measures, we observed Cronbach's alpha values ranging from 0.77 to 0.93, with an average alpha value of 0.87, indicating pretty high internal consistency. When alpha values are high, this indicates that measures are pretty reliable, so accounting for individual items would not greatly affect the results.

[27] We also performed an exploratory factor analysis to explore whether alternative measures of opportunities for deeper learning (e.g., subsetting the opportunity measures) would be more appropriate. These models showed that the single-factor opportunity measure provided the best fit to the data.

[28] We performed alternative models in which we statistically controlled for student background characteristics. Results of these alternative models largely resemble the results presented in this brief unless otherwise noted.

[29] Meade, A. W. (2005). Sample size and tests of measurement invariance. Paper presented at the 20th Annual Conference of the Society for Industrial and Organizational Psychology, Los Angeles, CA.

[30] In these models, relationships between the deeper learning opportunity measures and the latent deeper learning opportunity construct were constrained to be equal across subgroups. Therefore, the only difference between the two models was the relationship between the latent construct and the outcome measure.

[31] Mayer, S. E. 1997. *What money can't buy: Family income and children's life chances*. Cambridge, MA: Harvard University Press; Owens, A. (2018). Income segregation between school districts and inequality in students' achievement. *Sociology of Education*, *91*(1), 1-27.

[33] Zeiser, K. L., Brodziak de los Reyes, I., & Yang, R. (2020). *Equitable opportunities for deeper learning: Exploring differences between traditional and network schools*. Washington, DC: American Institutes for Research. Retrieved from

[34] McFarland, J., Hussar, B., de Brey, C., Snyder, T., Wang, X., Wilkinson-Flicker, S., . . . Bullock Mann, F. (2017). *The condition of education 2017* [NCES 2017-144]. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

[35] Results of alternative models that controlled for student background characteristics largely resemble the results shown here; however, after including statistical controls, the relationship between opportunities for deeper learning and perseverance was significantly weaker among Hispanic students than White students.

To learn more about AIR's research on Deeper Learning, contact Kristina Zeiser at kzeiser@air.org

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