Learning With Others

A Study Exploring the Relationship Between Collaboration, Personalization, and Equity

Technical Appendix

OCTOBER 2018

Wendy Surr | Kristina Zeiser | Olivia Briggs | Kimberly Kendziora

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A. Development of Study Measures

Development of Student Survey

The student survey was designed to measure student perspectives in three domains:
(1) opportunities for collaboration; (2) the classroom environment; and (3) students' mindsets and dispositions. The student surveys aimed to capture complex concepts such as group interdependence, feelings of inclusion, and a sense of social self-efficacy. Given that complex concepts such as these cannot be accurately measured by a single question, the student surveys comprised sets of questions for each desired measurement area.

To develop the student survey measures, we drew from the research literature in multiple areas, including student collaboration, culturally responsive teaching and learning, (microaggression, social-emotional learning, teacher-student relationships, engagement intrinsic motivation and self-efficacy. We also reviewed and drew or adapted selected items and scales from more than a dozen publicly available survey instruments (see Table 1). Finally, the research team developed dozens of original items.

Table 1. Sources Used to Inform Development of Student Survey Items and Scales

Author/Source	Instrument/Scale
1. Akey, T. M. (2006). School context, student attitudes and behavior, and academic achievement. New York, NY: MDRC. Retrieved from: https://www.mdrc.org/publication/student-context-student-attitudes-and-behavior-and-academic-achievement	Student Attitudes and Behavior Scales: conduct expectations scale; active learning strategies scale
2. Consortium on Chicago School Research (2009*). My school, my voice: high school senior survey.* Retrieved from http://ccsr.uchicago.edu/downloads/23532009_my_voice_senior_student_codebook.pdf	Academic engagement scale
3. Fredricks, J., Wang, M. T., Linn, J. S., Hofkens, T. L., Sung, H., Parr, A., & Allerton, J. (2016). Using qualitative methods to develop a survey measures of math and science engagement. *Learning and instruction, 43, 5-15.*	Behavioral cognitive engagement and emotional engagement scales
4. Guo, P., Choe, J., & Higgins-D'Alessandro, A. (2011). Report of construct validity and internal consistency finding for the comprehensive school climate inventory. Bronx, NY: Fordham University.	School climate inventory: support for learning scale

Author/Source	Instrument/Scale
5. Hansen, D., & Larson, R. (2005). *The Youth Experience Survey. 2.0. Instrument revisions and validity testing*. Unpublished manuscript, University of Illinois at Urbana-Champaign. Retrieved from: http://youthdev.illinois.edu/wp-content/uploads/2013/11/YES-2.0-Instrument.pdf.	Negative group dynamics scale
6. Haynes, E., Zeiser, K., Surr, W., Hauser, A., Clymer, L., Walston, J., & Yang, R. (2016). *Looking under the hood of competency-based education: The relationship between competency-based education practices and students' learning skill, behaviors, and dispositions.* Quincy, MA: The Nellie Mae Education Foundation.	Teacher expectations for learning scale; perceived teacher support scale; cognitive Engagement-self-regulated learning scale; academic self-efficacy scale
7. Johnson, D. W., & Johnson, R. T. (1983). Social interdependence and perceived academic and personal support in the classroom. *Journal of Social Psychology, 120*, 77-82.	Goal interdependence scale
8. Johnson, D.W., Johnson, R., & Anderson, D. (1983). Social interdependence and classroom climate. *Journal of Psychology, 114,* 135-142.	Peer personal support scale; peer academic support scale
9. Micari, M., & Drane, D. (2011). Intimidation in small learning groups: The roles of social-comparison concern, comfort, and individual characteristics in student academic outcomes. *Active Learning in Higher Education, 12*(3), 175-187.	Social comfort scale; social comparison concerns scale
10. Midley, C., Maehr, M., Hruda, L., Anderman, E., Anderman, L., Freeman, K. Gheen, M., Kaplan, A., Kumar, R., Middleton, M., Nelson, J., Roeser, R., & Urdan, T. (2000). *Manual for the patterns of adaptive learning scales.* University of Michigan. Retrieved from: http://www.umich.edu/~pals/PALS%202000_V13Word97.pdf	PALS survey, mastery orientation scale
11. Patrick, H., & Ryan, A. (2003). *Identifying adaptive classrooms: analyses of measures of dimensions of the classroom social environment.* Paper prepared for the Positive Outcomes conference. Washington, DC: Child Trends*.*	Classroom social environment scales; social self-efficacy scale
12. Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology, 99*(1), 83-98. http://dx.doi.org/10.1037/0022-0663.99.1.83	Social efficacy with peers scale

Author/Source	Instrument/Scale
13. Pintrich, P., Smith, D., Garcia, T., & McKeachie, W. (1991*). A manual for the use of the motivated strategies for learning questionnaire (MSLQ).* Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning.	Intrinsic goals orientation scale
14. Torres-Harding, S., Andrade, A.L., & Diaz, C.E.R. (2012). The racial microaggressions scale: a new scale to measure experiences of racial microaggressions in people of color. *Cultural Diversity and Ethnic Minority Psychology, 18*(2), 153-164.	Racial microaggression scales
15. Williams, D.R., Yu, Y., Jackson, J.S., & Anderson, N.B. (1997). Racial differences in physical and mental health: socioeconomic status, stress, and discrimination. *Journal of Health Psychology, 2*(3), 335-351.	Heightened vigilance scale

Development of the student survey included several rounds of review and revision. First, early versions of the survey were reviewed by several members of the research team, including two experts in the field of equity. Next, revised versions of the survey were reviewed by teaching staff and administrators from the four participating study sites. After this round of reviews and revisions, we conducted two, 45-minute focus groups with small groups of students representing a range of differing race/ethnic groups[1] at one our participating sites. During these focus groups, we asked students to read and respond to survey items, noting any questions they felt were confusing, made them feel uncomfortable, or included words they did not understand. During these groups, we also facilitated group discussion and encouraged students to explain why they had identified particular survey items as problematic. One of the aims of these student focus groups was to help ensure that items were interpreted similarly by students representing differing racial/ethnic groups. We consulted with an expert in survey design and student engagement throughout the survey development process. This expert provided us with suitable resources to inform item development, reviewed item wording and helped in the refinement of proposed survey constructs

Development of the Teacher Survey

The teacher survey was primarily designed to capture the same domains and constructs as those included in the student survey focused on opportunities for collaboration and perceptions of the classroom environment. To that end, we designed teacher survey items in

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[1] Students participating in the two focus groups included 5 Black, 2 White, 2 Mixed Race, 1 Hispanic, 1 Other) (N=11)

these two domains by rewording student survey items to be appropriate for teacher respondents. In addition to these two measurement areas, we also included questions in the teacher survey designed to capture teacher perceptions of the benefits and challenges associated with collaboration, perceived support from school leaders for collaboration and personalization, and the school and classroom level factors believed to help or hinder efforts to offer collaboration. Similar to the student survey, the development of the teacher survey included multiple rounds of reviews and revision, including reviews by teaching staff and administrators at our four participating sites, reviews by an expert in survey design, and reviews by experts in culturally responsive teaching and learning and equity.

Development of the Classroom Observation Instrument

A classroom observation instrument was developed to capture an independent perspective on the classroom environment and the nature and quality of opportunities for high-quality collaboration. The instrument was designed to capture three aspects of the classroom environment: personalization, socially supportive classroom, and expectations for learning. In addition, the instrument was designed to capture three aspects of opportunities for collaboration: teacher facilitation of group work, student-student interactions during group work, and the nature of the collaborative task.

Initially, we had planned to use selected sections from the *Classroom Assessment Scoring System (CLASS)* instrument (Pianta, Hamre, & Mintz, 2012). However, the CLASS did not sufficiently capture the features of high-quality collaboration. Therefore, we developed our own items, rating anchors, and rubric. To develop our instrument, we reviewed items from three tested observation instruments to determine how related constructs were being defined and measured (Pianta et al., 2012); *The Assessment of Afterschool Program Practices Observation Tool* (APT; Miller & Surr, 2005; Surr, Dennehy, Stavsky, & Richer, 2012), and collaborative group rubric (Pazos, Macari, & Light, 2010). The majority of the final observation items were developed by Wendy Surr, a member of the research team. In addition, several items (excluding rating anchors and scale) were drawn from the APT tool, authored by Miller & Surr (2005) and Surr et al. (2012). Items were defined using three anchor points representing low, medium, and high. In addition, a key to operationally define terms used within these three anchor points was established. A copy of the Collaboration Study observation instrument is available on the [Student-Centered Learning Research Collaborative Hub](#).

B. Site Recruitment

To recruit our four study sites, we worked through our existing contacts within foundations, intermediary organizations, and school networks. These efforts led to our identifying dozens of potential student-centered school sites in New England, the Midwest, and the Southeast. We provided potential schools with an overview of the study and the school selection criteria. Several district and school leaders expressed interest in the study but explained that, given the time of year, they had already made commitments to other studies or initiatives and felt that they were unable to take on something new. Several invitations to sites were successful, resulting in the recruitment of four sites that all satisfied the selection criteria, one in New England, one in the Midwest, and two in the Southeast. All four participating sites satisfied the selection criteria. Tables 2 and 3 provide an overview of the characteristics of the four participating schools.

Selection Criteria

- **School Model**: Selected schools had to embrace a student-centered learning model that had been implemented for at least 2 years and include[2]:

    - A focus on personalization including one or more of the following: use of personalized or individualized learning plans for all students, learner profiles, or advisories (advisories could be individual or small group).
    - Regular opportunities for student collaboration, at least twice monthly, in which students were expected to work as part of a group or team within their courses on a shared project or assignment that counted for credit, and required more than one class period to complete.
    - A diverse student population including at least 20% Black, Non-Hispanic, and 20% white, Non-Hispanic students. Our final school sample met these criteria as shown in Table 3.

- **Governance and Configuration**: Public high schools serving students in Grades 9–12 (schools could be charter, magnet, or other publicly funded schools of choice available to all students, but they could not have selective admission criteria).

- **School Size**: Our preferred enrollment for recruitment was 320 to 1,600 students in Grades 9–12. The final school sample had an average enrollment of 872 ranging from 419 to 1,201 students.

- **Location:** We initially targeted only schools in New England. However, we ultimately expanded our geographic focus to recruit sites from New England, the Midwest, and the Southeast.

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[2] We determined whether schools met our selection criteria by reviewing the school websites and other materials describing their models, and interviewing school leaders.

Table 2. Characteristics of Participating School Sites

Site	Type	Total Approximate Yearly Enrollment	Location	Student-Centered Model Meets Criteria	Student Demographics Meet Criteria
1	Public, comprehensive	1,200	Southeast	Yes	Yes
2	Public, charter	670	Midwest	Yes	Yes
3	Public, comprehensive	1,200	Southeast	Yes	Yes
4	Public, magnet	400	New England	Yes	Yes

Table 3. Racial/Ethnic Composition of Participating School Sites

	Black	White	Hispanic	Other Race/ Ethnicity
Average	48%	27%	21%	4%
Range	31%–64%	20%–34%	9%–39%	0.2%–3%

C. Data Collection

Student Data Collection

Consent Process and Rates

All 9-12 grade students in the four participating schools were invited to participate in the study. However, only students whose parents provided written consent were permitted to participate. . Consent forms were sent home with all students in English and Spanish and included a request for participation in surveys and a separate section to provide consent for participation in focus groups. Students who were 18 years of age or older could sign and return consent forms for themselves. Additional student assent forms were administered to all students, regardless of age, for those participating in focus groups. During survey administration, students were asked to give their verbal assent before beginning the survey.

Once signed consent forms had been received at schools, each designated school liaison sent copies of the signed consent forms to American Institutes of Research (AIR), and a list of all students who had active parental consent was created by AIR. In one of the sampled schools, participation in the study was covered under the annual permission that parents gave for their students to participate in educational research. Therefore, a separate consent process for participation in the survey was not conducted for students attending this school. However, active parental consent and student assent was obtained for student participation in focus groups at this site. A summary of our final student sample consent and response rates is provided in Table 4.

Table 4. Student Survey Consent and Response Rates

School	Enrollment	N with Consent	Percent With Consent	N With Survey Data	Overall Response Rate	Response Rate Among Consented Students
1	1,200	384	32%	312	26%	81%
2	668	250	37%	228	34%	91%
3	1,200	208	17%	175	15%	84%
4	419	403	96%	177	42%	44%
Total	**3,488**	**1,245**	**36%**	**892**	**26%**	**72%**

Student Survey Data Collection

All students who consented in each school were invited to respond to the 94-item student survey. The survey took approximately 20–30 minutes to complete and was administered online during the school day. At each site, research staff provided site liaisons with an orientation session to support student survey administration and a plan was devised regarding the timing of survey administration for consented students. In two of the schools, surveys were administered during students' advisory period. In one of the schools, it was administered during students' English class, and in the fourth school, the survey was administered in a variety of classes.

Prior to survey administration day, each school liaison provided teachers with instructions for administering the surveys which included a script to be read to students explaining that the survey would ask about their experiences working with other students at school. Teachers also let students know that there were no wrong answers to survey questions and that their responses were confidential. Participation in the survey process was voluntary. Before students took the survey, they were given an assigned identification number. Having a unique ID for each student enabled the research team to link each student's survey responses with student demographic and academic data.

To ensure that we had equal numbers of responses across subjects, students were randomly assigned to report on either their mathematics or their English class.[3] As shown in Table 5, our final sample of students who completed the surveys was almost evenly distributed across these two subjects.

The study team collected survey data from a total of 892 students attending the four school sites. However, not all of these students provided data on their collaboration experiences in math and English Language Arts (ELA) (see Table 5). A total of 31 survey respondents were not taking math or English, so they did not report on any subject-specific measures. Among those who reported about their math and English classes, 92% reported experiencing collaboration experiences (either reporting "yes" or "not sure," ranging from 73 percent to 98 percent across schools).[4] Therefore, analyses that examine relationships between opportunities for high-quality collaboration, classroom experiences, and outcomes focus on this subsample of 785 students who reported experiencing collaboration in their math or ELA classes.

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[3] At the start of the survey, students were asked to indicate the month in which they were born. If a student was born during an even-numbered month (e.g., February), the student was directed to answer questions about math. Students born during an odd-numbered month and were assigned to respond for their English course.
[4] Students who responded "yes" or "not sure" were asked questions about their collaboration experiences. Across schools, between 2% and 9% of students responded "not sure."

Table 5: Student Survey Respondents by Opportunities for Collaboration and Subject Area

School	Number With Data	Number of Respondents in Either Math or English	Number and Percent of Student Respondents Reporting[a] Opportunities for Collaboration	Among Students Who Report Having Opportunities for Collaboration Numbers of Student Respondents in Math and English	
				Math	English
1	228	228	224 (98.2%)	106	118
2	312	312	301 (96.4%)	147	154
3	175	149	134 (89.9%)	73	61
4	177	172	126 (73.2%)	62	64
Total	**892**	**861**	**785 (91.1%)**	**388**	**397**

[a]This includes students who responded either "yes" or "not sure" to the question of whether they had opportunities for collaboration in their math or ELA class.

Student Focus Groups

At each site, students were also invited to participate in focus groups. Focus groups were 30–45 minutes in length and were designed to more deeply explore students' collaborative experiences, including the extent to which students valued and enjoyed collaborative experiences, their perspectives on factors affecting social dynamics within collaborative groups, and perceptions of the teachers' role in facilitating collaboration. Focus groups also explored students' experiences of social comfort, inclusion, and exclusion during collaboration in school. Overall, we held eight focus groups with a total of 52 students across the four schools. Within each school, we conducted two focus groups with between four and eight students. Parental consent was obtained for all students participating in focus groups. In addition, at the start of groups, we explained the purpose for the discussion, and asked students to give their verbal assent. Students were also assured that their responses were confidential, that their participation was voluntary, and that they could refrain from answering any questions that they did not want to answer. All focus group participants were provided with lunch or a snack. *Student focus group protocols are included on pages 58–64.*

Composition of focus groups. We designed the composition of focus groups to allow us to better understand and compare any differences in the perspectives of Black students with regard to collaborative experiences, with the perspectives of students, in general. To that end, at each school, one of the two focus groups contained only students who self-identified as Black or African American. The other focus group at each school contained students representing a mix of differing racial/ethnic groups, including Black students. Student focus

group participants were selected from the sample of students who participated in the student survey so that we could use students' self-identified race/ethnicity and survey academic subject area to assign them to focus groups. In selecting students, we response first drew a random sample of 15–20 students per site among those who had parental consents for participation in both the survey and in the focus groups. Next, we sought to identify eight students from the random sample that would enable us to form a group that was balanced with respect to gender, race, grade level, and survey response subject area. For all Black focus groups, we recruited from the pool of students who had identified as Black on surveys. For mixed-race focus groups, we sought to include equal numbers of White, Black, and Hispanic students. For both the mixed race and all Black focus groups, we sought to include an equal number of males/females and equal representation across the four grade levels. Across the four sites, a total of 52 students participated in focus groups[5] (see Table 6).

Table 6. Total Number of Students Participating in Black and Mixed Race/Ethnicity Focus Groups by School

School	Black	Mixed Race/Ethnicity	Total
School 1	8	7	15
School 2	7	6	13
School 3	7	7	14
School 4	4	6	10
Total	26	26	52

Table 6A. Mixed Race Focus Groups: Gender and Grade Level Breakdown

School	Grade Levels Represented	Gender: % Female	Number Black[6]	Total
School 1	9–12	57%	1	7
School 2	9–12	50%	1	6
School 3	9–12	57%	2	7
School 4	Grades 9 & 12 only	0%	0	6
Range/Average	75% had 9–12	41%	1	26

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[5] All students who participated in focus groups also completed the student survey.
[6] In several of these focus groups, the students chose to not identify their race, or reported that they were biracial.

Table 6B. All Black Focus Groups: Gender and Grade Level Breakdown

School	Grade Levels Represented	Gender: % Female	Total
School 1	9–12	50%	8
School 2	9–12	57%	7
School 3	9–12	43%	7
School 4	Only grade 9	75%	4
Range/Average	75% had 9-12	56%	26

Student Demographics, Grades, and Attendance Data

For each student who participated in the survey, we requested district administrative data including students' gender, race/ethnicity, English language learner status, eligibility for free or reduced-price lunch, special education status, and course grades for the year prior to the study.

In addition, to examine relationships between high-quality collaboration, perceptions of the classroom environment, and academic outcomes, we collected student academic and demographic information from districts. District-provided student data included: students' current year course grades and rate of absenteeism (i.e., the number of days students were absent divided by the number of days students were enrolled) during the 2016–17 school year. For the measure of course grades both during the current academic year and the previous academic year, we documented grades in either students' math or English courses, depending on the academic subject for which students provided survey responses about their high-quality collaborative experiences. A numerical score from 0–4 was assigned for letter grades as follows: 0 = F and 4 = A, averaged across courses and/or semesters if students took multiple courses during the 2016–17 academic year. Information on students' course grades during the previous academic year were not available for Grade 9 students in our study because these freshmen had attended middle school during the previous year, and the majority of students' high school transcripts did not include information on middle school performance. In addition, students' eligibility for free or reduced-price lunch was only provided by half of our study sites.

Final Student Sample

Student data were collected from three sources: (1) online student surveys, (2) focus groups, and (3) demographic and academic records, which were provided for all students who completed the survey. Overall, 892 consented students participated in the study (see Table 7). Our final student survey sample also reflected the overall racial/ethnic composition of each of our respective schools (Table 8).

Table 7. Student Sample by Data Source

	Student Survey			Focus Groups		
	Students in Survey	**Survey, Mathematics**	**Survey, ELA**	**Black Focus Group**	**Mixed-Race Focus Group**	
Total	892	432	429	8	4 (N = 26)	4 (N = 26)
		869		8 (N = 52)		
Range	175–312	79–157	62–155	No Range	No Range	
		149–312				

Table 8. Racial/Ethnic Characteristics of Student Survey Sample

	Black	**White**	**Hispanic**	**Other Race/ Ethnicity**
Average	46%	24%	15%	15%
Range	28%–60%	18%–29%	9%–33%	7%–20%

Teacher Measures and Data Collection

Teacher Survey. At each site, all Grade 9–12 core subject and specialist teachers were invited to complete the 136-item, online survey during the spring of 2017. At each school, we worked with our designated site liaison to collect teacher survey responses. First, liaisons disseminated information about the study to all staff and notified teachers that they would receive an invitation and link to the teacher survey. Next, we obtained teacher names, email addresses, and subjects taught from each site.

In April and May of 2017, we sent individual emails to classroom teachers at each site. Emails were sent to classroom teachers in the school for core academic subjects (which included teachers in mathematics, ELA, science, social studies, and foreign language). Invitations were also sent to teachers of other subjects, such as technology and visual arts. Teachers clicking on the survey link were asked to provide their consent to participate on the survey opening page. Survey invitations were sent to a total of 196 teachers, and responses were received from 138 teachers (a 70 percent response rate; see Table 9). The number of teachers by subject area and school are presented in Table 9. Although 11 teachers did not complete the survey, we used available responses from items that they did complete. However, nine of these teachers did

not complete Section 2 of the survey and were not included in analyses that examine teacher experiences in specific courses.

Table 9. Number of Teacher Respondents by School and Subject Area

School	Number Consented to Participate	Completed	Subject Area						
			English	Math	Science	Social Studies	Other	Spanish	Did Not Report Subject
1	31	29	6	8	5	†	9	0	†
2	56	52	11	11	8	6	16	†	†
3	34	30	7	10	†	†	6	†	†
4	17	16	†	†	†	†	†	†	0
Total	**138**	**127**	**28**	**32**	**20**	**12**	**34**	**†**	**9**

†Cells containing fewer than 5 teachers have been suppressed.

Teacher Interviews

In-person interviews lasting 45–60 minutes were conducted with a sample of 28 grade 9–12 classroom teachers representing two subject areas: mathematics and ELA. Interviews were designed to gain a more in-depth understanding of teachers' beliefs about high-quality collaboration, how they designed and facilitated collaboration in their classrooms, and which student characteristics (e.g., gender, race) were believed to influence the dynamics in collaborative groups. In addition, interviewers asked teachers their perspectives on the benefits and challenges associated with offering collaboration, including the relative importance of providing opportunities for collaboration in the personalization of learning, and explored any contextual factors teachers felt helped or hindered their efforts to offer collaboration. For a copy of the teacher interview protocol, see page 64.

At two of the four sites where the total number of teachers was small, we were able to invite all mathematics and ELA teachers in the school to participate in the interviews. At the two larger sites, we sampled mathematics and English teachers based on the school schedule. We began by selecting only from those teachers and classes that we would be able to observe during our scheduled site visits. We examined the available teachers/courses during each day and because we typically had only one classroom observer available, we selected an equal number of ELA/math classrooms to observe in sequence, ensuring a cross section of grade and course levels (e.g., mix of introductory, honors level, remedial). We then invited teachers who were selected for classroom visits to participate in interviews. We interviewed eight teachers

(approximately 4 teachers in each subject) at three sites. In the smallest of our four sites, we were only able to recruit four teachers across mathematics and ELA for interviews, two per subject.

Teachers invited to participate in interviews were asked to provide consent and to provide additional verbal permission for audio recording. The majority of teacher interviews were conducted in person during site visits. However, due to scheduling constraints, we completed three interviews via phone within two weeks of each site visit. Participating teachers received a $25 gift card to thank them for their participation.

Classroom Visits and Interviews.

Classroom Visits. During site visits, we visited classrooms for each of the mathematics and ELA teachers who had been selected for both an observation and an interview (see selection approach, above). Classroom visits were scheduled for a single class period and ranged in duration from 15–55 minutes. The purpose of classroom visits was to capture the quality of classroom environments in the domains of interest to the study, including the quality of collaborative opportunities, the social-emotional environment, personalization, and expectations for learning. A copy of the observation rubric is available on the [Student-Centered Learning Research Collaborative Hub](#).

During each classroom visit, a member of the research team followed an observation protocol that required that they refrain from interacting with students and teachers during their visit other than to introduce themselves and find an appropriate place to sit or stand. During these classroom visits, observers were instructed to assign a rating for each of the 16 items con in the observation rubric. Ratings were assigned on a 3-point scale: low, medium, or high. Ratings were assigned during a series of 20-minute cycles (i.e., 15 minutes of observation followed by 5 minutes to assign ratings). Observers were specifically instructed to capture separate observation ratings for any collaborative activities. This was done by completing a new, separate set of ratings whenever a classroom activity shifted from a noncollaborative focus (e.g., full class discussion or instruction, or student independent work time, to a planned collaborative activity time). This enabled us to capture ratings for the 16 items separately for collaborative and other classroom activities.

Across the four sites, we visited a total of 30 classrooms, including 14 mathematics classrooms and 16 ELA classrooms.

Final Teacher Sample

Data were collected from and about classroom teachers from three sources: online teacher surveys, teacher interviews, and observations made during classroom visits to teachers who participated in the interviews. Overall, 138 teachers participated in the study (see Table 10).

Table 10. Teacher Sample by Data Source

	Survey, All Core Subjects	Survey, Mathematics	Survey, ELA	Teacher Interviews, Mathematics	Teacher Interviews, ELA	Classroom Visits, Mathematics	Classroom Visits, ELA
Total number of teachers	138	29	25	14	14	14	16
Range	17–56 per school	2–11 per school	4–10 per school	2–4 per school	2–4 per school	2–5 per school	4 per school

D. Measures

Technical Properties of Student Survey Measures

Before we began our analysis of survey data, it was important to confirm the technical quality of our survey instruments. In particular, we wanted to make sure that survey questions (i.e., items) were able to work together to reliably measure desired constructs such as dynamic and structural features associated with high-quality collaboration, specific aspects of the classroom environment, and student mindsets and dispositions such as engagement, intrinsic motivation, and self-efficacy. In addition, given our interest in racial/ethnic differences in the experiences and outcomes associated with collaboration, we wanted to ensure that Black and White students were interpreting survey items similarly regardless of their race.

Using groups of items to measure these constructs is more reliable than using just a single survey item because each item in a set addresses a different aspect of the practice or experience area. For example, three survey items in the student survey all relate to student experiences of responsive, respectful interactions with peers during collaboration. Together, these three items assess the extent to which students believe that students in their collaborative groups interact in ways that are responsive, respectful, and inclusive of all group members. We used several statistical tests to make sure that each set of questions was able to reliably capture each desired construct for both the student and the teacher surveys. First, for each set of survey items we calculated the items' internal consistency (which is referred to as the Cronbach's alpha) and performed exploratory factor analyses. During these analyses, we examined whether the measurement of our constructs could be improved by removing individual items, and whether certain related measures (e.g., behavioral and academic engagement) were so highly related that they might be better measured as one construct using a single measure. Next, using student survey data, we also performed a statistical test called confirmatory factor analyses (CFA) to further test whether our use of specific survey items to measure our theorized constructs fit well to the data. Although these analyses led us to remove a small number of survey items from our analyses, overall, our results confirmed that the items in our teacher and student surveys worked well to measure the theorized constructs.

As shown in Table 11 Cronbach's alpha values (a measure of internal consistency) ranged from 0.74–0.94. Results of confirmatory factor analyses (CFA) indicated that the eight elements fit well as a single measure of high-quality collaboration. Based on the test results, a few items were removed from the version of the student survey used in our final analyses. Any item that was removed is marked with "strikethroughs" to indicate the removal of that item.

Our next task was to make sure that our student survey measures worked similarly well for both Black and White students—in other words, that the meaning of survey questions, and the way in which responses to different survey questions relate to one another, do not differ between Black and White students. Tests that examine the measurement equivalence across groups is referred to as "invariance," that is, our survey measures did not systematically "vary" in their level of accuracy in measuring student experiences across groups of students. This is not the same as comparing the level or intensity of student experiences; if a survey measure is not invariant, that means that the survey measure captures the experiences of one group of students *more accurately* than it captures the experiences of another group of students. If a set of survey questions fails a test of invariance, it cannot be used to accurately compare experiences across groups because it would be like comparing apples and oranges.

Overall, the results of our invariance tests revealed that our student survey measures worked similarly well for and White students for measuring most of the 22 constructs. However, there were two exceptions. A test of invariance for the survey questions measuring perceived exclusion during collaborative activities and perceived microaggression in the classroom indicated that these sets of survey items were more strongly interrelated for Black students than for White students, indicating that these measures were better able to capture experiences of Black students. For example, the pattern of responses by Black students to questions designed to measure experiences of exclusion indicated that Black students perceived the question regarding whether they are given *important tasks to do for their collaborative group* as being more closely related to their perceptions of being *treated differently because of their gender or race* than did White students.

It is important to point out that these differences do not mean that Black or White students assigned higher or lower ratings to these questions, but rather, that what these questions were asking meant something different to Black students than they did to White students. Because we found that students were interpreting the meaning of items differently in these two scales that meant that we would not be measuring the same construct (e.g., perceived exclusion) if we asked one group versus another. In other words, these two survey scales did not pass the "invariance test."

Subsequently, we did not compare student ratings in the two areas of perceived exclusion and perceived microaggression. These two constructs (perceived exclusion and perceived microaggression) were therefore dropped from our comparative analyses because they did not work well across racial/ethnic groups. As shown in Table 11, most items met the tests of invariance. These items are indicated by a "thumbs up" icon. For any item that did not meet the invariance test, a "thumbs down" icon is indicated. A neutral thumb position is provided for two measures of perceptions of the classroom environment: teacher expectations and learning from and with peers. These two subconstructs capture a measure of "opportunities and expectations for learning," but when included together as two related subconstructs, the measure did not achieve measurement invariance. To resolve this issue, we look at teacher expectations and learning from and with peers as separate constructs; however, because each measure only has three survey items, we are not able to assess measurement invariance for these constructs.

Table 11. Technical Properties of Student Survey Measure

Section I: Students' Participation in High-Quality Collaborative Experiences

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
High-Quality Collaboration: Structural Quality Features	Group composition	When you work on a group project, problem, activity, or assignment with other students, how frequently does your group include (never/rarely; some of the time; most of the time; all the time)? *My group has…* a. At least one other student who is the same race or ethnicity as me. b. At least one other student who is a different race or ethnicity as me. c. At least one other student who knows *more* than me about the topic or skill we are working on. d. At least one other student I feel comfortable working with.	👈	2.8	0.7	0.74

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
	Established group norms and task clarity	Before you start working on your group project, how often does your math/English teacher clearly explain what you should do and how your group should work together (never/rarely; some of the time; most of the time; all the time)? *My teacher clearly explains…* a. The purpose or goal for our group project or activity. b. How we are supposed to share responsibility for getting the work done. c. What we are supposed to do when members of our group disagree.	👍	2.9	0.8	0.86
	Task requires collective effort)	When you are working with other students in a group in math/English, how often are the following statements true for your group (never/rarely; some of the time; most of the time; all the time)? a. We need every member of our group to take on responsibility for their part of the project or activity. b. We need everyone's ideas if we are going to be successful. c. Credit is based on a combination of our individual work and our group work.	👍	3.0	0.8	0.87
	Student-centered/ culturally responsive activity	What kinds of group projects, problems, activities, and assignments do you work on in your /English class? Rate how often the following statements are true (never/rarely; some of the time; most of the time; every time). *Our group projects, activities, and assignments…*	👍	2.6	0.7	0.82

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
		a. Include a topic I know something about. b. Have more than one possible solution or answer. c. Feel as if they are just the right level of challenge. d. Feel connected to my life outside school.				
High-Quality Collaboration Dynamic Quality Features	Interactions are responsive, respectful, and inclusive	How does your group actually work together? Rate how often the following statements are true for you and your group (never/rarely; some of the time; most of the time; every time). *When I work with other students in a group in my math/English class…* a. Students carefully listen to each other's points of view. b. Students give compliments to each other on their ideas or solutions. c. Students of different races get along well.	👍	2.8	0.7	0.79
	Constructive exchange	Rate how often the following statements are true for you when you are working in a group (never/rarely; some of the time; most of the time; every time). *When I work with other students in a group in my math/English class…* a. We build off each other's ideas. b. We talk about different solutions or points of view. c. Students feel comfortable disagreeing with each other. d. When students share their ideas, other students ask questions or give them feedback.	👍	2.9	0.8	0.92

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
	Shared leadership and decision making	How does your group actually work together? Rate how often the following statements are true for you and your group (never/rarely; some of the time; most of the time; every time). *When I work with other students in a group in my math/English class…* **a.** Students work as a team to plan our group's work. **b.** All members of our group have a say in team decisions. **c.** Our teacher talks through group decisions with us.	👍	2.8	0.8	0.80
Student Perceptions and Beliefs About Collaborative Experiences	Student felt included, liked, and accepted by group and social comfort	How often do you feel this way? Rate how often the following statements are true for you (never/rarely; some of the time; most of the time; every time). *When I work in a group in math/English class…* **a.** Other students include me in decisions. **b.** Other students ask for my opinion. **c.** Other students appreciate the work I do for our group. **d.** I feel comfortable sharing my ideas with the group. **e.** I feel as if it is okay to make mistakes in front of others in my group. **f.** I feel comfortable asking questions if I don't understand something.	👍	3.0	0.8	0.94
	Perceived exclusion	What does it feel like working in a group in math/English class? Rate how often the following statements are true	👎	1.4	0.7	0.89

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
	and inequality	for you (never/rarely; some of the time; most of the time; every time). *When I work in a group in my math/English class…* **a.** I feel as if I am not given anything important to do to help our group. **b.** I feel as if I am treated differently because of my gender. **c.** I feel as if I am treated differently because of my race or ethnicity.				

Section II: Student Perceptions of Classroom

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
Social-Emotional Support and Connection	Student believes peers provide emotional support	How much do you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot)? *In my math/English class…* **a.** I get along with most of the students in my class. **b.** Other students will take time to answer my questions, even if we are not friends. **c.** Another student would try to help me feel better if I was upset. **d.** Other students notice when I am good at something.	👎	2.8	0.7	0.79
	Microaggression (Reverse)	How do you feel when you are in your math/English class? Rate how often the following statements are true for you (never/rarely; some of the time; most of the time; all of the time).	👎	1.4	0.6	0.88

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
		When I am in math/English class… *(Microaggression—Invisibility)* **a.** I feel left out. **b.** I feel as if other students don't pay attention to what I have to say in class. **c.** I feel ignored by other students. *(Micro aggression—Criminality)* **d.** I feel singled out and treated unfairly by my teacher. **e.** I feel as if other students assume that I break the rules in class. **f.** I feel as if other students think I copy other students' work or that I am dishonest.				
	Social comparison concerns	How much do you agree with the following statements (never/rarely; some of the time; most of the time; all of the time)? *In my math/English class…* **a.** I feel as if I have to be careful about what I say and how I say it. **b.** I feel as if I just don't fit in with the other people in my class. **c.** I feel hesitant to share my ideas with others in the class. **d.** I leave the class feeling as if I am the only one who didn't understand the material well.	👍	1.7	0.7	0.77

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
Opportunities and Expectations for Learning	Perceived expectations for learning (from teacher)	How much do you agree with the following statements about your math/English teacher (don't agree; agree a little; mostly agree; agree a lot)? *My math/English teacher…* a. Expects me to do well in this course. b. Expects me to work harder than I thought I could. *c.* Doesn't let me give up when the work is hard.	👉	3.3	0.8	0.87
	Student believes that he or she learns from and with peers	How much do you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot). *In my math/English class…* a. I talk with other students about my coursework to help me understand things better. b. Other students give me helpful feedback on my work. c. When students share their ideas or work, I ask them questions to learn more about it.	👉	2.7	0.9	0.86
Personalization	Perceived teacher support for individual needs and cultural sensitivity	How much do you agree with the following statements about your math/English teacher (don't agree; agree a little; mostly agree; agree a lot)? *My math/English teacher…* a. Helps me figure out how I learn best. b. Gives me useful feedback on my work. c. Is respectful of differing religions and cultures. d. Helps me connect what I am learning in class with my life outside of school.	👍	3.0	0.8	0.86

Domain	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
	Student believes individual learning needs are being met	What is it like for you in your math/English class? How much do you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot)? *In math/English class…* a. I get to learn in the ways that work best for me. b. I do work that is the right level of challenge for me (not too hard or not too easy). c. I get to do work that I am interested in and that matters to me. d. I feel as if my individual learning needs are met.		2.5	0.8	0.87

Section III. Student Mind-Sets and Dispositions

	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
Engagement	Emotional engagement	How do you feel about your math/English class? Tell us how much you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot). a. I look forward to coming to my math/English class. b. Sometimes I get so interested in my math/English coursework that I don't want to stop. c. I care a lot about what I am learning in my math/English class.	👍	2.3	0.8	0.76

	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
Intrinsic Motivation	Behavioral engagement	How do you go about your work in your math/English class? Rate how often the following statements are true for you (never or almost never; sometimes; most of the time; all the time). *During my math/English class…* a. I stay focused on my work. b. I complete my coursework on time. c. I put effort into my learning. d. I keep trying even if something is hard.		3.1	0.6	0.83
	Task valuing	How much do you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot)? *What I am learning in my math/English course…* a. Is useful for my life right now. b. Will be useful to me in my other high school classes. c. Will be useful for my learning after high school (e.g., in college or job training). d. Will be useful for my future career.	☞	2.5	0.8	0.85
	Mastery orientation	How do you feel about your math/English class? Tell us how much you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot). a. I try to learn from my mistakes in my math/English classwork. b. It's important to me that I improve my math/English skills this year. ~~c. I like my math/English work best when it really makes me think.~~		3.0	0.7	0.75

	Constructs	Survey Items	Scale Invariance by Race/Ethnicity	Mean	Standard Deviation	Cronbach's Alpha
Self-Efficacy	Academic self-efficacy	How much do you agree with the following statements about yourself in math/English (don't agree; agree a little; mostly agree; agree a lot)? **a.** I can learn the material in my math/English class if I put in enough effort. **b.** I know I can do well on my math/English test or assessment even if it is hard. **c.** I believe I can master the skills taught in my math/English class. **d.** I expect to do well in my math/English class this year.	👍	3.1	0.7	0.87
	Social self-efficacy	How much do you agree with the following statements (don't agree; agree a little; mostly agree; agree a lot)? *In my math/English class…* **a.** It is easy for me to start a conversation with another student about what we are learning in class. **b.** I can explain my point of view about what I am learning with other students in my class. **c.** I can work well with other students in my class.		2.9	0.8	0.85

Note. Items that are crossed out were removed from the item set in order to achieve measurement invariance.

Teacher Survey Measures

Exploratory factor analyses were performed on teacher survey data to determine whether survey items accurately reflected theorized subconstructs.[7] Overall, results of these analyses confirmed that teacher survey measures adequately captured the constructs of collaborative activities: within each construct, all survey items loaded strongly (i.e., with factor loadings above 0.5) onto a single factor. Means and standard deviations of each teacher survey construct, as well as values of Cronbach's alpha, are provided in Table 12.

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[7] Because of the relatively small number of teacher survey respondents, we were unable to perform confirmatory factor analysis or tests for measurement invariance by academic subject. In addition, exploratory factor analyses that included multiple subconstructs (e.g., tests that included items from all four subconstructs associated with the structural quality of high-quality collaboration) did not perform as desired due to limited statistical power. Therefore, exploratory factor analyses focused on individual subconstructs.

Table 12. Technical Properties of Teacher Survey Measure

Domain	Construct/ Measurement Area	Items	Mean	Standard Deviation	Alpha
Teacher Perceptions and Beliefs About Collaborative Group Experiences	**Perceived benefits of collaboration (5 items)**	This survey is part of a study that focuses on student collaboration. 1. **10_a 1–5** Teachers differ in their perspectives about the intended purpose and benefits of offering collaborative group work to students. Think about the reasons why you offer collaborative group work to students. Please rate your level of agreement with the statements describing potential reasons why you might offer students collaborative group work in your classes. (Don't agree, agree a little, mostly agree, agree a lot) *I offer collaborative group work in order to….* a. Build students' collaboration and social skills. b. Enhance students' interest and engagement in a subject/lesson. c. Deepen students' learning of core academic concepts and skills. d. Build students' capacity to apply what they have learned to a new problem or context. e. Better meet the learning needs of individual students.	3.3	0.7	0.92
	Perceived challenges associated with collaboration and balancing collaboration with personalization (7 items)	2. **11_a_1–7** Teachers differ in their experiences assigning collaborative group work to students. Tell us how much you agree with the following statements. (Don't agree, agree a little, mostly agree, agree a lot) (Reverse score all items) a. Some students are just not able to learn effectively in collaborative groups. b. For many students, working in a group makes it harder for them to stay on task.	**2.3**	**0.8**	**0.85**

Domain	Construct/ Measurement Area	Items	Mean	Standard Deviation	Alpha
		c. Students who are struggling academically usually benefit more from individualized teacher help, than from working in a collaborative group. d. It is hard to find time for student collaboration when I am trying to personalize learning for each of my students. e. I would offer my students more opportunities for collaboration but there is simply too much content I have to cover in this class. f. Most students can learn more working on their own than they do working in a group. g. If given the choice, most students would prefer to work on their own rather than in a group.			
	Teacher perceptions of beliefs of school leaders related to value and importance of personalization and collaboration	3. **9_a_1–7** How much do you agree with the following statements in describing the policies, practices and perspectives of your school leaders? (Don't agree, agree a little, mostly agree, agree a lot) *Our school leaders …* a. Believe that student collaboration is an important schoolwide priority. b. Offer me professional development or coaching support to help me design high-quality *collaborative learning* experiences for my students. c. Support me as a teacher in adapting curriculum and approaches to be able to fit collaborative group work into my class time. d. Identify collaboration skills as an explicit learning goal for students. e. Believe that personalized learning for students is an important schoolwide priority. f. Offer me professional development or coaching support to help provide *personalized learning* experiences for my students.	3.1	0.7	0.91

Domain	Construct/ Measurement Area	Items	Mean	Standard Deviation	Alpha
		g. Support me as a teacher in adapting curriculum and approaches to be able to personalize learning for all students.			
	School contextual factors helping and hindering opportunities for high-quality collaboration	4. **Q12_a_1–8** To what extent do the following schoolwide policies and practices help or hinder your ability to provide *collaborative learning opportunities* for students? (Presents major obstacles, presents some challenges, neither helps nor hinders, is helpful) a. Our class schedule/length of class periods. b. The number/length of planning periods I am given each week. c. Size of my classes (i.e., number of students enrolled in my class). d. Composition of my classes (e.g., range of student abilities, numbers of students who have IEPs, LEP, or other learning challenges). e. Amount of content I am expected to cover in my classes. f. Required student assessments. g. Autonomy I am given by school leaders/department heads. 5. Amount of time I am given to collaborate with my fellow teachers to plan high quality collaborative group activities.	N/A	N/A	0.78

Nature of Collaborative Experiences Offered

Domain	Construct/Measurement Area	Proposed Items	Mean	Standard Deviation	Alpha
Structural Quality Features of High-Quality Collaboration	**Group composition** **(7 items)**	1. **Q25_a_1–4** How often do student groups in your selected class have the following characteristics? (Rarely/never, some of the time, most of the time, every time) a. About the same number of boys and girls. b. At least two students who share the same race or ethnicity. c. At least two students of different races/ethnicities. d. A mix of students with more and less knowledge and skill in the activity topical area.	2.4	0.6	0.70
	Established group norms and task clarity **(5 items)**	2. **Q26_a_1–5** Before students begin working in their groups, how often do you explain, review or provide written information on the following? (Never/rarely, some of the time, most of the time, every time) a. The purpose or goal for the group project, activity or assignment. b. What steps they are supposed to take to go about their work. c. How students are supposed to share responsibility for getting the work done. d. What students are supposed to do when members of the group disagree. e. What criteria you will use to determine students' individual or group grade.	**3.2**	**0.6**	**0.82**
	Interdependence: task requires collective and productive effort **(4 items)**	3. **Q29_a_1–4** How often are the following statements true in describing how students in your class must work together in order to function effectively within their groups? (Never/rarely, some of the time, most of the time, every time) *When students work together in groups (of 3 or more students)…*	**2.8**	**0.7**	**0.83**

Domain	Construct/Measurement Area	Proposed Items	Mean	Standard Deviation	Alpha
		a. Students can only successfully complete the group project or task when everyone fulfills their varying roles and responsibilities. b. A wide range of perspectives, ideas and work styles are needed for students to effectively solve the group problem or task. c. Students' grade/credit for their group work is based on a combination of their individual work and their group's work. d. Students are expected to engage in a structured reflection time or evaluation of their group work.			
	Task is student-centered, culturally responsive, non-routine, authentic, and problem focused	4. **Q30_a_1–3** How often do the assigned group problems, projects/activities in your class have the following characteristics? (Never/rarely, some of the time, most of the time, every time) *Group projects/activities/assignments …* a. Have more than one possible solution or answer. b. Are connected to an ongoing unit or theme students have been studying in class. c. Require that students apply what they have learned to a real-life problem or challenge.	2.6	0.6	0.83
		5. **Q30_a_4–7** How often do the assigned group projects/activities/assignments in your class have the following characteristics? (Rarely/never, some of the time, most of the time, every time) a. Include topics students already know something about. b. Are focused on a topic that was determined by the students themselves. c. Have an explicit connection with students' family traditions or culture (e.g., in topical focus or modes of learning—such as oral traditions).			

Domain	Construct/Measurement Area	Proposed Items	Mean	Standard Deviation	Alpha
		d. Have an explicit connection with students' lives outside of school (e.g., related to students' interests, hobbies, work).			
Dynamic Quality Features of High-Quality Collaboration (13 items)	**Interactions are responsive, respectful, and inclusive** (5 items)	6. **Q32_a_1–5** Students differ in how they interact with one another when they are working in groups. Please rate how often the following statements are true for your students. (Not sure/ cannot answer, never/rarely, some of the time, most of the time, every time/all of the time) a. Students carefully listen to each other's points of view. b. Students compliment each other on their ideas or solutions. c. Students of differing races get along well together. d. Students are able to stand up for themselves without putting others down. e. Students are able to disagree with others in their group without getting angry or upset.	2.5	0.5	0.84
	Constructive exchange (4 items)	7. **Q31_a_1–4** We recognize that student groups vary in how well they work together. Thinking in general about the students in your class, please rate how often do the following statements describe the students in your class when they are working in groups? (not sure/can't answer, never/rarely, some of the time, most of the time, every time/all of the time) a. Students build off each other's ideas. b. Students talk about different solutions or points of view. c. Students appear comfortable disagreeing with each other. d. When students share their ideas or answers, other students ask them questions or give them feedback.	2.6	0.6	0.81
	Shared leadership and decision making	8. **Q31_a_5–8** We recognize that student groups vary in how well they work together. Thinking in general about the students in your class, please rate how often do the following statements describe the	2.6	0.7	0.86

Domain	Construct/Measurement Area	Proposed Items	Mean	Standard Deviation	Alpha
	(4 items)	students in your class when they are working in groups? (not sure/can't answer, never/rarely, some of the time, most of the time, every time/all of the time) a. All students have a say in group decisions. b. All students work as a team to plan out the approach to the group's work (e.g., what tasks will need to be done and in what order). c. Students ask one another for their opinion. d. Students work together to decide how they will divide up the work (i.e., roles and responsibilities) among the team members.			

Once we conducted the statistical tests outlined above, we were able to confirm our final set of survey measures. The next step was to create scale scores for each construct by taking the average of each respondent's answers to the set of items measuring each subconstruct (e.g., constructive exchange). Because students and teachers were asked to respond to rated questions for survey constructs on a 4-point scale (e.g., Don't agree, Agree a little, Mostly agree, Agree a lot), each scale score was given a value ranging from 1 to 4, reflecting the average rating across the survey items in that set.

Student Grades/Administrative Data

For the measure of course grades both during the current academic year and the previous academic year, we focused on grades in either the students' math or English courses, depending on the subject for which they provided survey responses. Some districts provided course grades as lettered grades, whereas others provided a percentage grade. For the purpose of calculating an average course grade across the fall and spring (which were often reported separately in the transcript data), course grades were quantified on a scale ranging from 0 to 4 as follows[8]:

- 4: A-, A, A+, and percentage grades greater than or equal to 90

- 3: B-, B, B+, and percentage grades less than 90 and greater than or equal to 80

- 2: C-, C, C+, and percentage grades less than 80 and greater than or equal to 70

- 1: D-, D, D+, and percentage grades less than 70 and greater than or equal to 60

- 0: F, and percentage grades less than 60

To average grades throughout the academic year, the fall and spring grades were equally weighted. For students who took multiple mathematics courses within a semester, we used grades associated with the most advanced class that students took during the semester. For students who took multiple ELA courses within a semester, we used the course grade associated with the grade-level English course (e.g., "English 9") and did not use course grades associated with an alternative literature or composition course taken during the semester. All students who took multiple ELA courses in a semester took a grade-level–specific English class.

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[8] Some schools, and some teachers within schools, limited their grades to full letters (e.g., A, B, C) rather than more refined categories. Therefore, to quantify student grades, categories are collapsed as defined here to ensure consistent measures across students within and between schools.

Technical Properties of Observation Instrument

To confirm the level of observer agreement using the observation instrument, two rounds of interrater reliability testing were conducted. The first round had two observers, who had not received any training, view and independently rate a 20-minute classroom video. The results of this initial round indicated modest levels of agreement (65%). Next, the observers met with the tool developer to discuss areas of disagreement and points of confusion in using the rating anchors. Several refinements were subsequently made to item and rating anchor wording. Next, the same two observers visited one of the participating schools and observed two classrooms for 20–30 minutes each. Observers independently rated these two classrooms using the classroom observation rubric. For classroom one, observers had an 80 percent agreement rate for the assigned ratings of all items. For classroom two, observers had an 87.5 percent agreement rate.

Once we collected study data, we explored whether the 16 items could be used to measure desired latent constructs similar to those measured through survey items. In particular, we were interested in determining whether the observation items could capture the following constructs: high quality (structural quality) of activities, teacher personalization strategies, teacher facilitation of learning and group work, student engagement, and participation in collaboration. We performed an Exploratory Factor Analysis (EFA) using classroom ratings to determine whether items would naturally group by these intended factors. As illustrated in Table13, the results of these analyses indicated that items did not cleanly fall into varying groups. In fact, 13 of the 16 items loaded onto a single factor at a .3 or higher, with most items loading onto this single factor well above .5. Many items also loaded onto multiple factors, indicating that these could not be used to differentiate between different aspects of collaboration. Overall, these results indicated that the observation items could not be organized into the desired subscales.

Table 13. Exploratory Factor Analysis Results for Observation Ratings: Relationships Between Observation Measures and Potential Factors

Observation Item	Factor				
	1	**2**	**3**	**4**	**5**
Organized Activity	—	—	—	-.653	—
Activity Requires Collaboration	.888	—	—	.423	—
Activity is Challenging	—	—	—	—	.933
Activity Connects to Student Life	—	.770	—	—	—
Positive Teacher-Student Interactions	.749	—	—	—	—
Teacher is Student Focused	.960	—	—	—	.415
Teacher Solicits Student Ideas	.675	—	.567	.864	—
Teacher Promotes Student Autonomy	—	—	-.920	—	—
Teacher Promotes Group Interdependence	.484	-.719	—	.465	.589
Teacher Encourages Discussion	—	—	—	.891	—
Teacher Encourages Multiple Perspectives	—	.951	—	—	—
Students are Engaged	.982	—	—	—	—
Students Listen to Each other	.718	—	—	.587	.713
Students are Friendly	.781	—	—	—	.787
Students Have Constructive Exchanges	.661	—	.768	.598	—
Students Have Shared Leadership	—	—	.901	—	—

Note: — indicates that the absolute value of the factor loading was less than .4.

E. Data Analysis

Qualitative Analysis

Qualitative methods were used to analyze the data collected from teacher interviews, student focus groups, and classroom observation field notes. Three steps were taken to prepare the qualitative data for coding. First, protocols used during interview and focus groups were organized by question domains linked to our study's three research questions. Second, within the qualitative analysis software, NVivo 11 we set up an a priori coding structure that reflected the question domains within these protocols. Third, we uploaded the written transcripts that had been created from the audio files collected during interview and focus group sessions, as well as written classroom observation notes to NVivo for coding.

Before coding began, the members of the qualitative team engaged in training to establish interrater reliability across analysts. Each analyst reviewed sample transcripts and assigned parent and child nodes to 28 separate transcripts across all qualitative sources. Nodes refers to the themes identified. A parent node was a broad theme area. A child node was a sub-theme within that broad area. Next, NVivo was used to determine levels of agreement across disparate raters. The level of agreement on coding of nodes ranged from 96 percent agreement to 100 percent agreement across the three team members.

With interrater reliability established across independent raters, transcripts from interview and focus groups were then formally coded by the qualitative team members. Similar to the interrater reliability exercise each team member coded assigned transcripts for emergent themes using NVivo software. To analyze the qualitative data from interviews, focus groups, and observation field notes, each analyst reviewed a set of assigned coded transcripts for each source (e.g., focus groups) to confirm that responses had been appropriately assigned to the right domain. If a response, or portion of a response did not fit that domain, this excerpt was relabeled to a more appropriate code, or if needed, a new code was created.

Next, analysts reviewed all of the responses that appeared under each code. Within this group of responses, analysts looked for emergent subthemes. Once a subtheme was identified, the portions of responses within the domain were assigned a descriptive label to designate particular subtheme. For example, within the question domain of teacher facilitation of collaborative groups, analysts identified that many students talked about the level of support they perceived from teachers during collaboration. Therefore, a subtheme was created to designate perceived level of support from teachers during collaborative groups. The qualitative team created a master list of these codes along with their defining characteristics so that these

codes could be assigned across multiple transcripts and be used by multiple analysts in a consistent manner.

After all transcripts had been reviewed and coded, the next step was to determine the strength of the identified themes and subthemes. To do this, frequency counts were performed in NVivo to count the number of respondents and remarks assigned to each code. In other words, within the code of "structural quality elements for collaborative activities," how many teacher respondents reported that the collaborative activities they offered in their classroom were culturally responsive? For student focus groups, two types of frequency counts were performed, by number of focus groups, and by number of remarks within focus groups. The frequency tables we produced for both interviews and focus groups helped to identify the strongest themes.

Next, the analysts reviewed raw responses associated with these well-supported themes and subthemes to narratively characterize the nature of the specific finding. Analysts then examined identified themes and sub themes across sources (i.e., both focus groups and interviews) to identify those themes that had evidence across sources, as well as to identify those themes where findings from one source contradicted findings from another source, for example, differing perspectives by teachers and students on a subject.

The final steps included having analysts review all of the high-frequency and well-supported themes and subthemes to identify any areas of overlap as well as to better synthesize information in order to better refine the characterization of a particular theme. This phase of the work resulted in a set of key findings that reflected the qualitative results within and across data sources. These key findings were organized by our three research questions and shared with the quantitative research team to identify further areas of alignment.

Quantitative Analysis

Quantitative analyses focused on data collected through student survey data as well as district administrative records. The quantitative analyses was conducted in three phases: (1) test for differences across groups of students and teachers, (2) estimate relationships between factors, and (3) test for racial/ethnic differences in patterns of relationships among factors.

Tests of Differences Across Groups of Students and Teachers

The second phase of our quantitative analyses focused on tests of differences across groups of teachers and students. Various tests were used to explore differences between groups of students and teachers using survey data. To address Research Question 2, we explored the extent to which student reports of opportunities for high-quality collaboration differed by race

(i.e., between and Black students) or by course subject (i.e., between mathematics and ELA course experiences). We also examined whether teacher reports of high-quality collaboration differed by course subject (i.e., mathematics versus ELA). To address Research Question 3, we also examined differences between mathematics and ELA teachers in the contextual factors that influenced teachers' capacity to offer collaborative opportunities for students.

Analysis of Differences Using Student Survey Data

To test for differences in student reports of high-quality collaboration by course subject and by race/ethnicity, we performed Ordinary Least Squares (OLS) regression. These models allowed us to estimate the magnitude and significance of differences between student subgroups after statistically controlling for other student characteristics (gender, special education status, English learner status, grade level, and the school that students attended). Regression models that tested differences by race/ethnicity also accounted for whether students responded about their mathematics or ELA course; models that tested difference by course account for students' race/ethnicity.

Analysis of Differences Using Teacher Survey Data

For teacher surveys, statistical tests focused primarily on determining any differences by academic subjects (i.e., math versus ELA). We used two types of difference tests using teacher survey data: *t*-tests and chi-square tests. First, *t*-tests were used to compare differences in teacher survey scale scores by subject. The *t*-tests help determine whether any observed differences in scale scores represent "true" differences between groups. In other words, these differences are larger than what one would expect to observe by chance. For example, for Research Question 2, we examined whether teacher reports of the quality of collaborative opportunities differed between math and ELA teachers. The *t*-tests were run to compare differences in average ratings for each structural and dynamic feature associated with high-quality collaboration. Similarly, for Research Question 3, we used *t*-tests to compare teacher ratings of the level of perceived support from school leaders for collaboration.

Second, to examine whether responses to categorical survey questions (which included the option to select one of several response categories rather than assigning a rating on a scale) significantly differed by subject, we performed chi-square tests. Similar to *t*-tests, chi-square tests allowed us to test whether differences in teachers' responses to individual survey items were larger than what one would observe by chance.

Tests of the Strength and Direction of Relationships Among Factors

Our third phase of quantitative analyses focused on addressing Research Question 2 by testing the strength and direction of relationships among students' collaborative experiences,

perceptions of the classroom environment, and outcomes. As such, analyses performed for Research Question 2 focused exclusively on student-level survey and administrative data.

To most effectively examine networks of relationships, we performed an analytic approach called structural equation modeling (SEM). SEM was the most appropriate method to address our second research question because these models allowed us to (1) measure "latent" or unobserved constructs (e.g., academic engagement) using sets of items from the student survey; (2) estimate the relationships between these latent constructs for all of the students in our survey sample as well as separately for Black and White students; and (3) test whether the pattern of relationships between these constructs differed for Black and White students. In other words, SEM allowed us to consider relationships among multiple factors and identify the extent to aspects of the classroom environment influenced or explained the relationship between high-quality collaboration and student outcomes.

Because our study was interested in the extent to which experiences of high-quality collaboration were associated with positive classroom experiences and outcomes, it was important that we take steps to minimize the chance that any observed relationships we found were not due to other factors likely to influence relationships such as a student's age or gender. Therefore, in all SEM models, we included statistical controls to account for differences in several student demographic traits, including students' gender, special education status, English learner status, grade level, and the school that students attended.[9]

SEM models were used to estimate two different relationships between high-quality collaboration and student outcomes. First, the total outcome can be described as the relationship between high-quality collaboration and student outcomes after accounting for student background characteristics, but before accounting for perceptions of the classroom environment. Second, we estimated the direct relationship between high-quality collaboration and outcomes, or the relationship after accounting for both student background characteristics and perceptions of the classroom environment. Whereas we theorize that perceptions of the classroom environment are influenced by high-quality collaboration, and that these perceptions further influence student outcomes, the direct relationship can be described as "what is left" of

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[9] Models did not account for differences in students' socioeconomic status because not all districts in the sample were able to provide this information. When examining relationships with student grades, we also accounted for differences in students' grades during the previous academic year. Because we were unable to obtain students' grades during the eighth grade for the students in our sample, Grade 9 students were removed from these analyses. To maintain the full sample of survey respondents, we did not account for prior grades in SEM models that examined differences in mindset and dispositional outcomes. However, alternative analyses that accounted for prior grades among students in Grades 10–12 demonstrated that accounting for prior grades had a minimal effect on the relationship between high-quality collaboration and mindset/disposition outcomes.

the relationship between high-quality collaboration and outcomes after accounting for perceptions of the classroom environment.

To simplify the creation of a single measure of high-quality collaboration, Rasch scores were calculated for each student that summarized his/her responses to survey items addressing each subconstruct. In contrast to taking a simple average across relevant survey items, Rasch scores take into account the differences in the difficulty of individual items associated with each subconstruct. Therefore, in the SEM model, opportunities for high-quality collaboration were measured as a single latent construct that was estimated based on the eight Rasch scores associated with each of the eight features of high-quality collaboration. Constructs associated with perceptions of the classroom environment and mindset or dispositional outcomes were measured as latent constructs which were estimated based on responses to related survey items. In addition to examining each class of outcomes (i.e., efficacy, motivation, and engagement) separately, each measure of perceptions of the classroom environment was included in a separate model to identify the explanatory power of each individual measure.

Because we examined four different student outcomes (engagement, efficacy, motivation, and grades) and five different perceptions of the classroom environment (personalization, teacher expectations, social comparison concerns, teacher support, and peer support), we estimated a total of 20 SEM models (1) for all students in the survey sample, and (2) for students in the study.[10] After estimating total and direct effects of high-quality collaboration on student outcomes, we calculated the explanatory power of each classroom environment measure by calculating the extent to which the total effect was reduced after accounting for the classroom environment measure (e.g., see Table F-4). Specifically, the percent reduction in the total effect is calculated by subtracting the direct relationship from the total relationship, and dividing this difference by the total relationship ([total-direct]/total).

Test for Racial/Ethnic Differences in Patterns of Relationships Among Factors
Finally, to test whether the pattern of relationships significantly differed between Black and White students, we estimated SEM models for both groups of students in two different ways. First, we estimated a model in which relationships between high-quality collaboration, perceptions of the classroom environment, and student outcomes were allowed to differ across groups. In the second model, relationships were constrained to be equal across groups. By

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[10] Although the study also considered attendance as a student outcome, we did not find a significant effect of high-quality collaboration on attendance. Therefore, we did not run further SEM models to examine the ways in which perceptions of the classroom environment influenced the relationship.

comparing the model fit statistics between these two models, we were able to determine whether the pattern of relationships differed between Black and White students.

Analyses of Observation Data

During our analyses, we explored whether the 16 items could be used to measure desired constructs similar to those measured through survey items. As shown in Table 13 the results of our Exploratory Factor Analysis (EFA) indicated that items did not cleanly fall into varying groups. In fact, 13 of the 16 items loaded onto a single factor at a .3 or higher, with most items loading onto this single factor well above .5. Many items also loaded onto multiple factors indicating that these could not be used to differentiate between factors. The results of these tests showed that observation items could not be organized into subscales.

The first step in our analyses of observation ratings was to document and describe the numbers of rating cycles, length of these cycles, and prevalence of the various activity types. The majority of classroom visits were captured in two rating cycles, with a range of 1 to 4. Overall, the 29 classroom visits generated 37 sets of ratings.

Based on these descriptive results, we determined that the prevalence of concurrent activities was too low to represent its own category of ratings. Therefore, we collapsed the categories of whole class and concurrent activities into one category relabeled as "Other classroom activities." If there were multiple cycles and therefore multiple sets of ratings for pair/group activities, these ratings were also collapsed and averaged to produce a single set of ratings for collaborative activities for each classroom. This resulted in our having two sets of ratings for over half (16 of the 29) classrooms.

The next step was to describe the range of ratings assigned to each of the 16 individual items. The frequencies for each rating were produced, as well as an average rating. For nearly all items, ratings fell across the three rating points, and most had an average rating near the midpoint of the scale. This variation in ratings indicated that the rubric was working well to capture variation in quality across classrooms. Because observers had been instructed to assign codes to specify the nature of the activity observed (i.e., collaborative versus other types of classroom activities such as whole group, or independent work time), we were able to calculate average item ratings for "collaborative" activities and "other" classroom activities.

The last set of analyses of observation ratings examined differences by activity duration and type. We used an analysis of covariance (ANCOVA) approach to test the variance within each observation item using activity type (collaborative, whole class, and other), and duration of activity as covariates (Tables 14, 15, and 16). These tests yielded few statistically significant

differences by duration or activity type, with only a few exceptions. See results for the items that showed statistically significant differences.

Table 14. Results of Analysis of Covariance for the Observation Item Activity Offers Opportunity for Collaboration, and Item Averages by Activity Type

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F-statistic	P-value
Intercept	6.143	1	6.143	38.044	0.000
Duration of Activity (minutes)	0.054	1	0.054	0.333	0.570
Activity Type	5.925	2	2.963	18.346	0.000
Observation Rating Averages for Collaboration Item (by activity type)					
Pairs/Groups	2.000				
Whole Class	1.101				
Whole Class/Varied	1.042				

Table 15. Results of Analysis of Covariance for the Observation Item Activity is Challenging

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F-statistic	P-value
Intercept	4.524	1	4.524	11.452	0.003
Duration of Activity (minutes)	2.033	1	2.033	5.147	0.033
Activity Type	0.029	2	0.014	0.037	0.964

Note. Because duration is a continuous variable, we do not present item averages for this covariate.

Table 16. Results of Analysis of Covariance for the Observation Item Students Engage in Constructive Exchange, and Item Averages by Activity Type

Source	Type III Sum of Squares	Degrees of Freedom	Mean Square	F-statistic	P-value
Intercept	5.088	1	5.088	22.365	0.000
Duration of Activity (minutes)	0.024	1	0.024	0.105	0.749
Activity Type	3.325	2	1.663	7.308	0.004
Observation Rating Averages for Collaboration Item (by activity type)					
Pairs/Groups	1.792				
Whole Class	1.299				
Whole Class/Varied	1.000				

F. Study Findings

Table F-1. Strength of Relationships Between High-Quality Collaboration and Perceptions of Classroom Environment

	Personalization		Opportunities and Expectations		Social-Emotional Supports	
	Teacher Support	**Needs are Met**	**Teacher Expectations**	**Learning From Peers**	**Peer Support**	**Social Comparison Concerns**
High-Quality Collaboration	0.57	0.55	0.54	0.56	0.69	-0.22

Table F-2. Strength of Relationships Between High-Quality Collaboration and Mindset and Dispositional Outcomes

	Engagement		Intrinsic Motivation		Self-Efficacy	
	Behavioral Engagement	**Emotional Engagement**	**Task Valuing**	**Mastery Orientation**	**Academic Self-Efficacy**	**Social Self-Efficacy**
High-Quality Collaboration	0.49	0.52	0.44	0.55	0.48	0.61

Table F-3. Relationships Between High-Quality Collaboration and Grades, Before and After Accounting for Mindset and Dispositional Outcomes

	Relationship With High-Quality Collaboration: All Students		
Outcome	**Before accounting for classroom environment**	**Before accounting for classroom environment**	**Percent Reduction**
Motivation	0.123	0.067	45.5%
Efficacy	0.123	0.034	72.4%
Engagement	0.123	0.014	88.6%

Table F-4. Relationships Between High-Quality Collaboration and Mindset and Dispositional Outcomes and Grades Before and After Accounting for Perceptions of the Classroom Environment

Outcome	Classroom Environment	Relationship With High-Quality Collaboration: All Students		
		Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction
Task Valuing	Personalization	0.436	0.141	67.7%
Mastery Orientation		0.550	0.325	40.9%
Academic Self-Efficacy		0.479	0.147	69.3%
Social Self-Efficacy		0.607	0.442	27.2%
Behavioral Engagement		0.486	0.283	41.8%
Emotional Engagement		0.516	0.132	74.4%
Grades		0.123	0.085	30.9%
Task Valuing	Teacher Expectations	0.436	0.325	25.5%
Mastery Orientation		0.550	0.362	34.2%
Academic Self-Efficacy		0.479	0.248	48.2%
Social Self-Efficacy		0.607	0.511	15.8%
Behavioral Engagement		0.486	0.362	25.5%
Emotional Engagement		0.516	0.386	25.2%
Grades		0.123	0.089	27.6%
Task Valuing	Social Comparison Concerns	0.436	0.441	-1.1%
Mastery Orientation		0.550	0.566	-2.9%
Academic Self-Efficacy		0.479	0.474	1.0%
Social Self-Efficacy		0.607	0.589	3.0%
Behavioral Engagement		0.486	0.478	1.6%

Outcome	Classroom Environment	Relationship With High-Quality Collaboration: All Students		
		Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction
Emotional Engagement		0.516	0.502	2.7%
Grades		0.123	0.105	14.6%
Task Valuing	Learning from and with Peers	0.436	0.337	22.7%
Mastery Orientation		0.550	0.435	20.9%
Academic Self-Efficacy		0.479	0.355	25.9%
Social Self-Efficacy		0.607	0.198	67.4
Behavioral Engagement		0.486	0.390	19.8%
Emotional Engagement		0.516	0.439	14.9%
Grades		0.123	0.103	16.3%

Table F-5. Strength of Relationships Between High-Quality Collaboration and Perceptions of Classroom Environment, Among Black Students

	Personalization		Opportunities and Expectations for Learning		Social-Emotional Supports	
	Teacher Support	Needs are Met	Teacher Expectations	Learning From Peers	Peer Support	Social Comparison Concerns
High-Quality Collaboration	0.54	0.50	0.50	0.54	0.63	-0.19

Table F-6. Strength of Relationships Between High-Quality Collaboration and Mindset and Dispositional Outcomes, Among Black Students

	Behavioral Engagement	Emotional Engagement	Task Valuing	Mastery Orientation	Academic Efficacy	Social Efficacy
High-Quality Collaboration	0.49	0.53	0.43	0.53	0.48	0.57

Table F-7. Relationships Between High-Quality Collaboration and Grades Among Black Students Before and After Accounting for Mindset and Dispositional Outcomes

Outcome	Relationship with High-Quality Collaboration: Black Students		
	Before accounting for mindset and dispositional outcome	After accounting for mindset and dispositional outcome	Percent Reduction
Motivation	0.135	0.091	32.6%
Efficacy	0.135	0.083	38.5%
Engagement	0.135	0.026	80.7%

Table F-8. Relationships Between High-Quality Collaboration and Mindset and Dispositional Outcomes and Grades Among Black Students Before and After Accounting for Perceptions of the Classroom Environment

Outcome	Classroom Environment	Relationship With High-Quality Collaboration: Black Students		
		Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction
Task Valuing	Personalization	0.432	0.184	57.4%
Mastery Orientation		0.534	0.384	28.1%
Academic Self-Efficacy		0.484	0.211	56.4%
Social Self-Efficacy		0.573	0.406	29.1%
Behavioral Engagement		0.487	0.324	33.5%
Emotional Engagement		0.53	0.214	59.6%
Grades		0.135	0.119	11.9%
Task Valuing	Teacher Expectations	0.432	0.375	13.2%
Mastery Orientation		0.534	0.423	20.8%
Academic Self-Efficacy		0.484	0.307	36.6%

Outcome	Classroom Environment	Relationship With High-Quality Collaboration: Black Students		
		Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction
Social Self-Efficacy	Social Comparison Concerns	0.573	0.488	14.8%
Behavioral Engagement		0.487	0.436	10.5%
Emotional Engagement		0.530	0.449	15.3%
Grades		0.135	0.103	23.7%
Task Valuing		0.432	0.449	-3.9%
Mastery Orientation		0.534	0.548	-2.6%
Academic Self-Efficacy		0.484	0.480	0.8%
Social Self-Efficacy		0.573	0.565	1.4%
Behavioral Engagement		0.487	0.486	0.2%
Emotional Engagement		0.530	0.537	-1.3%
Grades		0.135	0.136	-0.7%
Task Valuing	Learning from and with Peers	0.432	0.361	16.4%
Mastery Orientation		0.534	0.478	10.5%
Academic Self-Efficacy		0.484	0.354	26.9%
Social Self-Efficacy		0.573	0.155	72.9%
Behavioral Engagement		0.487	0.380	22.0%
Emotional Engagement		0.530	0.512	3.4%
Grades		0.135	0.128	5.2%

Table F-9. Percentage of Relationship Between High-Quality Collaboration and Outcomes Explained by Classroom Experiences

Outcome Domain	Outcome	Classroom Environment	Relationship With High-Quality Collaboration: Black Students			Relationship With High-Quality Collaboration: White Students			Difference Between White and Black Students is Significant?
			Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction	Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction	
Motivation	Task Valuing	Personalization	0.432	0.184	57.4%	0.503	0.091	81.9%	Yes
	Mastery Orientation		0.534	0.384	28.1%	0.608	0.254	58.2%	
Efficacy	Academic Self-Efficacy		0.484	0.211	56.4%	0.488	0.053	89.1%	No
	Social Self-Efficacy		0.573	0.406	29.1%	0.731	0.591	19.2%	
Engagement	Behavioral Engagement		0.487	0.324	33.5%	0.536	0.21	60.8%	No
	Emotional Engagement		0.53	0.214	59.6%	0.500	0.078	84.4%	
Motivation	Task Valuing	Teacher Expectations	0.432	0.375	13.2%	0.503	0.337	33.0%	Yes
	Mastery Orientation		0.534	0.423	20.8%	0.608	0.362	40.5%	
Efficacy	Academic Self-Efficacy		0.484	0.307	36.6%	0.488	0.144	70.5%	Yes
	Social Self-Efficacy		0.573	0.488	14.8%	0.731	0.635	13.1%	
Engagement	Behavioral Engagement		0.487	0.436	10.5%	0.536	0.327	39.0%	No
	Emotional Engagement		0.53	0.449	15.3%	0.5	0.42	16.0%	

Outcome Domain	Outcome	Classroom Environment	Relationship With High-Quality Collaboration: Black Students			Relationship With High-Quality Collaboration: White Students			Difference Between White and Black Students is Significant?
			Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction	Before accounting for classroom environment	After accounting for classroom environment	Percent Reduction	
Motivation	Task Valuing	Social Comparison Concerns	0.432	0.449	-3.9%	0.503	0.474	5.8%	No
	Mastery Orientation		0.534	0.548	-2.6%	0.608	0.634	-4.3%	
Efficacy	Academic Self-Efficacy		0.484	0.48	0.8%	0.488	0.483	1.0%	Yes
	Social Self-Efficacy		0.573	0.565	1.4%	0.731	0.671	8.2%	
Engagement	Behavioral Engagement		0.487	0.486	0.2%	0.536	0.527	1.7%	No
	Emotional Engagement		0.53	0.537	-1.3%	0.5	0.429	14.2%	
Motivation	Task Valuing	Learning from and with Peers	0.432	0.361	16.4%	0.503	0.324	35.6%	No
	Mastery Orientation		0.534	0.478	10.5%	0.608	0.435	28.5%	
Efficacy	Academic Self-Efficacy		0.484	0.354	26.9%	0.488	0.326	33.2%	No
	Social Self-Efficacy		0.573	0.155	72.9%	0.731	0.23	68.5%	
Engagement	Behavioral Engagement		0.487	0.38	22.0%	0.536	0.483	9.9%	No
	Emotional Engagement		0.53	0.512	3.4%	0.5	0.36	28.0%	

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Learning With Others: Student Focus Group Protocol

Interviewer:	School Code:
Focus Group Code:	Date and Time:

Student Focus Group Protocol (5 minutes)

Thank you for taking the time to speak with me this [morning/afternoon]. Before we start, I would like to give you a little background about who I am and why I am here. I would also be glad to answer any questions that you might have for me. I work for a nonprofit organization called American Institutes for Research, or AIR.

We are asking you to be part of a research study. This study has three main goals:

1. To understand the kinds of opportunities students have to work together during school;

2. To better understand how opportunities to work together might influence how students experience their classes and how they do in school; and

3. To better understand how students from varying racial/ethnic backgrounds might experience and benefit from working together differently.

Your parents (or you, if you are over age 18) have signed a consent form allowing you to participate. I want to assure you that all information you share today will be kept strictly confidential. No identifying information about you or what you say will ever be shared with anyone outside the study team. All private information about you that we collect will be stored using high data security standards.

We are interested in hearing about your ideas and experiences with collaboration. By *collaboration,* I mean an activity or project in which you are expected to work together with other students on a shared task, problem, or project. So, not just when you sit together with other students while everyone does his or her own work. Those times when you are working together with other students on an activity or project in school.

During our discussion today, I want to clarify that there are no right or wrong answers to the questions I will be asking. In fact, I hope to hear about all of the different ideas and experiences

that students have when they collaborate. So, remember you will help us the most if you share your honest opinions—not what you think I want to hear.

Even though your parent or guardian has provided consent on your behalf, your participation in this study is voluntary. You may choose at any time not to answer a particular question or to stop your participation altogether.

Do you have any questions before we begin? If at any time you have questions, please feel free to ask.

To ensure the accuracy of the information we report, I would like your permission to record our discussion today. We want to record this conversation to accurately capture all of your feedback. We will not share what you say with your parents, teachers, or school, and at the end of the study, we will delete the audio file.

Do I have your permission to record the conversation? [If *yes*, begin recording.] Okay, thank you.

Background

1. First, I'd like to learn a little bit about you. Let's go around the room: Tell me your first name, grade level, and the first thing that comes to mind when you think about collaborating with your peers? ***Probes:*** *What does the word "collaboration" mean to you? If you had to explain it to someone else, what would you say?*

Students' Participation in High-Quality Collaborative Experiences

Nature of Collaborative Activities

2. I'd like to know a little more about the kinds of group activities you work on in your classes. Can someone give me an example? Can you describe a group activity you did recently? *Probes: What class/subject was it in? What was the activity? How many other students were there?*

    a. What are the collaborative group activities you get to do in your classes usually like? **Probes:** Do you get to choose a topic or project you want to work on? Do the group activities usually have topics that require in-depth discussions? Are they quick questions that you review with the group to make sure everyone got the correct answer? Are they projects where tasks need to be split up and each member has a role?

3. Do you usually think the collaborative group activities are interesting? Why/why not?

a. Do the kinds of activities that you do in small groups ever feel connected to your life outside of school? For example, are they activities you like to do when you are out of school? What about your culture or family background?

b. If *yes,* tell me about a group project or activity that felt connected to your life. Did it feel different working on this task than on another task that did not feel connected?

Task Valuing

4. Why do you think teachers ask you to work in groups for certain activities?

a. What advantages, if any, do you believe there are to working in groups? Probes: Do you learn more about the subject—more knowledge/skills in an academic area? Learn more about working with others?

b. Do you think what you learn from working in a group (e.g., knowledge or group skills) is useful to your life outside of school? If yes, how so? Will it be useful to you in the future? If yes, in what ways?

Composition of **Groups**

5. Talk to me about your group work. Who usually decides which students you work with in your groups?

a. Does your teacher ever give you the opportunity to choose your own groups? If so, who do you usually pick to be in your group? **Probes:** A friend? Someone who knows a lot about the topic? What are you looking for—what's most important to you—when you decide who to have in your group?

i. How much does it matter to you who is in your group?

6. Does it affect your group dynamics and/or the product that you develop together when you get to pick who is in your group? If *yes*, how?

a. How often do you choose to work with peers who look like you (i.e., race or gender)?

7. Does it matter to you whether the other students you're working with in your group look like you (share your gender, race, cultural background)?

8. Does it affect your group dynamics—how you get along and work together—and/or the product or project that you develop together when most or all of the students in your group share your gender or race? If *yes*, how?

Perceived Teacher Supports for Students' Needs and Cultural Competence

9. How does your teacher help facilitate or support your group work? **Probes:** Does he/she help resolve questions? Does he/she make sure everyone has something to do to help the group? Are there any other things he/she does to help?

   a. Do you ever feel like your teacher is *too* involved? Doesn't give you enough space and independence to do your group work?

   b. Does your teacher ever do anything to help you feel personally connected to the group work you do in class? If so, what does he/she do? How does he/she help you feel more connected to the group work? *Probes: Does he/she seem to be aware of your needs as a student? Is he/she aware of your family or cultural background?*

Student Perceptions and Beliefs About Collaborative Learning Experiences

Student Perceptions of Positive and Negative Collaborative Learning Experiences

10. What has been your experience working in groups? ***Probe:*** *Do you like group work? Why or why not?*

11. I'd like you all to think about either a positive or negative challenging experience you have had working in a group in school on a project or activity. If you have had both kinds of group experiences, you can think about both of those times—but when you are sharing, I want you to clarify whether you are talking about your positive or negative experience. I'd like to hear about your experiences and find out what made them so positive or negative and challenging for you. I want everyone to think about this experience—or experiences—as I ask the next few questions. [***Note:*** after each construct, invite one member of the group to start sharing—and be sure to have him/her note whether he/she had a positive or negative experience; then solicit from the group any similarities or differences in their own experiences: "Has anyone had a similar experience? A different experience?"]

   Interdependence/shared decision making

   a. How did the group divide up the work?

      i. Did everyone put in effort and share responsibility for making sure the work got done?

      ii. Did you feel like the group divided up the work fairly? What was your role? Did you feel like you were doing more or less than others? [Please describe.] What do you think the reasons might be for some students doing less of the work? ***Probes:*** *Social loafing/not interested/unmotivated versus not feeling like they are included? Like their ideas/contributions matter?*

iii. *[If no]* What do you think your group could have done differently to give everyone the chance to share their ideas, give everyone responsibility and help make decisions, and make student experiences more equitable?

Student inclusion, acceptance, and social comfort

b. How did your fellow group members treat each other? How did they treat you?

i. Did you feel that others in the group were accepting of your thoughts and contributions? Did they ask for your opinion? Did they listen to you when you had something to say?

Vigilance and social comparisons

a. How comfortable/uncomfortable did you feel in your group? Did you feel like you could be "yourself"? Act the way you usually act? Say what you usually say? Learn the way you usually learn? *Probes: Did you wonder about what other students might be thinking about you? Did you feel comfortable sharing your ideas? Did you ever hold back from answering questions or sharing information in front of other students?*

i. What did the other students do that made you feel more or less comfortable?

Microaggressions/student inequity, discrimination, and exclusion

a. Was everyone treated equally? Did everyone have the same opportunity to make decisions? Lead or direct what the group would do? Take credit for what the group did?

b. What was your role in the group?

c. Did you ever feel marginalized or excluded? For example, did you ever feel like you didn't have a say in group decisions or that other students saw your opinions and ideas as less important than other students? What was it that made you feel that way?

d. Did you ever feel like the other students in your group blamed you for something or unfairly targeted you? If yes, tell me what happened.

Personalization/opportunities to learn

a. In general, do you think students learn more or less when they are working in a group? **Probe:** Is the learning about how to work together, about learning the actual subject/topic, or both?

i. When you had your positive/negative collaborative experience, did you feel like you were able to learn the "way" you like to learn? Why or why not?

ii. When you were working in this group, did you ever feel like you had to change your style of learning to fit in with the group? ***Probe:*** *How did this make you feel?*

iii. In general, do you feel that you get more accomplished when you adapt your learning style to others in the group or retain your own learning style?

Student Perceptions of Relationship Between Collaboration and Classroom Environment

I have one last set of questions for you. Now I'd like you think about your classroom experiences overall. In other words, I want to know what your classroom is like in general—whether it is a whole class lesson, you are working alone, or you are working in groups—just what it is like in the class.

12. I am curious whether you think classrooms where students get the chance to work in small groups all the time are different from classrooms where students never or rarely work in small groups? ***Probes:*** *For example, have you ever been in a class in which it was usually the whole class learning in rows? Have you ever been in a class in which you often work in groups? What about an experience when a teacher might switch from mostly whole-class instruction to offering more collaborative group activities?*

    a. How are classes in which there is a lot of group work different from classes in which there is rarely or never any group work? **Probes:** The energy? The tension? How the whole class gets along? How students behave? Are students more willing to share their ideas and opinions openly? Does it change how students approach their learning—extent to which they might seek out help from other students?

13. Do you feel any different in the classes where you do group work more often? **Probes:** Do you feel more/less motivated, interested in your work? Do you feel more/less supported by your peers? Do you feel more/less comfortable sharing your opinions/ideas in front of the whole class? Do you feel like teachers treat you/other students differently?

Closing Questions

14. Is there anything else you would like to share with me about your experiences working in groups that we did not discuss today?

Learning With Others: Teacher Interview Protocol

Interviewer:	Teacher:
School:	Date and Time:

Teacher Interview Protocol (5 minutes)

Thank you for taking the time to speak with me this [morning/afternoon]. Before we start, I would like to give you a little background about who I am and why I am here. I would also be glad to answer any questions you might have for me. I work for a nonprofit organization called American Institutes for Research, or AIR.

We are asking you to be part of a research study. This study has three main goals:

1. To understand the kinds of opportunities students have to work together during school;

2. To better understand how opportunities to work together might influence how students experience their classes and how they do in school; and

3. To better understand how students from varying racial and ethnic backgrounds might experience and benefit from working together differently.

You have been selected to participate in this interview because you are a mathematics or English language arts teacher at your school. Our discussion will take approximately 45 minutes to an hour to complete. I want to assure you that all information obtained today will be kept strictly confidential. Our study reports will summarize interview findings across all sites and teachers and will never include your name.

We are interested in hearing about your ideas and experiences with engaging students in collaborative activities. By *collaborative* we mean activities, projects, or problems in which students are expected to work with one or more students on a task together. There are no right or wrong answers to the questions I will be asking today, so please feel free to share your honest opinions.

Do you have any questions before we begin? If at any time you have questions, please feel free to ask.

To ensure accuracy of the information we report, I would like your permission to record our discussion today. At the end of the study, the audio file will be deleted.

Do I have your permission to record the conversation? [If *yes*, begin recording.] Okay, thank you.

Teacher Demographics

1. What subject area(s) and grade level(s) do you teach?

2. How long have you been a teacher at [School Name]?

SCL Model and School Climate

3. How would you describe your school model or approach to someone unfamiliar with [School Name]? What makes [School Name] [School Name]?

   Probe *for emphasis on personalized learning and collaboration, and focus on learning knowledge and skills beyond academics (e.g., deeper learning competencies such as self-directed learning, critical thinking and problem solving, and social skills). Also, explore teacher perceptions of the nature/quality of social-emotional climate (student–teacher relationships, teacher–teacher relationships).*

Structural Quality Features of High-Quality Collaboration

Frequency of Collaborative Activities

4. I'd like to start out by talking about how often you offer collaborative learning activities in the classes you teach. About how often? To what extent does this vary by the subject? Grades? Other factors? During the interview, I would like you to reflect on the [observed class] in particular. However, feel free to share with me how the class we observed may be similar to or different from the other classes you teach.

Nature of Collaborative Activities

5. What kinds of collaborative projects, problems, or activities do you typically offer in this class? Can you give me an idea of the range of activities?

6. Can you give me an example of a high-quality collaborative experience you have offered in this class? What made or makes a collaborative experience "high quality"?

7. What do you see as the important characteristics or features that make a collaborative learning experience high-quality? [Note: The interviewee may have answered some of these follow-up questions earlier.]

a. What kinds of design/structural features do you associate with a high-quality collaborative learning activity or opportunity? Probes: nature of the task/activity; preparation of students; composition of groups.

b. What kinds of dynamic features (e.g., how students engage with one another) do you associate with high quality? Probes: What are you hoping to see with respect to the nature *of interactions between students; extent of constructive exchange between students; productivity of the group; shared decision making, leadership, interdependence of the group?*

Task is Student-Centered/Culturally Responsive: Reflects Students' Interests, Background, Culture, and/or Lived Experiences

8. In this class, do you ever assign collaborative projects—activities that are designed to connect with students' lives outside of school (e.g., connect with their interests)? What about activities that may connect with your students' culture or background? ***Probes:*** *Do the tasks require students to pull from their lived experiences or knowledge base outside of the classroom to contribute to and connect with the assignment in a meaningful way? For example, during a lesson on immigration, would there be an aspect focused on the students' personal connections (e.g., what they know about it and what the immigration process was like for them or their family)?*

9. How important is it that the collaborative group activity connects with students' background and life outside of school? Is it always important? Only sometimes important? ***Probes:*** *To what extent is this a regular consideration when planning? If you had to choose between emphasizing the academic skills/concepts and connecting with students' lives, how would you prioritize, balance, or integrate these two aims?*

Composition

10. In this class, do you assign students to groups? *(If no, skip to the next question.)* How do you assign students? What do you think about when putting together groups? What characteristics are important? What are the characteristics of your ideal group?

a. Do you ever make explicit decisions about group assignments or tasks with regard to gender? What about race/ethnicity?

b. What about academic ability level? To what extent do you consider students' varying levels of competency in the topic/subject when composing groups?

    c.   What about students' varying levels of social skills? To what extent do you consider students' varying levels of social competence when composing groups?

    d.   What other factors do you consider (e.g., language, interests)?

11. Do students ever have the opportunity to choose their own groups? *(If no, skip to question 12.)* What are the most common ways students choose their fellow group members (e.g., friends, academic skills level, gender, race/ethnicity)?

12. How often do students choose group members who are the same race/ethnicity?

13. I am curious to hear your thoughts about how the composition of groups influences the dynamics of those groups. What kinds of student characteristics influence how groups interact or work together?

    a.   To what extent have you found that race/gender plays a role or influences the dynamics of your student groups?

    b.   Do students ever have specific roles during group work? Do you assign these roles, or can students select them—or a mix of both?

    c.   Do you think that students' cultures and backgrounds influence the type of roles students take on in their groups? How?

    d.   In cases where students can select their role in the group, do you find that different subgroups of students select certain roles? Do they avoid certain roles? Why do you think this is the case?

Teacher Facilitation of Collaborative Group Work

Teacher Role

14. How do you see your role when students are working in collaborative groups? What are you trying to do or not do?

    a.   Does your role change depending on the task or activity?

Facilitation of Group Dynamics To Promote Peer Responsiveness, Inclusion, and Mutual Respect

15. What has been your experience with how students interact and treat each other during group time? What are some of the ways in which you have seen positive, respectful interactions (inclusive, supportive, fair)? How about ways in which you have seen students not treating each other as respectfully or equitably as you might like?

a. Are there certain groups that require more facilitation? If *yes,* why? What do you do to support those students?

b. What do you do when a group is not supporting its members? When you see incidences of exclusion? Disrespect?

c. What tells you that a student or student are feeling uncomfortable in a group? How do you typically handle a situation like that?

d. Do you have any structures in place for students to openly share opinions and perspectives with their groups without concerns that they will be judged or made fun of? Are there any specific strategies you use—or have students use with one another?

Facilitation of Group Dynamics To Promote Autonomy, Productive Struggle, and Peer Interdependence

16. How do you design—or facilitate—collaborative activities to ensure that all students play an equal role in the group work?

a. What role or strategies, if any, do you use to facilitate group decision making? Collective planning?

b. How do you typically respond when students in a group are encountering difficulties with the task/problem? Probe: Do you usually offer to help? Let them work it out on their own*? What do you see as your role during these times?*

Facilitation of Group Dynamics To Promote Constructive Exchange of Perspectives, Opinions, and Ideas

17. Do you have different academic expectations for students when they work in groups—as opposed to when they work independently? If yes, how are these expectations different?

18. What kinds of strategies, if any, do you use to help facilitate how students learn with and from one another during group time? Probes: Encourage students to help each other (peer coaching*)? Ask open-ended questions? Encourage students to critique each other's work? Encourage students to debate their positions? Other ways to promote learning during group time?*

Teacher Perceptions and Beliefs About Collaborative Group Experiences

Perceived Benefits

19. What are some reasons you might have students collaborate on an activity/task/assignment rather than work individually? What are you hoping students gain from engaging in a task collaboratively that they wouldn't experience if they worked independently? Probes: Building social skills, deepening skill/understanding of academics, enhanced relationships, outcomes such as motivation, self-efficacy, engagement?

20. Do you feel that collaborative group work influences the classroom climate overall? If so, how? Probes: Does it change students' relationships with one another? Are students more or less willing to share their ideas and opinions openly? Does it change how they approach their learning—the extent to which they might seek help from other students related to their *learning?*

    a. Have you ever taught a class in which you used primarily a whole-class format, and then switched to offering more collaborative group activities? If so, what kinds of changes did you observe in the student? In yourself?

Perceived Challenges

21. What are some of the challenges or limitations you believe are associated with collaborative learning activities?

    a. Do you think that all academic subjects lend themselves to collaborative learning? Why/why not?

    b. Have you had times when you felt students did not benefit? Tell me about those times. What kinds of issues did you observe/experience? What was it about the collaborative learning activity/experience that made it less effective/successful?

    c. Do you think that all students benefit from collaborative learning activities in the classroom? Why/why not? What are the characteristics of those students who benefit/don't benefit from collaborative activities?

    d. Do you make any accommodations for the students who struggle with collaborative work?

Challenges Balancing Collaboration and Personalization

22. Educators use the term "personalized learning" to refer to a lot of different approaches. They also see a wide range of goals for personalizing learning for students. I am curious about what comes to mind when you hear the term "personalized learning." What does it mean to you?

    a. Would you say that you strive to personalize learning for students in this class? How?

23. What is your perspective on how personalized learning and collaboration are related? Do you see personalization as having a role in collaboration, or are the two mutually exclusive?

    a. Do you lose aspects of personalization when students collaborate? If *yes,* which aspects?

    b. How do you ensure that the needs of individual students are met during collaboration work? What strategies, if any, do you use to incorporate personalization into collaboration work? Can you give me an example?

24. What are the major barriers to meeting the individual needs of students during collaborative group work? Are there certain subgroups of students who you believe cannot have their individual needs adequately met during collaboration? Why do you think this is the case?

School Contextual Factors

25. To what extent do you think your school context helps or hinders your ability to offer successful collaborative opportunities in the classroom?

    a. Can you tell me about some of the ways you feel your school structures, policies, practices, or leaders help you offer more collaboration? Probe: schedule, class size, class composition, goals, curriculum/lesson planning support, professional learning communities (PLCs), behavior expectations, coaching support.

    b. Can you tell me about some of the ways school structures, policies, practices, or leaders may hinder your ability to offer students collaborative opportunities? What are these obstacles? Probe: schedule, class size, class composition, goals, curriculum/lesson planning support, PLCs, behavior expectations, coaching support.

    c. Do you ever plan opportunities for student collaboration with your colleagues? Probe: specific*ally, in PLCs or with student coaches.*

26. Has the school or district offered you any professional development to help you increase your capacity to design and facilitate collaborative learning activities for students? If so, what kinds of professional development were offered? What kind do you think is most needed?

Closing Questions

27. Is there anything else you would like to share with us about your experiences offering collaborative activities in your classes that we did not discuss?

References

Walters, K., Smith, T., Leinwand, S. Surr, W., & Stein, A. *Examining student-centered instruction in high school mathematics: an in-depth study of exemplary teachers and their students (draft under review),* for the Nellie Mae Education Foundation. Washington, D.C.: American Institutes for Research