



Math Corps Replication Site Prospective Findings

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Executive Summary

Nearly 30 years ago, Dr. Steven Kahn and Professor Leonard Boehm started Math Corps, a summer camp for middle school students who could benefit from mentoring and positive influences. Dr. Kahn and Professor Boehm's primary goal for the camp was to support the emotional and social needs of the students in Detroit; accordingly, the educators leveraged their backgrounds as math teachers to create an intensive summer program that provides not only social and emotional support, but also high quality math instruction.

In 2015, the National Science Foundation awarded Wayne State University (WSU) an Advancing Informal STEM Learning (AISL) grant, enabling the Math Corps summer camp to be replicated in three cities (Cleveland, Ohio; Philadelphia, Pennsylvania; and Utica, New York) in summers 2017, 2018, and 2019. As part of the grant, WSU contracted with Mathematica to conduct an independent evaluation of Math Corps. This report presents the prospective analysis and findings, which offer descriptive information on the characteristics and mathematics achievement of students at the three replication sites.

Findings

- **The replication sites appeared to serve their priority communities.** The average neighborhood median household income for Math Corps participants was relatively low, and participants lived in neighborhoods where more than a third of people younger than 18 were in poverty.
- **Attendance at Math Corps was consistently high in Cleveland and Philadelphia and somewhat lower in Utica.** Across all years, the average attendance on any given day of camp was 96 and 98 percent in Cleveland and Philadelphia, respectively, and 88 percent in Utica.
- **Homework completion was generally high except for in Utica in 2018.** The average homework completion rate on any given day of camp was 97 percent in Philadelphia, 95 percent in Cleveland, and 86 percent in Utica.
- **Students made large and statistically significant gains on the Math Corps exam between the start and end of camp in all sites and years.** In all sites and years, students' gains on the Math Corps exam before and after the program were statistically significant. On average, students scored about 38 percent on the pre-program exam and 75 percent on the post-program exam.

Math Corps is an inspiring program that serves students from minority and disadvantaged backgrounds with the goal of improving their life trajectory. The findings of this prospective analysis suggest the three replication sites were largely successful in implementing the Math Corps summer camp, and that Math Corps can be reasonably replicated in new sites in a relatively short period of time (within three years). Students who attend Math Corps demonstrate significant gains in math achievement during camp. A prior retrospective analysis showed that Math Corps increases long-term outcomes such as college enrollment. Taken together, these are promising findings. Other communities seeking a math-focused program that supports short- and long-term outcomes, as well as the emotional needs of middle school students, may find that Math Corps is the right fit.

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I. Introduction and background

Nearly 30 years ago, Dr. Steven Kahn and Professor Leonard Boehm started Math Corps, a summer camp for middle school students who could benefit from mentoring and positive influences. Dr. Kahn and Professor Boehm’s primary goal for the camp was to support the emotional and social needs of the students in Detroit; accordingly, the educators leveraged their backgrounds as math teachers to create an intensive summer program that provides not only social and emotional support, but also high quality math instruction.

Since its founding in 1991 at Wayne State University (WSU), Math Corps has grown substantially. The program gained fame through press coverage and a documentary film, leading other institutions in several cities across the nation to investigate setting up a Math Corps summer camp. The Detroit Math Corps currently serves about 400 middle and high school students each summer. In addition, it offers ongoing support on Saturdays throughout the school year.

At its core, the Math Corps is about a very simple but unwavering belief—that all children have a unique and special greatness within them and that, through hard work and a commitment to excellence and with the support of a caring family or community, that greatness can be realized.

**—From the Math Corps website,
www.mathcorps.org**

In 2015, the National Science Foundation awarded WSU an Advancing Informal STEM Learning (AISL) grant, enabling the Math Corps summer camp to be replicated in three cities (Cleveland, Ohio; Philadelphia, Pennsylvania; and Utica, New York) in summers 2017, 2018, and 2019. As part of the grant, WSU contracted with Mathematica to conduct an independent evaluation of Math Corps. The evaluation has two components: (1) a quasi-experimental retrospective analysis focusing on Math Corps’ long-standing program in Detroit, and (2) a descriptive prospective analysis of the Math Corps replication sites in Cleveland, Philadelphia, and Utica.

This report presents the prospective analysis and findings, which offer descriptive information on the characteristics and mathematics achievement of students at the three replication sites. In the rest of Chapter I, we provide background on Math Corps and a summary of each replication site. In Chapter II, we describe the methodological approach for the prospective analysis and present descriptive statistics on participants. In Chapter III, we present the prospective findings and discuss their implications. The retrospective analysis and findings were presented in a prior report (Fox and Harris 2020).

Math Corps

Math Corps is a summer camp math enrichment and mentoring program that seeks to provide children from disadvantaged backgrounds with a high-quality learning environment and a safe place. Math Corps also seeks to provide students with more than learning opportunities: the camp is a place where students can build family and community connections and learn to strive to achieve more than they might otherwise. Math Corps develops cultural norms for interacting with one another and uses the Socratic approach to help build community while students learn and internalize mathematical concepts. The Socratic method uses questioning to stimulate critical thinking, draw out ideas, and solidify beliefs and understanding (Rapanta 2018). The Math Corps math curriculum, developed by WSU and designed for a summer camp setting, has been refined over decades of implementation. This curriculum aims to

strengthen connections through teams and mentors. Specifically, high school students (called teaching assistants, or TAs) mentor middle school students, and college students and professors mentor TAs and middle school students. Math Corps strongly encourages students to return to the program year after year; the goal is for middle school participants to ultimately become TAs and college mentors.

Math Corps is designed to be a six-week summer camp. Attendance is mandatory Monday through Thursday, when students receive instruction in both basic and advanced math topics. Each day, camp begins with an assembly at 9:30 a.m. All students attend the assembly together to learn the Math Corps philosophy and cultural norms, have fun, and celebrate successes among their peers. After assembly, students have 1.5 hours of “Team Time,” which includes their basic math course and a practice session, during which TAs and college student instructors help students with their work. The basic math courses include “The Real Numbers” for 7th graders, “The Operations on Real Numbers” for 8th graders, and “The Foundations of Algebra” for 9th graders. After the morning Team Time, students break for lunch, take their advanced math course, and have time to write in journals. University professors teach the afternoon advanced math courses using the Socratic method. These courses include a variety of hands-on activities that encourage students to use multiple approaches to problem solving. Each day ends with special math activities, such as playing chess, making tessellations (a geometric tiling activity), studying astronomy, or learning about probability. On Friday, the camp offers special activities such as Movie Day, Craft Day, Volunteer Day, Game Day (board and video), Karaoke Day, or a field trip (for example, to a planetarium).

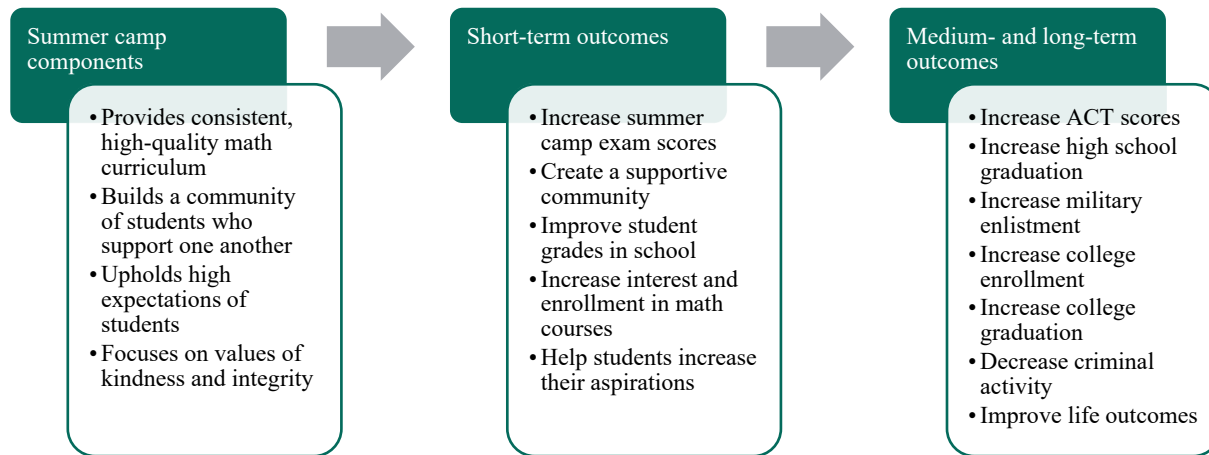
The Math Corps philosophy emphasizes establishing high expectations for students and asking students to have high expectations of themselves. In addition, Math Corps actively works to build a sense of family, where every student is supported emotionally, experiences mentorship, and builds meaningful and lasting friendships. To those ends, the Math Corps values of kindness, integrity, and student greatness are promoted throughout each day, along with a sense of family and community. All participants are expected to attend, arrive on time, and complete their homework daily. In addition, students are held to strict standards of behavior. Having fun is considered a daily requirement and violence is strictly prohibited.

Components of Math Corps

Math Corps uses the activities described above to achieve student outcomes (Figure I.1). Most notably, Math Corps draws on its well-established math curriculum and philosophy to change life trajectories for the better. In the short term, Math Corps seeks to raise scores on its pre- and post-program exam and on weekly quizzes created by Math Corps administrators. The quizzes provide camp administrators with formative data on student progress, and the pre- and post-program exams provide benchmark data on students’ math understanding. Math Corps also seeks to build a tight-knit community, which many administrators and Math Corps participants consider a second family. In the medium term, Math Corps seeks to increase high school graduation rates, improve ACT test scores, and boost college enrollment. Math Corps also encourages enlistment in the military for young adults for whom that is a desirable and suitable career path.

In the longer term, Math Corps encourages students to graduate from college, enter the workforce, and avoid criminal behaviors. The ultimate goal of the program is to put them on a path to better life outcomes.

Figure I.1. Math Corps logic model



Replication sites

The replication sites were selected because they had summer camp programs in development and were considered to be in a strong position to implement Math Corps. In addition, each replication site had dedicated leaders who were committed to serving the underserved students of their communities using the “Math Corps way.”

The replication plan, as stated in the grant proposal, included two core elements:

1. Intensive training for replication site staff at WSU. For three consecutive summers, each site would send their staff (including high school TAs, college student instructors, college student assistants, and senior camp personnel) to WSU for training. The training would cover program operation, philosophy, principles, and practices; and the pedagogical approach. The training sought to give replication site staff opportunities to witness the Math Corps culture in practice at WSU and help develop a similar culture at each replication site.
2. Scale-up of each replication camp, from four weeks initially to five or six weeks, serving 120 students, including 7th and 8th graders and TAs.

Over the course of the retrospective and prospective studies, we met regularly with WSU staff to discuss the study. During those conversations, WSU staff provided informal information about their perspectives on the replication sites. They reported that these two core elements were not entirely implemented as originally planned. For example, staff from all three replication sites went to WSU for training in the first summer, but in the second and third summers, training took place in each replication site’s home city. In addition, as we describe in Chapters II and III, the sites did not scale up their camps as much as they had hoped. In addition to these overarching themes, scale-up varied across sites due to the different starting points for each site and the differences in program demand and students served. Below, we briefly describe each replication site.

Cleveland

The Cleveland Math Corps took place each summer at Cleveland State University. Staff at Cleveland State University, Case Western Reserve University, and the Federal Reserve Bank of Cleveland had been

interacting with WSU and working to implement a Cleveland Math Corps for several summers before the AISL grant. Prior to the grant, Cleveland staff had observed and helped teach at the Detroit Math Corps, and several Detroit staff had been going to Cleveland to help implement a Cleveland Math Corps. Staff saw the AISL grant as an opportunity to better support their efforts to implement and grow the Cleveland Math Corps.

Given the relatively close geographic proximity of Cleveland and Detroit and the collaboration between Math Corps staff in both sites before the grant, WSU staff continued to support Cleveland during the grant. This continuity may have contributed to the similarities in culture between the Cleveland and Detroit Math Corps. One similarity was that the morning assembly at both camps focused on building students' self-esteem. The leader at Cleveland was reportedly a bit more formal in her mannerisms than the leadership in Detroit, resulting in assemblies with more structure; nonetheless, overall, the goals and attitudes were similar across sites.

Philadelphia

The Philadelphia Math Corps took place at Drexel University each year of the grant. It was initially led by a small nonprofit organization that had been offering summer tutoring for several years before the grant. One of the nonprofit's leaders had learned about the Detroit Math Corps and traveled to Detroit to meet with Dr. Kahn and see the camp in person. For about two years before the AISL grant, the nonprofit created and operated a small summer camp, which it modeled on Math Corps. The nonprofit viewed the AISL grant as an opportunity to build the capacity of the Philadelphia staff to operate a Philadelphia Math Corps and increase the number of students served.

After receiving the AISL grant, the nonprofit struggled with staff availability, finances, hiring, and student recruitment, so WSU sent its staff to Philadelphia each summer to help the Philadelphia nonprofit prepare for camp and lead and teach during camp each summer. However, despite the assistance from WSU, the nonprofit continued to struggle, and leadership reportedly did not embrace the Math Corps philosophy to the extent WSU would have liked. For example, Math Corps believes all students are great and emphasizes student greatness in all interactions, even when disciplining students. The nonprofit leaders reportedly did not buy into the Math Corp vision of student greatness and focused on student weaknesses during punishments, which is not consistent with the Math Corps way. Given these challenges, the camp operations were transferred from the nonprofit to Drexel University after summer 2018. Drexel University brought in new leadership and camp instructors, all of whom reportedly embraced the Math Corps culture and leaned on the assistance of WSU staff to help run the camp in summer 2019.

Utica

The president of Mohawk Valley Community College (MVCC) learned about Math Corps through a friend at WSU who invited him to visit and observe Math Corps in Detroit. After that visit, the president of MVCC was determined to bring Math Corps to Utica. Before the AISL grant, MVCC had received Gear Up and Upward Bound grants that it used to provide a summer camp to local middle and high school students. The AISL grant was an opportunity to focus on middle school students and math instruction.

MVCC planned to transition several staff who supported its Gear Up and Upward Bound grants to the Math Corps efforts. However, the staff transition occurred behind schedule. Thus, the Utica Math Corps

began with a staffing shortage the first year. WSU offered to send staff to help, but Utica staff declined and were content to run the camp on their own.

The culture was reportedly slightly different at Utica. Although Utica implemented the math curriculum consistently with the Math Corps model, WSU staff hypothesized that the relatively lower level of interaction they had with Utica led to less familiarity with the Math Corps philosophy. For example, Utica did not hold a closing ceremony for the students in the first summer, which is a key part of the Math Corps culture. The closing ceremony is an evening event where families attend and students receive awards for their accomplishments during camp. Each student receives a certificate during the ceremony as a way for parents to see their child succeeding. When WSU staff learned that the Utica Math Corps did not offer a closing ceremony, WSU asked Utica to offer one. Utica agreed to an event for parents the same day as a planned picnic, but WSU staff reported that it was not the same as the ceremony they intended. In addition, the population Utica serves is more diverse than in other sites and includes a wide variety of immigrant groups, so the Utica Math Corps tailored activities to meet the needs of its population.

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II. Study design and descriptive statistics

This chapter describes the research questions that guide the study and the sources of data we used to answer the research questions. We also explain how we constructed the sample for analysis, the methods we used, and the descriptive statistics of the study participants.

Research questions

To understand the participation patterns and outcomes for students in the replication sites in Cleveland, Philadelphia, and Utica, we examined the following research questions:

- What were the attendance rates for participants in the three replication sites?
- What were the homework completion rates and scores for participants in the three replication sites?
- What were the achievement gains for participants in the three replication sites?

To answer these research questions, we conducted descriptive analyses on all Math Corps participants in the three replication sites.

Data sources

We drew on data from three sources to conduct the prospective study.

- 1. Administrative data from WSU.** Our primary data source was individual-level data from each site's program records, which WSU compiled and provided to the study team. These data included information on all students who participated in Math Corps in the three replication sites from 2017 to 2019. The data included participant demographics and other background information provided on Math Corps applications, and data on Math Corps participation, including attendance, homework, and exam scores. Specifically, the data included gender, race, prior school type, prior grades, and the participant's address. The attendance data included a record for each day of camp and whether the student was present, absent, suspended, withdrawn, or dismissed from the program. Similarly, the homework data included a record for the homework due on each day of camp and the score each student received. Lastly, the data included students' scores on the pre- and post-program exams. The percentage of participants with missing data is generally very low, except that information on prior grades was not available for Philadelphia in 2018, and 18 percent of participants in Cleveland were missing post-program exam scores (Appendix Table A.1).
- 2. Data from the American Community Survey.** Using the individual-level data received from WSU, we obtained data on the neighborhoods in which the participants were living at the time they applied to Math Corps. Using participant addresses and a geocoder, we identified the census tract each participant lived in and merged that onto data from the American Community Survey (ACS). Specifically, we merged onto our data file each participant's neighborhood median household income, general poverty rate, and poverty rate for those younger than 18. Those data came from the ACS five-year estimates from 2014–2018 (U.S. Census Bureau 2018a; U.S. Census Bureau 2018b).
- 3. Data from the Robert Graham Center.** Using the geocoded results, we also merged onto our data file the tract-level Social Deprivation Index from the Robert Graham Center (2015). The index is a composite measure of demographic characteristics collected in the ACS in the domains of income, education, employment, housing, household characteristics, transportation, and demographics.

Analytic approach

We conducted the descriptive analyses using the individual-level analytic data file we created from the data sources described above. From the available data, we created several additional variables and produced descriptive statistics of those variables.¹

For exam scores, we conducted paired *t*-tests to examine whether the difference between scores pre- and post-program were statistically significantly different. As an exploratory analysis, we also estimated a regression model to investigate exam score differences by site. Using all participant records with pre- and post-program exam scores, we estimated a model in which the dependent variable was the post-program exam score, and the independent variables were the pre-program exam scores, indicators for year of camp, and indicators for site. The parameters of interest were the indicators for site. We also investigated differences in exam scores by course instructor. Given the implementation differences across sites, we estimated a separate regression for each site. The dependent variable was the post-program exam score, and the independent variables were the pre-program exam scores, indicators for year of camp, and indicators for course instructor. We performed a joint F-test on the indicators for course instructor to see whether a student's course instructor had any influence on scores.

Characteristics of Math Corps participants

A total of 542 students participated in Math Corps across the three replication sites and years (Table II.1). As described in Chapter I, the replication sites planned to begin by serving grades 7 and 8 and expand to additional grades over time. However, two sites only served grade 7 in the first year, and only two sites served all three grades by the final year. Specifically, in 2017, Philadelphia and Utica served only 7th-grade students, and Cleveland served both 7th- and 8th-grade students. In 2018, all three sites served 7th- and 8th-grade students. In 2019, Cleveland and Utica served all grades, and Philadelphia served only 8th- and 9th-grade students (Table II.1).

Table II.1. Number of participants in Math Corps, by site, year, and grade

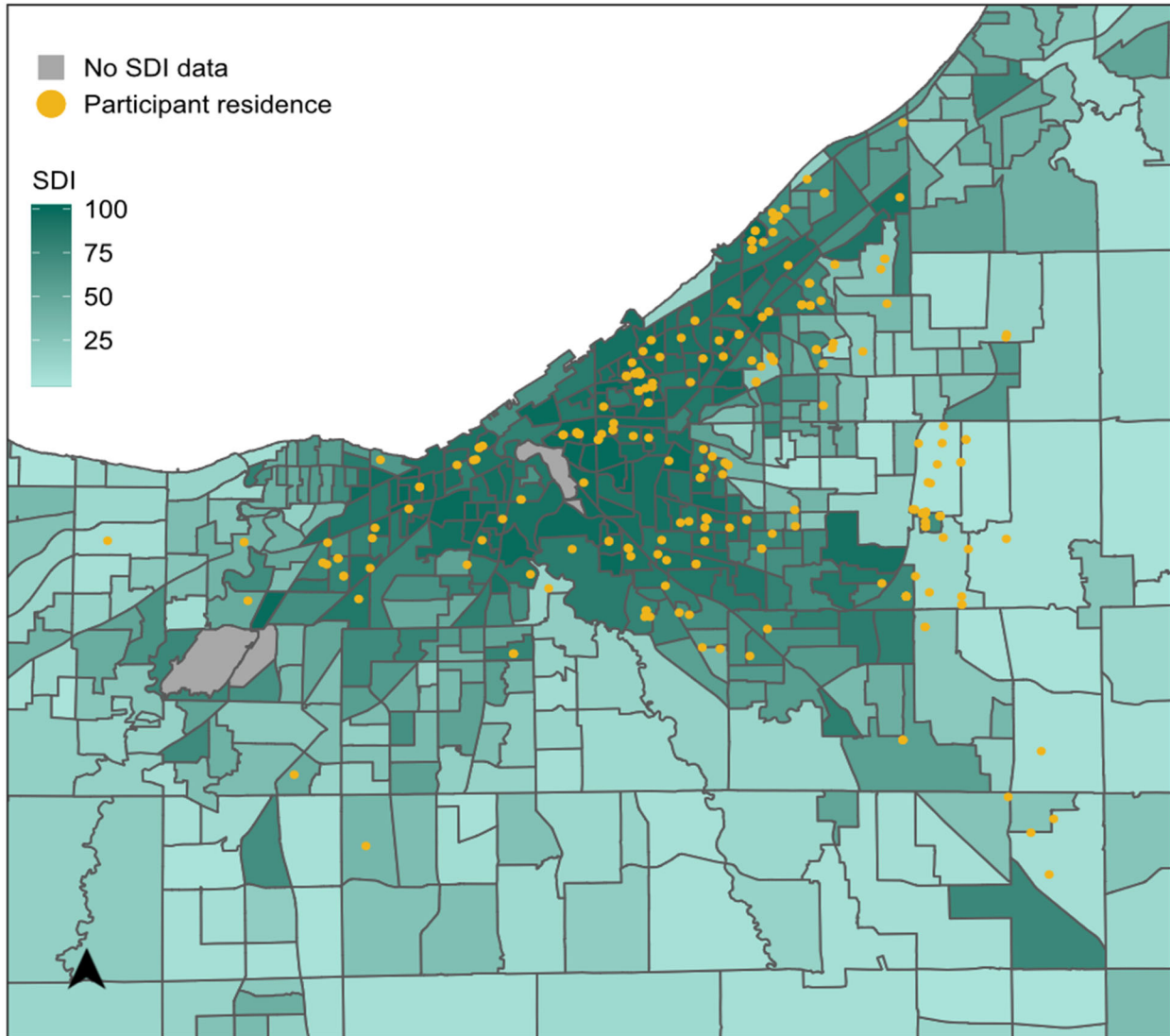
Year and grade	Cleveland	Philadelphia	Utica	All sites combined
2017 total	79	38	38	155
Grade 7	40	38	38	116
Grade 8	39	0	0	39
Grade 9	0	0	0	0
2018 total	79	58	58	195
Grade 7	38	35	25	98
Grade 8	41	23	33	97
Grade 9	0	0	0	0
2019 total	85	48	59	192
Grade 7	32	0	18	50
Grade 8	35	32	21	88
Grade 9	18	16	20	54
All years and grades combined	243	144	155	542

Source: Wayne State University Math Corps administrative data.

¹ The data included both missing values and scores of zero for homework, but these codes were not used systematically to distinguish between a missing homework assignment and a true score of zero. We assumed that if a student was present, a score of zero was a true zero. We assumed that if a student was absent, a score of zero was a missing homework assignment (that is, not handed in). To the extent that students were present but did not turn in the homework, our analyses would be underestimating the average score received (because scores of zero are included in that average) and overestimating the percentage of homework assignments completed (because scores of zero count as being turned in). It is unlikely that students were absent, turned in the homework, and received a score of zero.

All of the replication sites appeared to serve their priority communities, as evidenced by the neighborhoods in which the students lived at the time they applied to Math Corps. In Figures II.1–II.3, the yellow dots indicate where students lived, and they are overlaid on census tract–level information on the Social Deprivation Index in green. Darker shades of green indicate greater social deprivation. Across all three sites, Math Corps primarily served students from the most disadvantaged neighborhoods in the city.

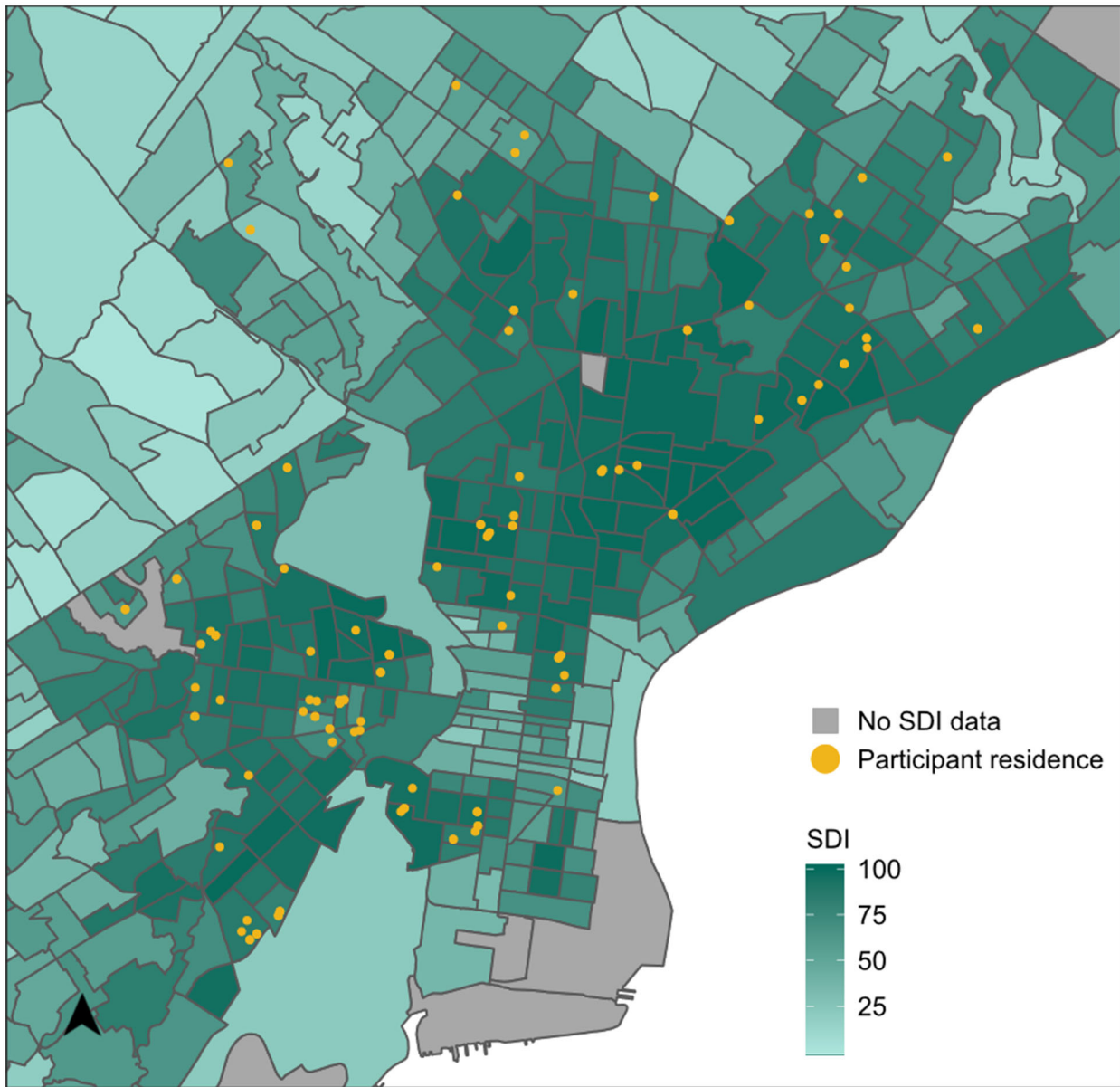
Figure II.1. Residence of Math Corps participants in Cleveland



Source: Wayne State University Math Corps administrative data. The Social Deprivation Index (SDI) is a composite index from the Robert Graham Center (2015).

Note: The SDI measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

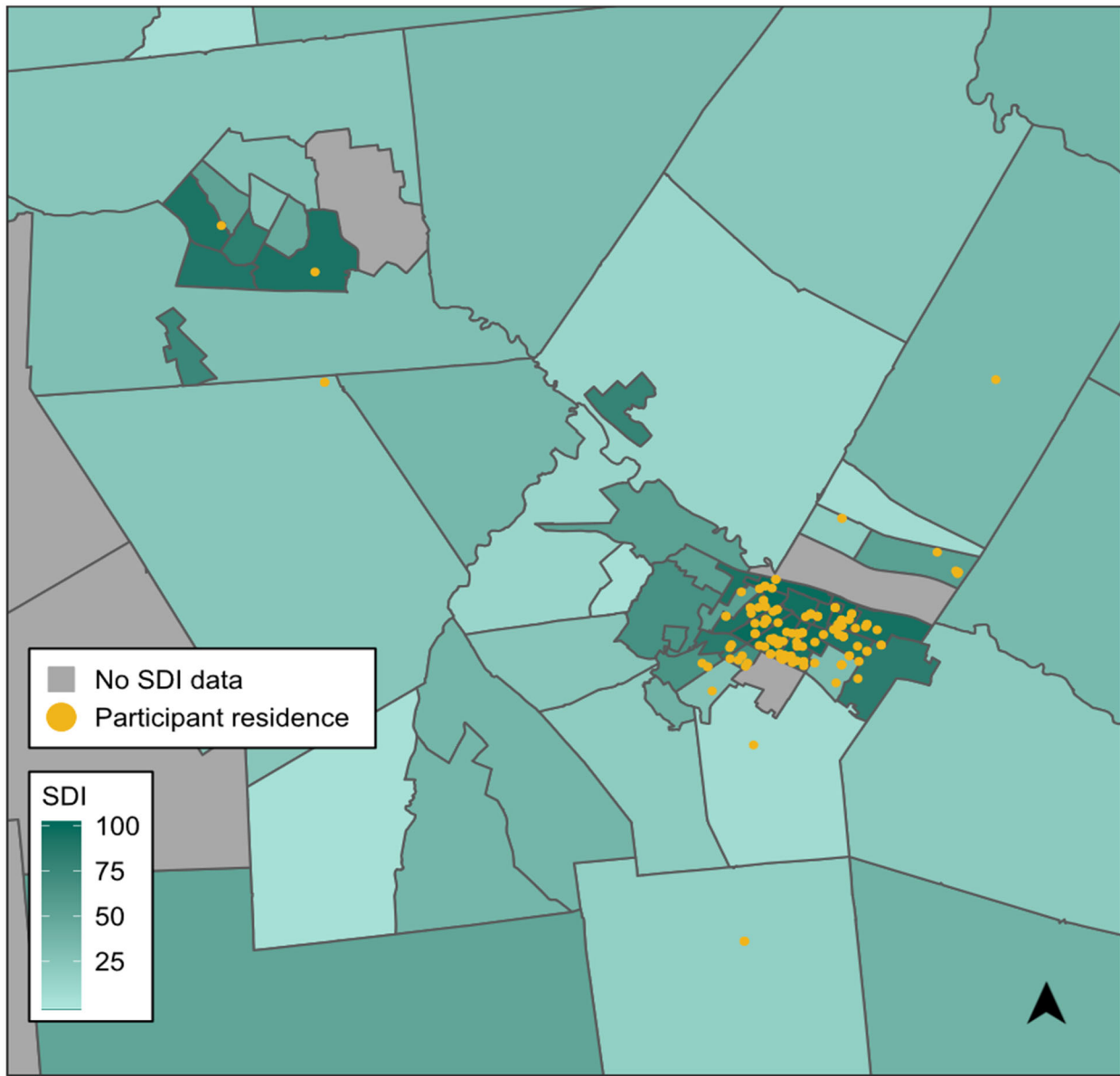
Figure II.2. Residence of Math Corps participants in Philadelphia



Source: Wayne State University Math Corps administrative data. The Social Deprivation Index (SDI) is a composite index from the Robert Graham Center (2015).

Note: The SDI measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

Figure II.3. Residence of Math Corps participants in Utica



Source: Wayne State University Math Corps administrative data. The Social Deprivation Index (SDI) is a composite index from the Robert Graham Center (2015).

Note: The SDI measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

All sites reached their priority communities, though participants in Utica had somewhat different characteristics than those in Cleveland and Philadelphia (Table II.2). Utica served a lower percentage of Black students than did Cleveland and Philadelphia and a higher percentage of Asian, Hispanic, and White students. This likely partially reflects the racial and ethnic makeup of the three cities, as Utica has a lower proportion of Black residents than Cleveland and Philadelphia. All sites still served students from low-income households. The average neighborhood median household income ranged from about \$34,000 in Utica to \$49,000 in Philadelphia. Participants in Utica had the highest average neighborhood

poverty rate for people younger than 18, which was approximately 44 percent (compared to 35 and 37 percent in Cleveland and Philadelphia, respectively).

All three sites served roughly equal numbers of female and male students, though Utica had slightly more female students. Students tended to have a B-grade average coming into Math Corps, and many students returned after their first year of participation. The return rate ranged from 58 percent in Cleveland to 76 percent in Philadelphia. Lastly, about 85 percent of Utica students attended a public school before attending Math Corps, whereas roughly half of the students in Cleveland and Philadelphia attended public schools and half attended charter schools. Characteristics by site and year are available in Appendix Tables A.2–A.4.

Table II.2. Characteristics of Math Corps participants, by site

Characteristic	Cleveland	Philadelphia	Utica	All sites combined
Gender				
Female	52.3	49.3	61.4	54.1
Male	47.7	50.7	38.6	45.9
Race and ethnicity				
Asian	0.4	11.8	26.1	10.8
Black	87.9	75.0	39.2	70.5
Hispanic	5.0	11.8	24.8	12.5
Native American	0.8	1.4	0.0	0.7
White	4.6	3.5	22.9	9.5
Other	5.4	3.5	5.2	4.9
Prior participation				
Previous Math Corps participant ^a	57.9	76.4	64.9	64.5
Prior school				
Prior school was public	51.7	47.2	84.9	59.9
Prior school was charter	41.7	52.1	13.2	36.4
Prior school was other ^b	6.7	0.7	2.0	3.7
Prior achievement				
Prior grade point average	3.1	3.2	3.0	3.1
Prior English grade	2.8	3.2	2.7	2.8
Prior math grade	2.8	3.2	2.7	2.8
Prior science grade	2.9	3.5	2.9	3.0
Measures of neighborhood poverty				
Median household income	\$49,290	\$39,745	\$34,291	\$42,503
Poverty rate	26.6	30.0	32.6	29.2
Under-18 poverty rate	34.7	36.9	43.6	37.8
Social Deprivation Index (range: 1–100)	67.1	84.1	84.8	76.6
Sample size	243	144	155	542

Source: Wayne State University Math Corps administrative data. Median household income, poverty rate, and under-18 poverty rate are American Community Survey five-year estimates, 2014–2018, tables S1701 and S1903. Social Deprivation Index is a composite index from the Robert Graham Center (2015).

Note: All numbers are percentages unless otherwise noted. Race categories are not mutually exclusive, so they do not add up to 100 percent. Letter grades were converted into a numeric scale as follows: 4.0 = A, A+; 3.7 = A-; 3.4 = B+; 3.0 = B; 2.7 = B-; 2.4 = C+; 2.0 = C; 1.7 = C-; 1.4 = D+; 1.0 = D; 0.7 = D-; and 0.0 = F. The Social Deprivation Index measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

^a Only applicable for participants in grade 8 or 9.

^b Other types of schools include home schools, private schools, and parochial schools.

III. Findings and discussion

Using all 542 Math Corps participants, we conducted descriptive analyses on attendance, homework, and exam scores. We first summarize our findings, then discuss potential implications and present limitations of the analysis, and provide recommendations for the future.

Findings

Attendance at Math Corps was consistently high in Cleveland and Philadelphia and somewhat lower in Utica. The average attendance on any given day of camp was 94 percent across all sites and years. Attendance was highest in Philadelphia, where 98 percent of students attended camp on any given day, compared to 96 percent in Cleveland and 88 percent in Utica (Table III.1). These attendances rates reflect the attendance of students who were never dismissed or withdrew from the camp. Across all three years, Cleveland Math Corps staff dismissed 17 percent of its participants, and Philadelphia dismissed 8 percent. Dismissals appear to have been very rare in Utica; only one student in 2019 was dismissed.

Table III.1. Attendance at Math Corps, by site and year (percentages)

Year	Cleveland	Philadelphia	Utica	All sites combined
2017				
Student was dismissed or withdrew at any point	12.7 (33.5)	15.8 (37.0)	0.0 (0.0)	10.3 (30.5)
Student was present for every day of Math Corps ^a	58.0 (49.7)	78.1 (42.0)	39.5 (49.5)	57.6 (49.6)
Students present on a given day ^a	95.9 (3.2)	97.9 (2.2)	94.6 (7.5)	96.0 (2.4)
2018				
Student was dismissed or withdrew at any point	17.7 (38.4)	8.6 (28.3)	0.0 (0.0)	9.7 (29.7)
Student was present for every day of Math Corps ^a	47.7 (50.3)	84.9 (36.1)	27.6 (45.1)	52.3 (50.1)
Students present on a given day ^a	95.9 (2.2)	98.7 (1.6)	81.8 (6.6)	93.0 (2.9)
2019				
Student was dismissed or withdrew at any point	20.0 (40.2)	2.1 (14.4)	1.7 (13.0)	9.9 (29.9)
Student was present for every day of Math Corps ^a	48.5 (50.3)	72.3 (45.2)	39.7 (49.3)	52.0 (50.1)
Students present on a given day ^a	96.1 (2.2)	97.6 (1.9)	88.9 (4.4)	94.6 (2.0)
All years combined				
Student was dismissed or withdrew at any point	16.9 (37.5)	8.3 (27.7)	0.6 (8.0)	10.0 (30.0)
Student was present for every day of Math Corps ^a	51.5 (50.1)	78.81 (41.0)	35.1 (47.9)	53.7 (49.9)
Students present on a given day ^a	95.9 (2.0)	98.1 (1.1)	87.6 (3.1)	94.4 (1.5)

Source: Wayne State University Math Corps administrative data.

Note: Standard deviations in parentheses. The sample size for calculating dismissals and withdrawals is the total number of students. For Cleveland: 79, 79, 85 (2017–2019); for Philadelphia: 38, 58, 48 (2017–2019); for Utica: 38, 58, 59 (2017–2019). The sample size for the subsequent calculations is the number of students who were never dismissed or withdrew. For Cleveland: 69, 65, 68 (2017–2019); for Philadelphia: 32, 53, 47 (2017–2019); for Utica: 38, 58, 58 (2017–2019). The number of attendance days varied by site and year. For Cleveland: 16, 22, 22 (2017–2019); for Philadelphia: 16, 16, 16 (2017–2019); for Utica: 16, 16, 16 (2017–2019).

^a Only calculated with attendance records of students who were never dismissed and never withdrew.

The Detroit Math Corps follows a rule that if students miss three days of camp, they are to be dismissed. None of the replication sites strictly followed this rule; in other words, all sites had participants who missed three or more days of camp and were not dismissed. The discrepancy was largest in Utica. Had Utica followed the dismissal rule, 30 percent of its students across the three years would have been dismissed. Furthermore, had those students been dismissed (and therefore excluded from our attendance rate calculations), the average attendance on any given day would have been on par with that of Cleveland and Philadelphia (around 96 percent).²

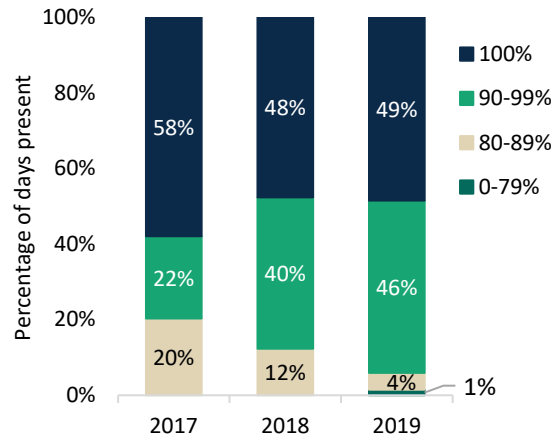
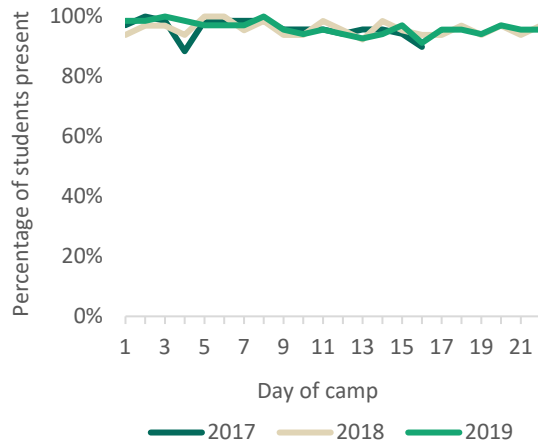
We also explored the daily variation in attendance rates (left panel of Figure III.1). In Cleveland and Philadelphia, attendance was consistently high in all three years (above 90 percent except for one day). In Utica, daily attendance varied greatly. Attendance fluctuated from 80 to 100 percent and occasionally dropped below 70 percent. Utica appeared to have the highest attendance in 2017 and the lowest attendance in 2018, followed by an increase in attendance in 2019 that did not surpass the 2018 rates.

We also examined attendance at the student level to get a sense for how much of camp the students attended. Students attending Math Corps in Philadelphia had the highest rates of attending every day of camp. Overall, 79 percent of Philadelphia's students attended every day (Table III.1). More than 90 percent of students attended at least 90 percent of camp in each of the three years (right panel of Figure III.1). In Cleveland, overall, 52 percent of students attended every day of camp. Across all three years, at least 80 percent of students attended at least 90 percent of camp. Cleveland had its highest attendance in 2019, when 95 percent of students attended at least 90 percent of camp. In Utica, only 35 percent of students overall attended all of camp. Utica's student-level attendance was on par with Cleveland's in 2017 but was much lower in 2018 and 2019. In those years, only 45 to 62 percent of students attended at least 90 percent of camp. About a quarter in each year attended less than 80 percent of camp, which is equivalent to missing at least 4 days of a 16-day camp.

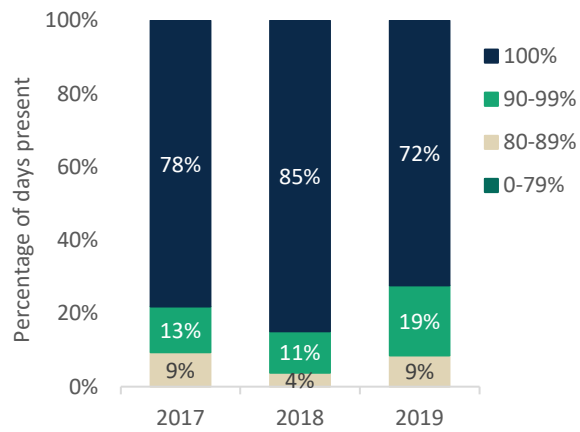
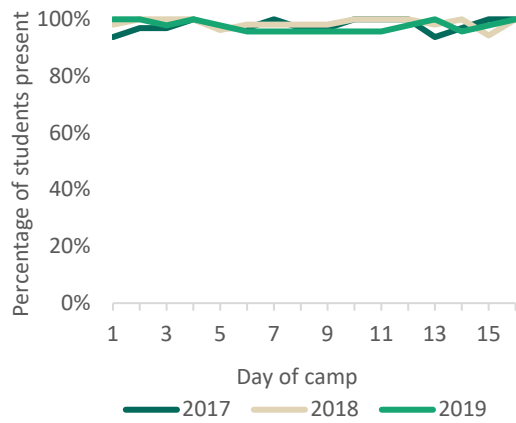
² We explored whether the lack of dismissals was an adaptation to Math Corps or a data quality issue by examining attendance after the third absence. The vast majority of students with three or more absences attended camp multiple days after their third absence, suggesting that students had not been dismissed. All of the attendance rates discussed in this chapter are based on students who were never dismissed (and never withdrew).

Figure III.1. Attendance at Math Corps, by site

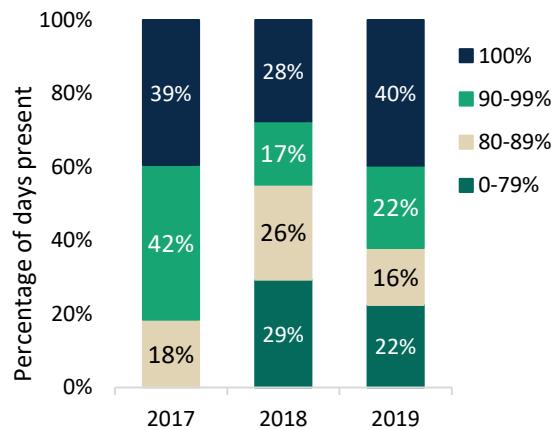
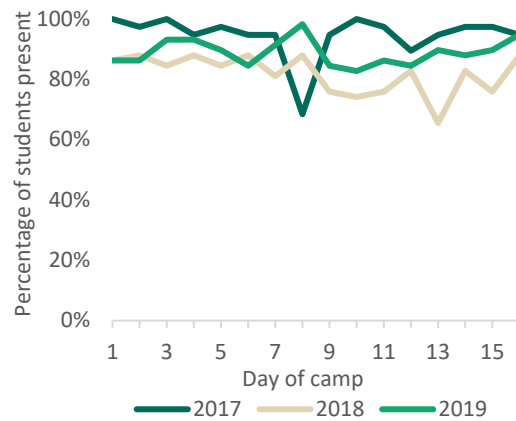
Cleveland



Philadelphia



Utica



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the percentage of students present on a given day of camp is the number of students who were enrolled in camp that day (in other words, the number who were not dismissed or withdrawn). The sample size for the percentage of days a student was present is the number of students who were never dismissed or withdrew at any time during the camp. For Cleveland: 69, 65, 68 (2017–2019); for Philadelphia: 32, 53, 47 (2017–2019); for Utica: 38, 58, 58 (2017–2019). The number of attendance days varied by site and year. For Cleveland: 16, 22, 22 (2017–2019); for Philadelphia: 16, 16, 16 (2017–2019); for Utica: 16, 16, 16 (2017–2019).

Homework completion was generally high except for in Utica in 2018. The average homework completion rate on any given day of camp was 97 percent in Philadelphia, 95 percent in Cleveland, and 86 percent in Utica (Table III.2). As with the attendance rates, the homework completion calculations are based on students who were enrolled in camp on a given day (in other words, students who had been dismissed or who had withdrawn are not in the denominator for the percentage of students who completed the homework on a given day). Because Utica did not dismiss students and homework is typically turned in when students attend camp, it is not surprising to see lower homework completion in this site. Specifically, attendance rates were lowest in Utica in 2018, and this is reflected in the homework completion rates. The average percentage of the total homework assignments that students completed is above 90 percent in all sites and years except in Utica in 2018, when the average was 74 percent, and in Cleveland in 2019, when the average was 89 percent. Homework scores for completed homework did not vary much by site, as students scored an average of 8.7 out of 10 in all sites.

Table III.2. Homework completion and scores, by site and year

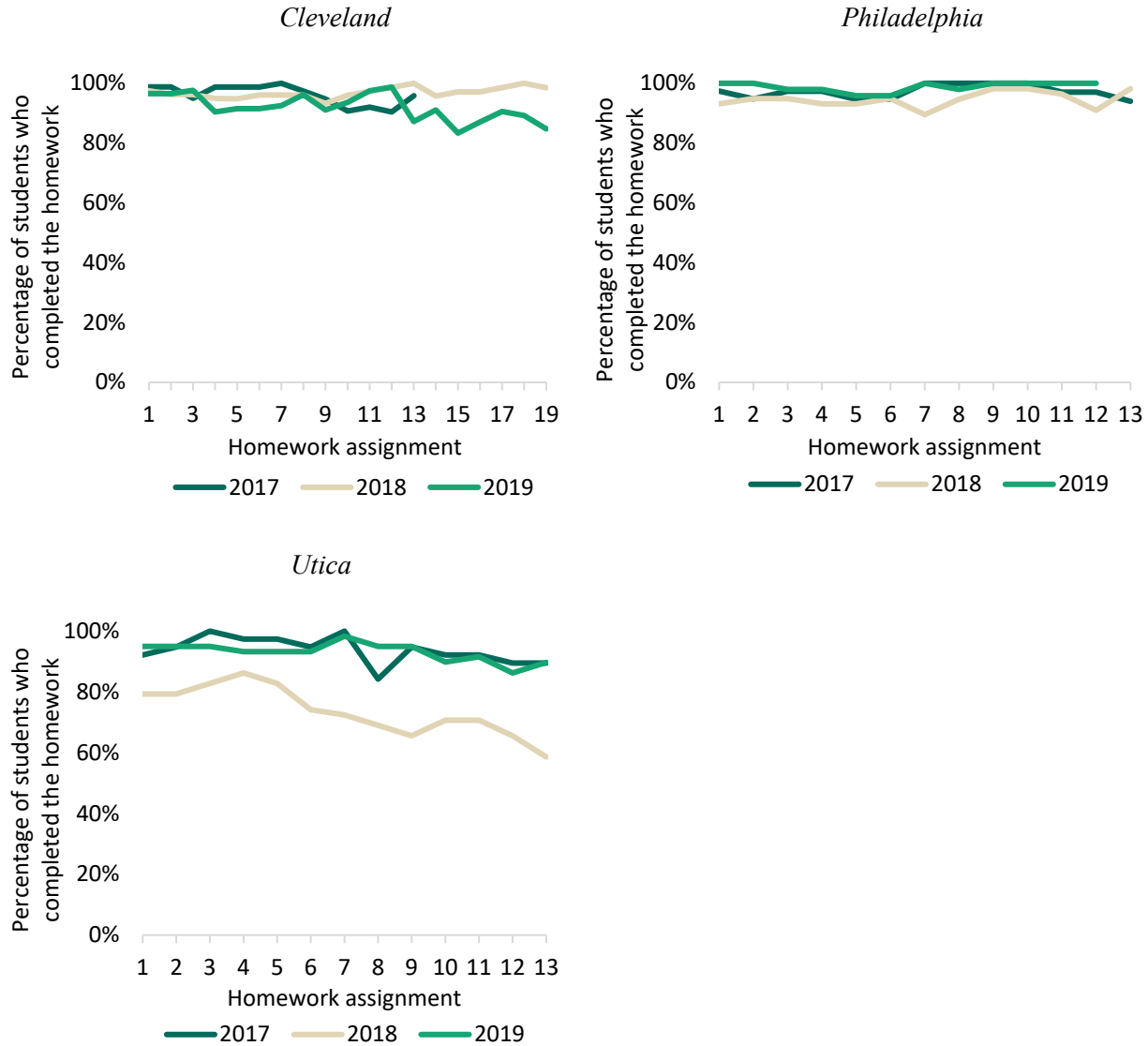
Year	Cleveland	Philadelphia	Utica	All sites combined
2017				
Percentage of homework completed	94.2 (14.0)	95.1 (15.8)	93.7 (9.6)	94.3 (13.5)
Average homework score	8.5 (1.7)	8.4 (2.3)	8.2 (1.9)	8.4 (1.9)
Percentage of students who completed the homework on a given day	96.1 (3.3)	97.2 (2.3)	93.7 (4.5)	95.7 (2.3)
2018				
Percentage of homework completed	92.7 (21.1)	93.6 (17.5)	73.6 (29.5)	87.3 (24.6)
Average homework score	8.9 (1.2)	8.6 (1.5)	8.6 (2.2)	8.7 (1.6)
Percentage of students who completed the homework on a given day	96.8 (1.7)	94.6 (2.7)	73.6 (8.1)	91.7 (4.7)
2019				
Percentage of homework completed	89.4 (15.0)	98.3 (7.7)	92.9 (16.5)	92.7 (14.4)
Average homework score	8.8 (1.2)	9.0 (1.3)	9.2 (0.9)	8.9 (1.2)
Percentage of students who completed the homework on a given day	91.9 (4.5)	98.8 (1.7)	93.1 (3.1)	92.4 (4.2)
All years combined				
Percentage of homework completed	92.1 (17.0)	95.5 (14.5)	85.9 (23.2)	91.2 (18.7)
Average homework score	8.7 (1.4)	8.7 (1.7)	8.7 (1.8)	8.7 (1.6)
Percentage of students who completed the homework on a given day	94.5 (2.0)	96.6 (1.5)	85.9 (4.5)	92.7 (1.7)

Source: Wayne State University Math Corps administrative data.

Note: Standard deviations in parentheses. The sample size is the number of students who ever received a homework assignment. For Cleveland: 79, 79, 85 (2017–2019); for Philadelphia: 38, 58, 48 (2017–2019); for Utica: 38, 58, 59 (2017–2019). The number of homework assignments varied by site and year. For Cleveland: 13, 19, 19 (2017–2019); for Philadelphia: 13, 13, 12 (2017–2019); for Utica: 13, 13, 13 (2017–2019). The percentage of homework completed for a given student is calculated across the homework assignments on days the student was enrolled in the camp (whether he or she was present or absent). In other words, the denominator does not include homework on days when the student was dismissed or had withdrawn from the camp. Average homework score is the number of points earned out of 10 and is based on assignments that students completed and turned in. The sample size for the percentage of students who completed the homework on any given day is the number of students who were not dismissed or withdrawn on that day.

We also explored the daily variation in homework completion rates (Figure III.2). Homework completion rates in Cleveland and Philadelphia did not vary greatly, but rates did vary some in Utica. Utica experienced lower completion rates in 2018, and it appears that homework completion declined as camp went on that year. Such a decline is not evident in the other years or sites. In addition to examining daily variation in homework completion, we looked at the distribution of homework scores. These varied across assignment, site, and year, with no consistent pattern. Students did not score consistently higher earlier or later in the camp or for specific assignments (see Appendix Figures A.1–A.9).

Figure III.2. Homework completion at Math Corps, by site



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the percentage of students who completed the homework on any given day is the number of students who were not dismissed or withdrawn on that day. The sample size for the number of students who ever received a homework assignment (the upper bound for these figures) is as follows: For Cleveland: 79, 79, 85 (2017–2019); for Philadelphia: 38, 58, 48 (2017–2019); for Utica: 38, 58, 59 (2017–2019). The number of homework assignments varied by site and year. For Cleveland: 13, 19, 19 (2017–2019); for Philadelphia: 13, 13, 12 (2017–2019); for Utica: 13, 13, 13 (2017–2019).

Students made large gains on the Math Corps exam between the start and end of camp in all sites and years. Students take an exam at both the start and end of Math Corps. The exams consist of 20 open-ended questions, and the exam score is the percentage of questions answered correctly. In all sites and years, students made statistically significant gains between the pre- and post-program exams. On average, students scored about 38 percent on the pre-program exam and 75 percent on the post-program exam. Across sites and years, the gains ranged from 29 percentage points in Utica in 2019 to 53 percentage points in Philadelphia in 2017. We explored whether the post-program exam scores differed by site when considering students’ pre-program exam scores. We found that Philadelphia’s scores were statistically significantly higher than those in Cleveland and Utica, which were not different from one another. We also conducted analyses within site and year to explore whether having a particular course instructor was associated with higher or lower post-program exam scores (taking into account the pre-program exam scores), and we did not find any statistically significant differences.

Table III.3. Exam scores, by site and year

Year	Cleveland	Philadelphia	Utica	All sites combined
2017				
Pre-Math Corps exam score	38.7 (23.9)	34.1 (27.9)	39.7 (27.4)	37.8 (25.7)
Post-Math Corps exam score	75.0 (21.3)	87.0 (15.6)	73.7 (28.0)	77.5 (22.6)
Difference between pre- and post-program exam scores	36.3*	53.0*	34.0*	39.7*
Number of students with pre- and post-program exam scores	66	32	36	134
2018				
Pre-Math Corps exam score	31.0 (21.7)	40.7 (23.0)	39.0 (29.5)	36.4 (24.8)
Post-Math Corps exam score	70.8 (25.3)	85.1 (20.1)	70.6 (28.4)	75.2 (25.5)
Difference between pre- and post-program exam scores	39.8*	44.4*	31.6*	38.8*
Number of students with pre- and post-program exam scores	65	51	48	164
2019				
Pre-Math Corps exam score	31.9 (23.0)	51.0 (25.1)	43.0 (30.5)	40.8 (27.2)
Post-Math Corps exam score	66.6 (24.9)	82.8 (18.1)	72.2 (27.5)	72.9 (24.9)
Difference between pre- and post-program exam scores	34.7*	31.8*	29.2*	32.1*
Number of students with pre- and post-program exam scores	68	47	56	171
All years combined				
Pre-Math Corps exam score	33.9 (23.0)	42.8 (25.7)	40.8 (29.2)	38.4 (26.0)
Post-Math Corps exam score	70.8 (24.0)	84.8 (18.3)	72.1 (27.7)	75.0 (24.5)
Difference between pre- and post-program exam scores	36.9*	41.9*	31.3*	36.6*
Number of students with pre- and post-program exam scores	199	130	140	469

Source: Wayne State University Math Corps administrative data.

Note: Standard deviations in parentheses. Table includes students who had both a pre- and post-program exam score. Scores are shown as percentages; differences are shown in percentage point units.

*Difference between pre- and post-program exam scores is statistically significant at the 0.05 level.

Discussion

The exam score gains were smaller at the replication sites than at the Detroit Math Corps, where WSU records show pre-program exam scores are consistently around 35 percent correct and post-program exam scores are consistently around 90 percent correct—a 55 percentage point increase (Math Corps 2016). On average, replication sites experienced about a 37 percentage point increase, from an average of 38 percent correct on the pre-program exam and 75 percent correct on the post-program exam. The smaller gains among the replication sites are not surprising because the Detroit Math Corps was established nearly 30 years ago and has benefited from consistent leadership over time, and because students attend camp for six weeks each summer. In contrast, the replication sites were newly developed, had relatively new leaders who were learning the Math Corps curriculum and philosophy, and were serving students for only four or five weeks each summer.

The student gains at the replication sites are significant, even though they are smaller than those at the Detroit Math Corps. The exams contain few multiple-choice questions; students must calculate their own answer for nearly all of the questions. The 7th- and 8th-grade exams are tailored to the grade level; both exams contain numerous questions about fractions, including questions that examine student understanding of fraction magnitudes and operations with fractions, and ability to solve word problems involving fractions. Thus, the gains are potentially a sign of fidelity to the math curriculum and high-quality math instruction during camp.

Example question on 8th-grade Math Corps exam:
A basketball player hit 13 out of 20 shots. What percent of the 20 shots did she hit?

Because instruction was closely aligned with the exam content, student gains were expected. Math instruction during the camp breaks down the concepts tested, and students are quizzed on the concepts each week. A central goal of the camp is to show students that they can master complex math concepts, which reinforces the camp's goal of raising students' expectations of themselves and their self-esteem.

The strong attendance rates also likely contributed to the student achievement gains and could suggest students enjoyed attending camp. As noted, 98 percent of Philadelphia students and 96 percent of Cleveland students attended camp on any given day (Table III.1). These attendance rates are higher than those in the local school districts, where Philadelphia middle schools report an average of 93 percent attendance and Cleveland schools report an average of 91 percent (The School District of Philadelphia 2019; Ohio School Report Cards 2020). At Utica's Math Corps, unlike the other two sites, attendance (88 percent) was lower than the average in the local school district (92 percent) (New York State Education Department 2018).

It is important to consider these differences in attendance within the context of Math Corps attendance policies. Attendance is mandatory at Math Corps and, as noted in earlier in this chapter, students who miss more than three days of camp are supposed to be dismissed. Local middle schools do not dismiss students from school based on poor attendance. Thus, Cleveland and Philadelphia certainly had higher attendance rates among those students who were not dismissed. Utica's Math Corps did not appear to implement the Math Corps attendance and dismissal policy, which likely contributed to its lower attendance compared to Cleveland and Philadelphia. This fact also makes Utica's attendance more comparable to the attendance rates of the local school district.

The strong homework completion rates are a sign that the replication sites adhered to an important part of the Math Corps model, and they likely contributed to the strong achievement gains each site realized. The

homework questions were similar to the post-program exam questions, so by doing their homework daily, students were practicing the math skills and content that were in the quizzes each week and on the post-program exam. This ongoing practice and assessment may have been a mechanism contributing to the gains in exam scores. Our findings show that Utica's attendance rates, homework rates, and exam score gains were lower than those in Cleveland and Philadelphia, which could also suggest that attendance and homework completion are important drivers of the post-program exam scores.

As noted earlier in the chapter, our findings suggest that adherence to the Math Corps model was stronger in Cleveland and Philadelphia than in Utica, which is consistent with informal reports from WSU staff about the three sites. WSU sent Math Corps staff and teachers to Cleveland and Philadelphia to help run the camp and teach classes. In addition, the Detroit Math Corps leadership mentored the leaders in Philadelphia and Cleveland. However, WSU did not send staff to teach at Utica, and Utica's leaders did not have the same mentorship from Detroit that the other two sites experienced. These staff connections likely offered the Cleveland and Philadelphia sites relatively more oversight and support than Utica and may have helped Cleveland and Philadelphia better enforce Math Corps' attendance and homework policies.

Although the sites replicated Math Corps with a decent level of fidelity, they implemented programs at a smaller scale than originally planned. Replication sites' plans varied by the number of students they planned to serve in the first year, but all planned to serve 120 students by the end of the grant. Cleveland planned to support 120 students each year, and the data showed it had about 80 participants each year. Philadelphia planned to grow from 60 students in the first year to 120 by the end of the grant; it served about 40 to 60 students each summer, and the second summer was its largest year (enrollment was lower in 2019). Utica grew from about 40 to 60 students, whereas it planned to grow from 60 students in the first year to 120 students by the end of the grant. Based on conversations with WSU staff, it is possible the replication sites needed to do more to build the awareness of and demand for Math Corps in the new locations.

In addition to not meeting their original enrollment goals, none of the sites extended camp as planned. All three replication sites planned to offer Math Corps for four weeks in the first year. Philadelphia planned to increase to five weeks by the end of the grant, and Cleveland and Utica planned to increase to six weeks. The data show Cleveland increased its camp length to five weeks by 2019, but neither Philadelphia nor Utica increased from four weeks. There are many potential reasons for the lack of increase, including limited financial and staffing resources to support a longer camp, lack of perceived student interest in a longer-duration camp, and staff prioritizing improved camp quality and implementation over increased length.

Limitations

It is important to note a few limitations of this analysis. First, the prospective analysis is based on administrative data collected by the Math Corps sites, which only include homework and attendance as measures of implementation. These data limit the extent to which the study can examine implementation or explain why students experienced gains in post-program exam scores. Second, the study did not examine the costs or resources needed to replicate Math Corps in new locations or sustain implementation over time, and thus it cannot compare program costs and benefits.

Conclusion and recommendations

The findings of this prospective analysis suggest the three replication sites were largely successful in implementing the Math Corps summer camp. They also show some variation in implementation and outcomes across the three sites.

The well-defined curriculum and philosophy of Math Corps and the support WSU provided to the three replication sites likely facilitated implementation in the new locations. This is promising because the retrospective analysis found that Detroit's Math Corps had a large and statistically significant positive impact on college enrollment: middle school students who attended Math Corps were 11 percentage points more likely than comparison students to enroll in college within four years of high school graduation (Fox and Harris 2020). The fact that a middle school summer camp can impact college enrollment is remarkable, particularly when considering the context in which Math Corps is implemented. Detroit's Math Corps serves disadvantaged students from inner-city Detroit who typically attend schools with lower-than-average high school graduation rates.

In a city where the dreams of children are so often unfulfilled, the Math Corps has from the beginning, been about making a difference and changing lives.
—From the Math Corps website,
www.mathcorps.org

The potential to replicate a program that has positive impacts on college enrollment is exciting. Taken together, the findings from the prospective and retrospective analyses suggest a few considerations for future Math Corps work:

- **Strengthen data collection by Math Corps.** Math Corps could take several steps to enhance its data collection and ability to analyze program outcomes. For example, Math Corps could distribute a permission form to the parents of all applicants, requesting permission to collect school records. This would facilitate data collection from local districts or the state on applicant and participant outcomes, such as high school graduation. Similarly, by collecting school records, Math Corps could avoid relying on student self-reports of grades or grade point averages. It would also benefit from continuing its efforts to improve data collection so that data are available for analyses close to real time, which could facilitate formative feedback to Math Corps sites and support timely outcome analyses.
- **Examine additional term outcomes.** This prospective analysis examined student achievement outcomes during Math Corps by examining scores on the Math Corps exams at program end. The retrospective analysis examined long-term outcomes including college enrollment, college graduation, and adult criminal activity. Other outcomes would be useful in determining how achievement gains on the Math Corps exam relate to student achievement in schools and other outcomes. Future research should examine other outcomes that Math Corps seeks to effect, such as student mindsets, attitudes, and beliefs about math and themselves; grades; math course completion; behavior or disciplinary actions during school; and long-term outcomes such as high school graduation, military enlistments, and job obtainment, wages, and job retention.
- **Connect qualitative implementation data with outcome data.** This analysis and the prior retrospective analysis were entirely based on administrative data, which provided limited insights into Math Corps implementation. Separately from this study, Math Corps has engaged other researchers in analyses that look at Math Corps implementation. Future analyses of Math Corps would benefit from

combining implementation analyses with outcome analyses. Combining such analyses might explain why student outcomes were attained, something this study was not able to do.

- **Draw on implementation science to inform future replication and scale-up efforts.** A growing body of research has emerged on the conditions that programs and organizations must meet to be ready to scale up (Bradach and Grindle 2014; Coburn 2003; Fixsen et al. 2013; Levin 2013; Maxwell and Richman 2019; Sutton 2014). The research points to the importance of program readiness—that is, guidance, materials, tools, training, and other supports to facilitate scale-up. In addition, the readiness of organizations within which a program is implemented is equally important, such as leadership, culture, and infrastructure to support implementation. More systematic attention to the implementation and scale-up factors identified in research will facilitate ongoing scale-up at the replication sites and could help future sites that wish to implement Math Corps.

Math Corps is an inspiring program that serves students from minority and disadvantaged backgrounds with the goal of improving their life trajectory. The retrospective analysis showed that Math Corps increases student enrollment in college. This prospective analysis shows that Math Corps can be reasonably replicated in new sites in a relatively short period of time (within three years). Taken together, these are promising findings. Other communities seeking a math-focused program that supports the emotional needs of middle school students and improves their outcomes may find that Math Corps is the right fit.

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Appendix

The tables in this appendix provide more detailed data on each of the replication sites.

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Table A.1. Percentage of records with non-missing data for each data element, by site

Data element	Cleveland	Philadelphia	Utica	All sites combined
Gender	100.0	100.0	98.7	99.6
Race	98.4	100.0	98.7	98.9
Grade	100.0	100.0	100.0	100.0
Poverty	97.9	98.6	96.1	97.6
Previous Math Corps participant ^a	100.0	100.0	100.0	100.0
Prior school type	98.8	100.0	98.1	98.9
Prior grade point average	93.4	54.9	82.6	80.1
Prior English grade	95.5	31.9	82.6	74.9
Prior math grade	97.5	58.3	87.7	84.3
Prior science grade	95.1	31.9	82.6	74.7
Complete attendance record	98.8	100.0	100.0	99.4
Complete homework record	99.6	99.3	100.0	99.6
Pre-Math Corps exam score	100.0	100.0	97.4	99.3
Post-Math Corps exam score	81.9	90.3	92.3	87.1
Sample size	243	144	155	542

Source: Wayne State University Math Corps administrative data.

Note: A student is missing data for poverty if we were unable to geocode his or her address. A student has a complete attendance record if we know whether the student was absent, dismissed, present, suspended, or withdrawn for every day of camp. A student has a complete homework record if we know whether or not the student completed the homework for every assignment.

^a Only applicable for participants in grade 8 or 9.

Table A.2. Characteristics of Math Corps participants in 2017, by site

Characteristic	Cleveland	Philadelphia	Utica	All sites combined
Gender				
Female	46.8	60.5	60.5	53.5
Male	53.2	39.5	39.5	46.5
Race and ethnicity				
Asian	0.0	7.9	13.2	5.2
Black	88.3	78.9	50.0	76.5
Hispanic	6.5	13.2	23.7	12.4
Native American	1.3	2.6	0.0	1.3
White	3.9	5.3	23.7	9.2
Other	3.9	2.6	0.0	2.6
Prior participation				
Previous Math Corps participant ^a	53.8	–	–	53.8
Prior school				
Prior school was public	51.9	47.4	92.1	60.6
Prior school was charter	36.7	52.6	7.9	33.5
Prior school was other ^b	11.4	0.0	0.0	5.8
Prior achievement				
Prior grade point average	3.2	3.1	2.3	3.0
Prior English grade	2.8	–	2.3	2.6
Prior math grade	2.8	3.1	1.9	2.6
Prior science grade	3.0	–	2.6	2.9
Measures of neighborhood poverty				
Median household income	\$49,699	\$34,782	\$32,206	\$41,815
Poverty rate	26.6	34.0	34.8	30.4
Under-18 poverty rate	36.4	43.1	46.7	40.6
Social Deprivation Index (range: 1–100)	66.9	88.0	88.3	77.3
Sample size	79	38	38	155

Source: Wayne State University Math Corps administrative data. Median household income, poverty rate, and under-18 poverty rate are American Community Survey five-year estimates, 2014–2018, tables S1701 and S1903. Social Deprivation Index is a composite index from the Robert Graham Center (2015).

Note: All numbers are percentages unless otherwise noted. Race categories are not mutually exclusive, so they do not add up to 100 percent. Letter grades were converted into a numeric scale as follows: 4.0 = A, A+; 3.7 = A-; 3.4 = B+; 3.0 = B; 2.7 = B-; 2.4 = C+; 2.0 = C; 1.7 = C-; 1.4 = D+; 1.0 = D; 0.7 = D-; and 0.0 = F. A dash (–) indicates that no data were available for the calculation. The Social Deprivation Index measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

^a Only applicable for participants in grade 8 or 9.

^b Other types of schools include home schools, private schools, and parochial schools.

Table A.3. Characteristics of Math Corps participants in 2018, by site

Characteristic	Cleveland	Philadelphia	Utica	All sites combined
Gender				
Female	51.9	44.8	57.1	51.3
Male	48.1	55.2	42.9	48.7
Race and ethnicity				
Asian	0.0	6.9	28.6	10.4
Black	89.9	79.3	42.9	73.1
Hispanic	5.1	12.1	23.2	12.4
Native American	1.3	1.7	0.0	1.0
White	2.5	3.4	23.2	8.8
Other	6.3	3.4	5.4	5.2
Prior participation				
Previous Math Corps participant ^a	53.7	91.7	63.6	66.3
Prior School				
Prior school was public	46.8	50.0	89.3	60.1
Prior school was charter	45.6	50.0	8.9	36.3
Prior school was other ^b	7.6	0.0	1.8	3.6
Prior achievement				
Prior grade point average	3.0	–	3.2	3.1
Prior English grade	2.7	–	2.9	2.7
Prior math grade	2.8	–	2.8	2.8
Prior science grade	2.8	–	3.0	2.9
Measures of neighborhood poverty				
Median household income	\$42,308	\$39,288	\$33,282	\$38,850
Poverty rate	29.9	30.7	33.1	31.1
Under-18 poverty rate	38.6	37.5	43.8	39.7
Social Deprivation Index (range: 1–100)	74.1	84.6	84.6	80.3
Sample size	79	58	58	195

Source: Wayne State University Math Corps administrative data. Median household income, poverty rate, and under-18 poverty rate are American Community Survey five-year estimates, 2014–2018, tables S1701 and S1903. Social Deprivation Index is a composite index from the Robert Graham Center (2015).

Note: All numbers are percentages unless otherwise noted. Race categories are not mutually exclusive, so they do not add up to 100 percent. Letter grades were converted into a numeric scale as follows: 4.0 = A, A+; 3.7 = A-; 3.4 = B+; 3.0 = B; 2.7 = B-; 2.4 = C+; 2.0 = C; 1.7 = C-; 1.4 = D+; 1.0 = D; 0.7 = D-; and 0.0 = F. A dash (–) indicates that no data were available for the calculation. The Social Deprivation Index measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

^a Only applicable for participants in grade 8 or 9.

^b Other types of schools include home schools, private schools, and parochial schools.

Table A.4. Characteristics of Math Corps participants in 2019, by site

Characteristic	Cleveland	Philadelphia	Utica	All sites combined
Gender				
Female	57.6	45.8	66.1	57.3
Male	42.4	54.2	33.9	42.7
Race and Ethnicity				
Asian	1.2	20.8	32.2	15.8
Black	85.5	66.7	28.8	63.2
Hispanic	3.6	10.4	27.1	12.6
Native American	0.0	0.0	0.0	0.0
White	7.2	2.1	22.0	10.5
Other	6.0	4.2	8.5	6.3
Prior participation				
Previous Math Corps participant ^a	64.2	68.8	65.9	66.2
Prior School				
Prior school was public	56.1	43.8	75.9	59.0
Prior school was charter	42.7	54.2	20.7	38.8
Prior school was other ^b	1.2	2.1	3.4	2.1
Prior achievement				
Prior grade point average	3.1	3.4	3.3	3.2
Prior English grade	2.8	3.2	2.8	2.9
Prior math grade	2.8	3.3	3.1	3.0
Prior science grade	2.9	3.5	3.0	3.1
Measures of neighborhood poverty				
Median household income	\$55,613	\$44,421	\$36,505	\$46,784
Poverty rate	23.4	25.9	30.9	26.4
Under-18 poverty rate	29.3	30.8	41.5	33.6
Social Deprivation Index (range: 1–100)	60.4	80.1	82.9	72.4
Sample size	85	48	59	192

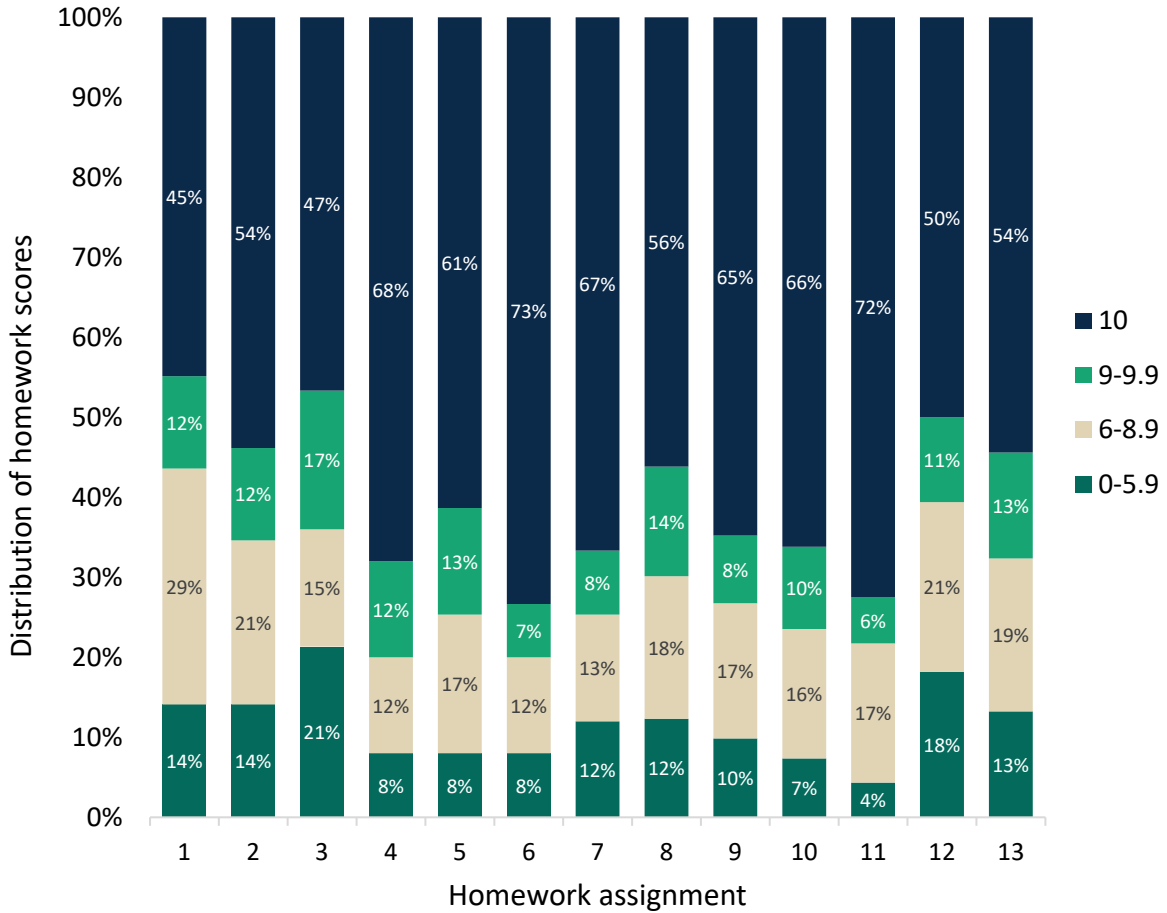
Source: Wayne State University Math Corps administrative data. Median household income, poverty rate, and under-18 poverty rate are American Community Survey five-year estimates, 2014–2018, tables S1701 and S1903. Social Deprivation Index is a composite index from the Robert Graham Center (2015).

Note: Race categories are not mutually exclusive, so they do not add up to 100 percent. Letter grades were converted into a numeric scale as follows: 4.0 = A, A+; 3.7 = A-; 3.4 = B+; 3.0 = B; 2.7 = B-; 2.4 = C+; 2.0 = C; 1.7 = C-; 1.4 = D+; 1.0 = D; 0.7 = D-; and 0.0 = F. The Social Deprivation Index measures socioeconomic variation that contributes to health-related outcomes based on demographic estimates from the American Community Survey. A higher score indicates greater social deprivation.

^a Only applicable for participants in grade 8 or 9.

^b Other types of schools include home schools, private schools, and parochial schools.

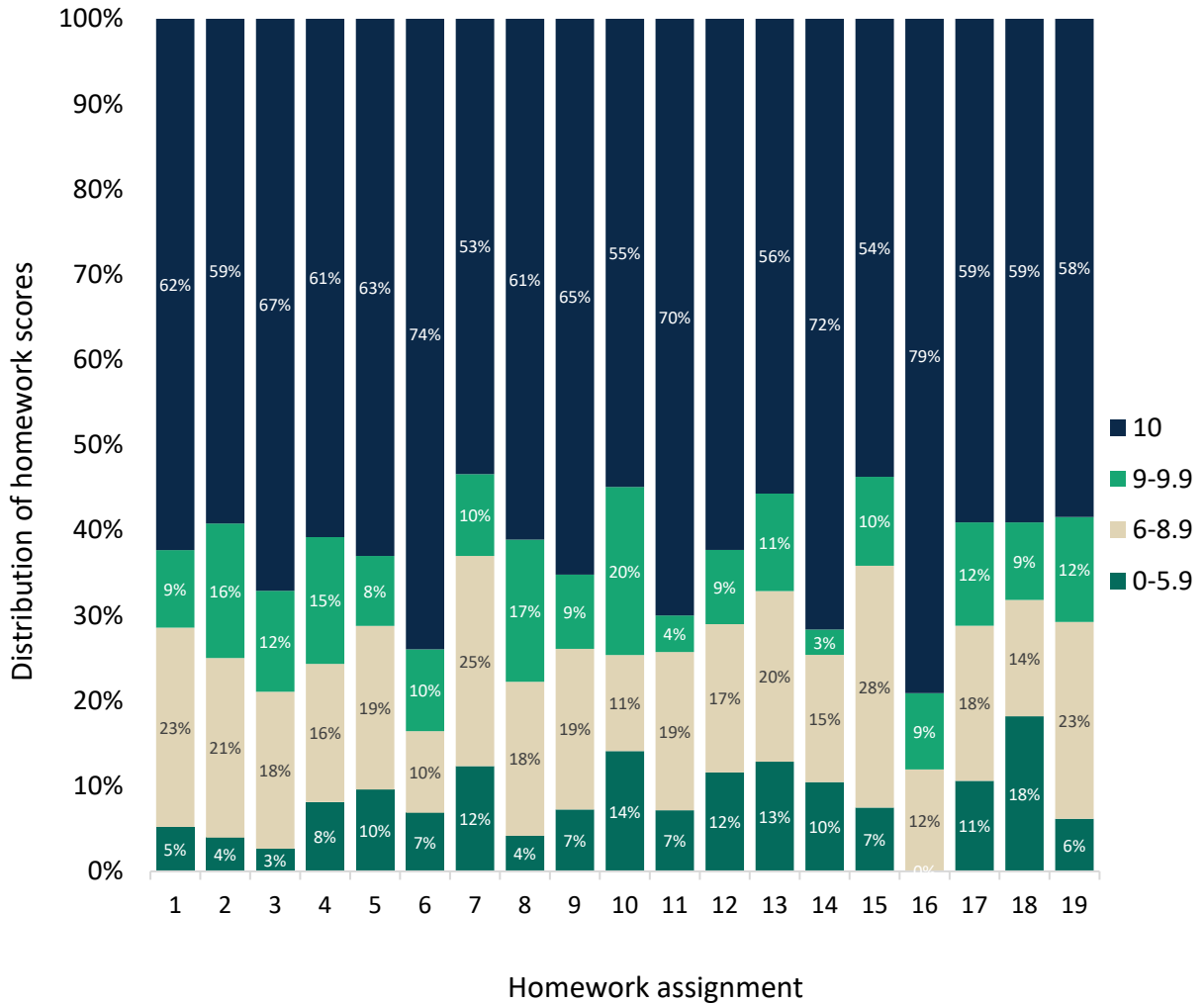
Figure A.1. Homework scores in Cleveland, 2017



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 79.

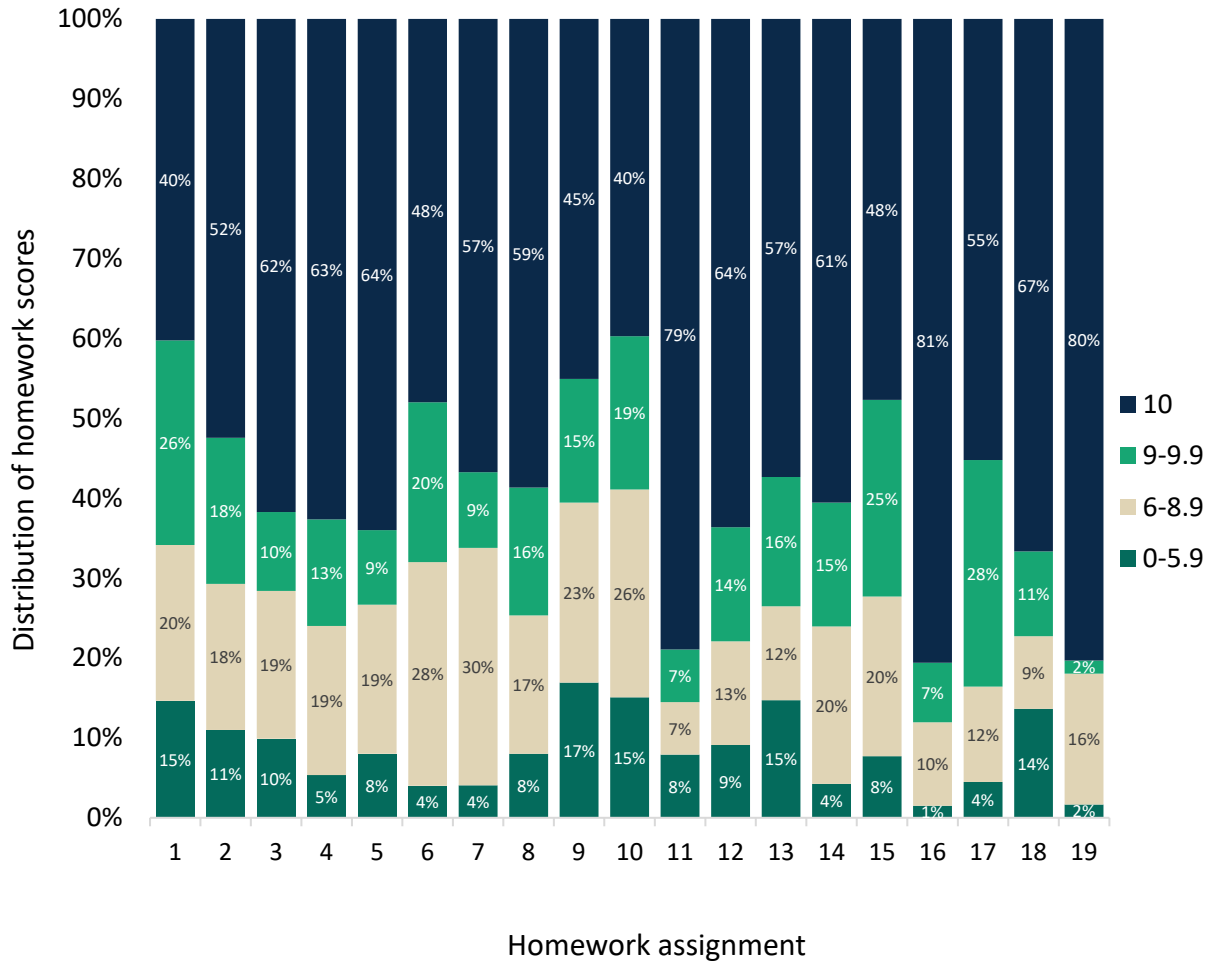
Figure A.2. Homework scores in Cleveland, 2018



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 79.

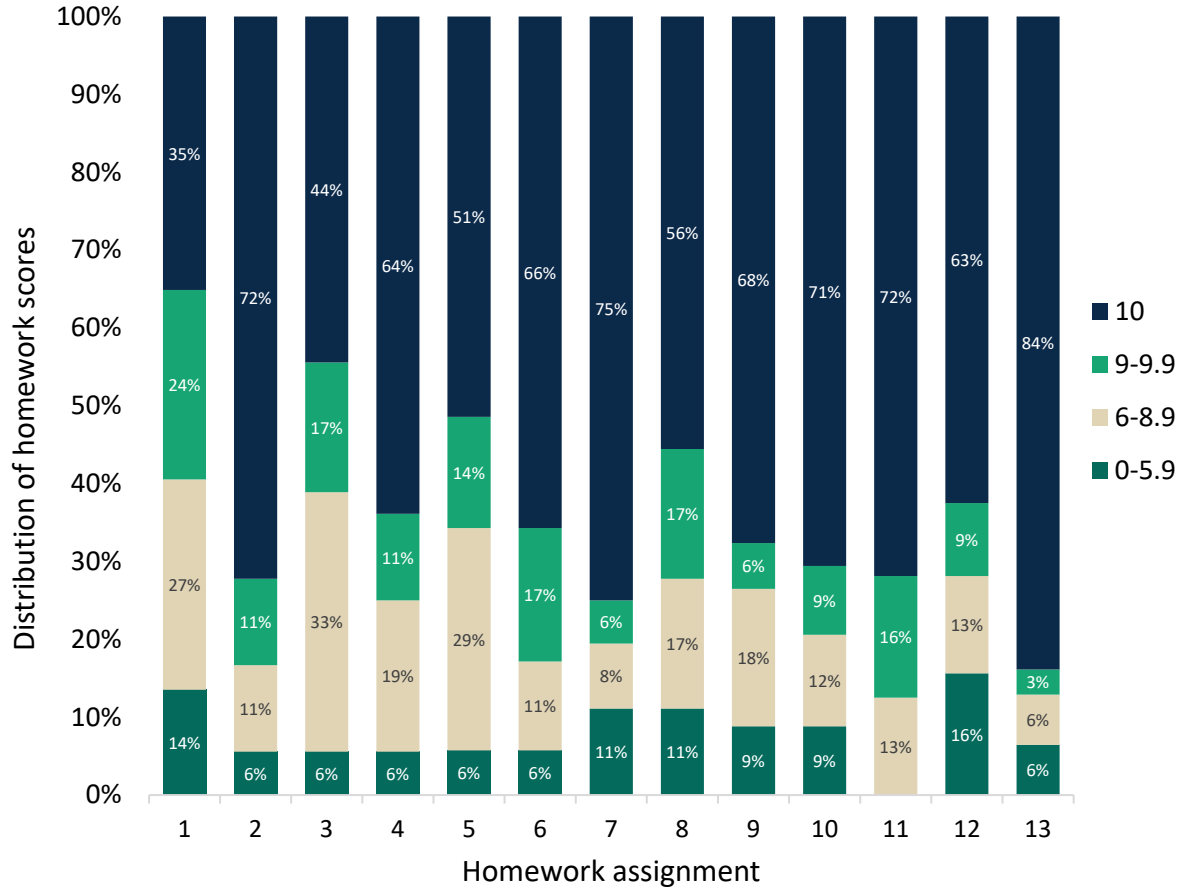
Figure A.3. Homework scores in Cleveland, 2019



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 85.

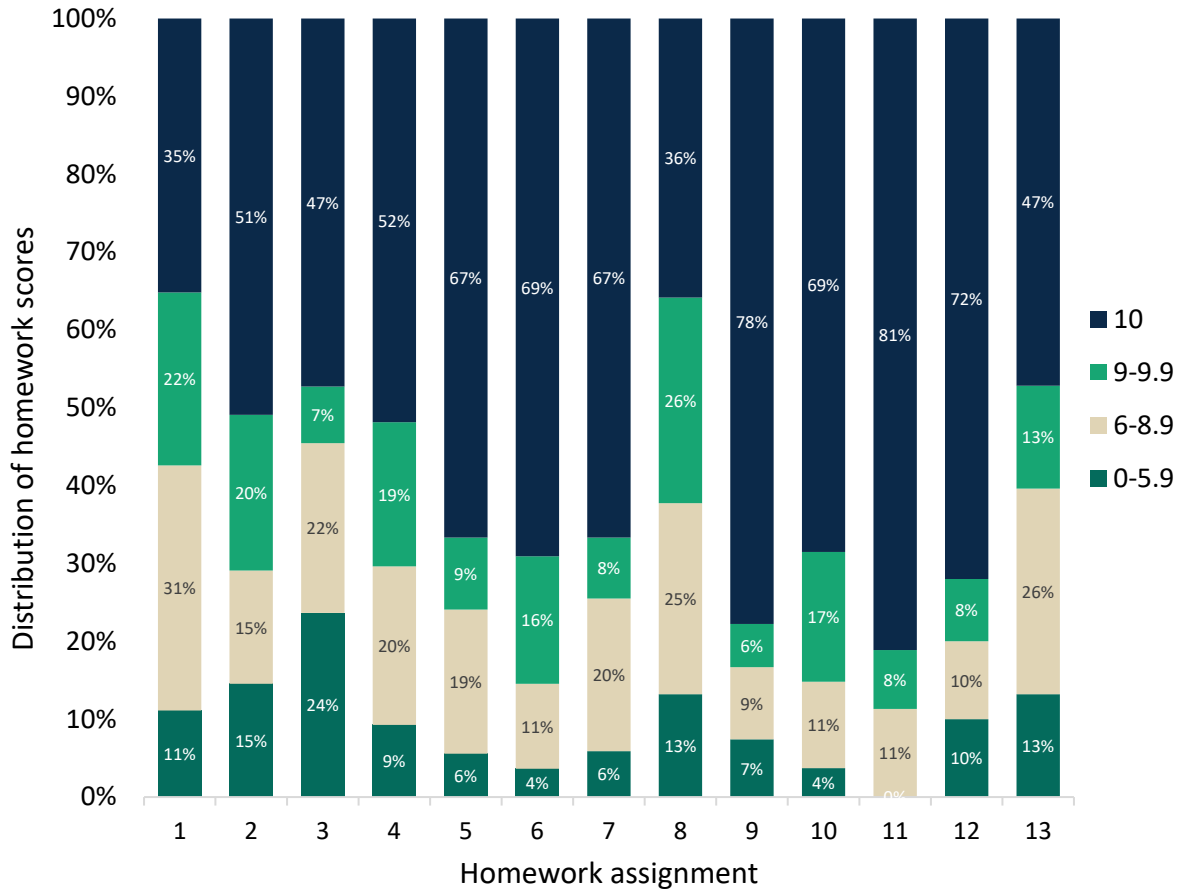
Figure A.4. Homework scores in Philadelphia, 2017



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 38.

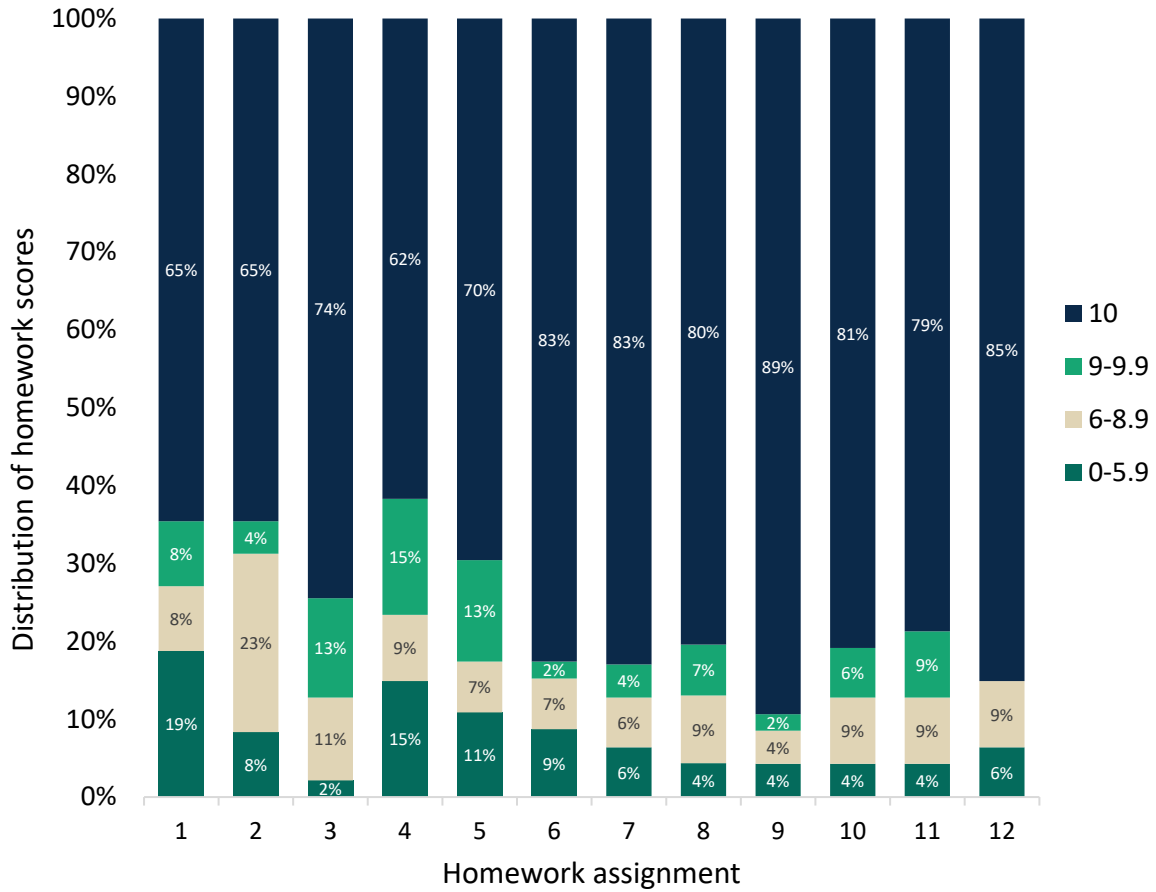
Figure A.5. Homework scores in Philadelphia, 2018



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 58.

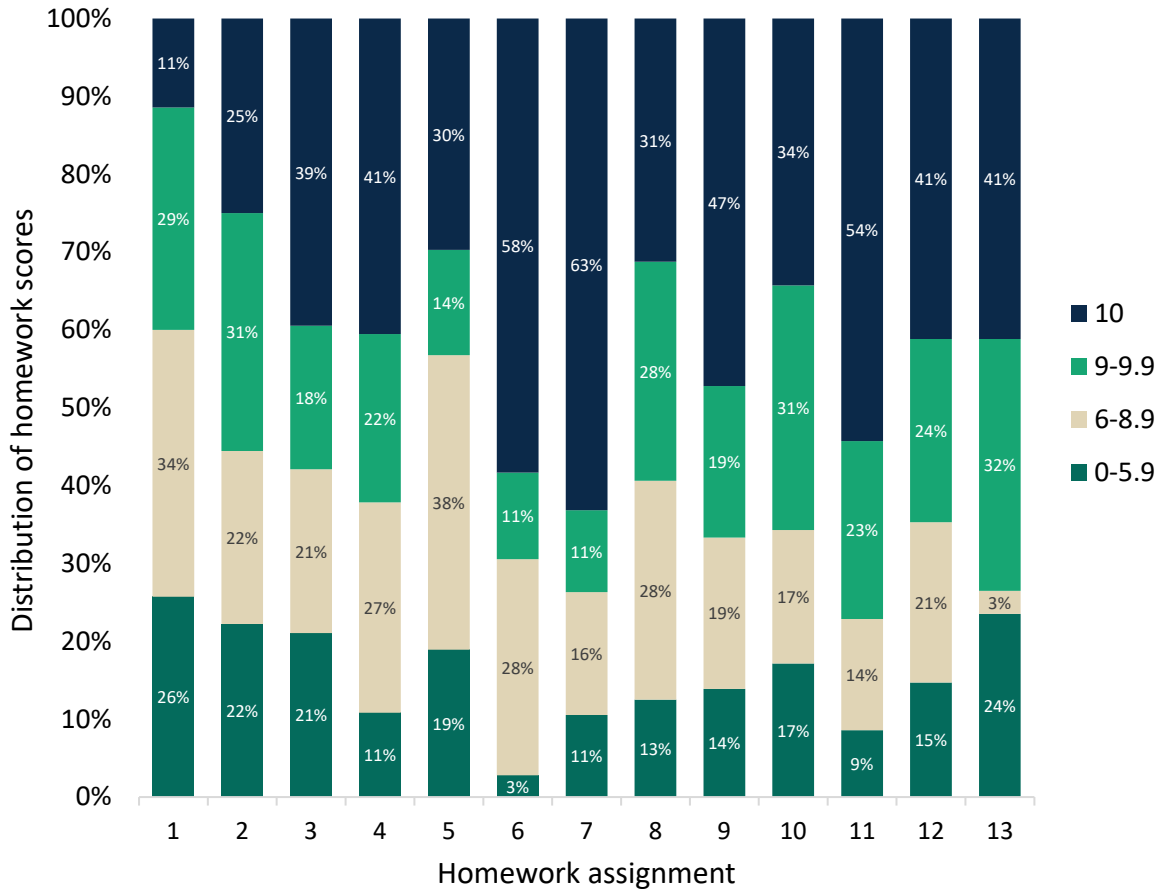
Figure A.6. Homework scores in Philadelphia, 2019



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 48.

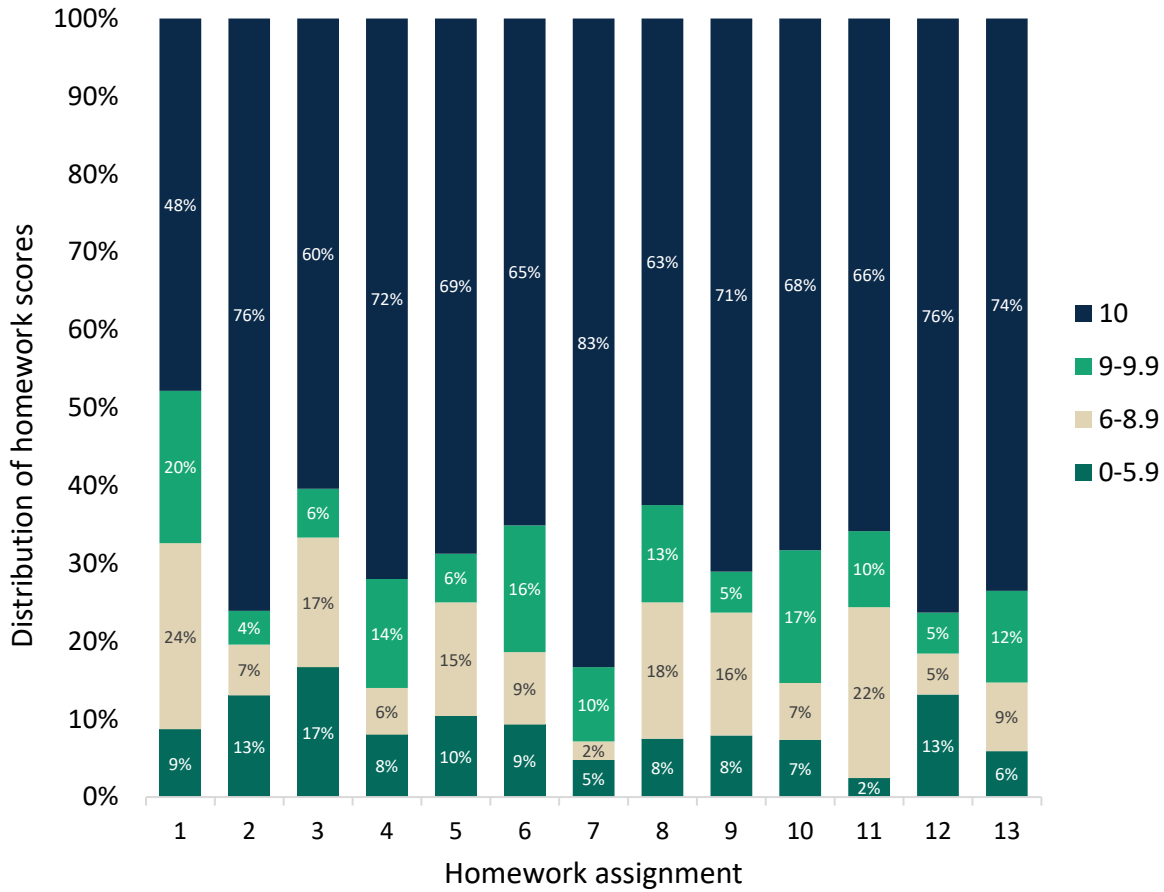
Figure A.7. Homework scores in Utica, 2017



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 38.

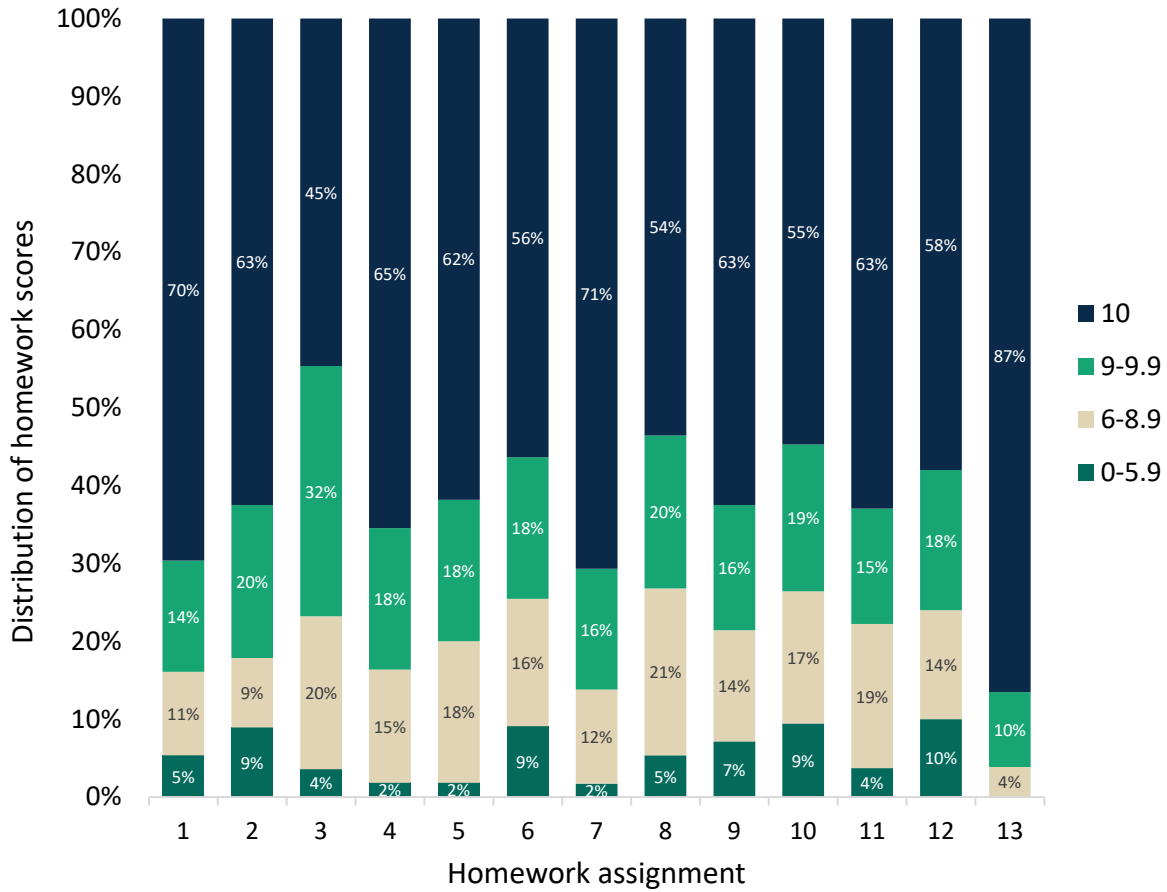
Figure A.8. Homework scores in Utica, 2018



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 58.

Figure A.9. Homework scores in Utica, 2019



Source: Wayne State University Math Corps administrative data.

Note: The sample size for the homework score on any given day is the number of students who were not dismissed or withdrawn on that day and who turned in the homework. The sample size for the number of students who ever received a homework assignment (the upper bound for this figure) is 59.

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