

RESEARCH REPORT APRIL 2023

Exploring Chicago Connected Participation Patterns

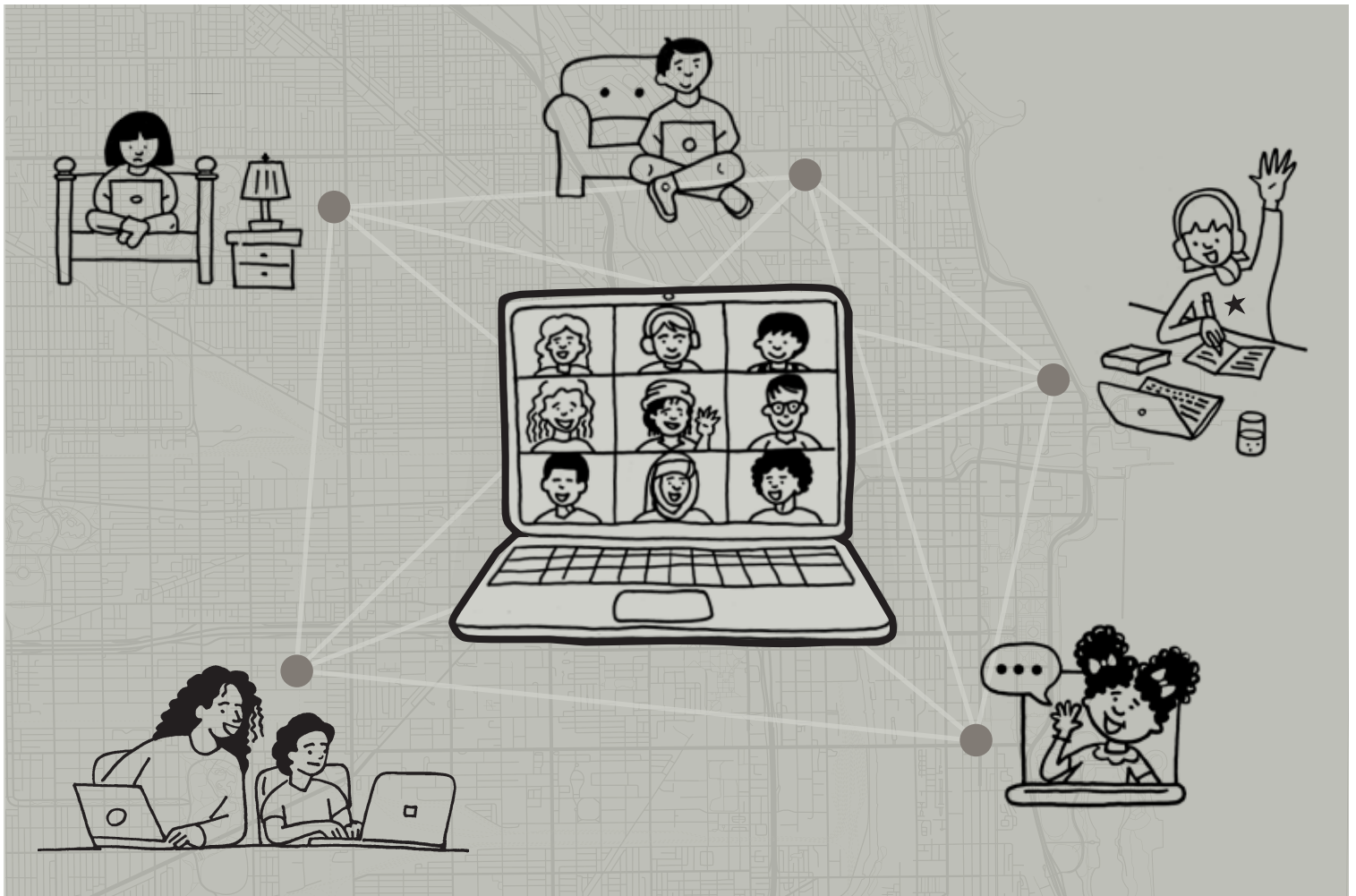


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Introduction

Internet access is increasingly considered a necessity, not a luxury, as it facilitates reading news, banking, paying taxes, learning, applying for jobs, and much more. It became evident during the COVID-19 pandemic that having internet access was vital, especially for children whose main way to continue their education was through online school. In fact, 93% of parents nationwide with K-12 children reported their children had online instruction during the pandemic.¹ But not every family has convenient and reliable internet access, particularly families with lower incomes. For example, 24% of families with middle incomes said their children had to do schoolwork on a cellphone, while 37% of families with lower incomes reported using cellphones. Some families reported having to rely on public wi-fi because there was no reliable connection at home: 11% of families with middle incomes and 23% of families with lower incomes.²

In the city of Chicago, 1 in 5 children under the age of 18 did not have access to in-home internet prior to the start of the pandemic and that number was higher in Black and Latinx neighborhoods (e.g., nearly one-half of children under 18 in West Englewood), based on the 2014–18 American Community Survey five-year estimates.³ During the first few months of the pandemic, Chicago Public Schools (CPS) reported that 7% of its students in district-run schools had not accessed Google Classroom or Google Meet since the start of the remote learning.⁴ These students were not able to participate in online learning, and presumably many others struggled with unreliable internet or inconvenient ways of accessing it.

Recognizing that not having reliable internet access was a barrier to remote learning, the City of Chicago,

CPS, Kids First Chicago, philanthropic partners, community-based organizations, and internet service providers came together to launch Chicago Connected in June of 2020. The goal of the program was to address these inequities by providing free internet service for four years to CPS students who were eligible, aiming to serve 100,000 students either through wired broadband or hotspots. Since then, the program expanded to graduating CPS twelfth-graders who attended City Colleges of Chicago in the fall of 2021,⁵ and in August of 2022 it was announced that all students enrolled in City Colleges of Chicago who were eligible would have access to Chicago Connected and could receive internet services for up to three years while enrolled in City Colleges.⁶

It is important to understand whether Chicago Connected helped bridge the gap of the digital divide among CPS students who did and did not have reliable internet access. This study asks:

- To what extent did students eligible for Chicago Connected participate in the program?
- What were the background characteristics of students who participated in Chicago Connected?
- Did participation in Chicago Connected differ across schools? Were characteristics of schools related to these differences?

Findings from this study can help better understand the need for internet access for CPS students and where future efforts to offer free internet should be focused, to address inequities in this area. Ultimately, lessons from Chicago Connected can help guide other similar programs across the nation.

¹ McClain, Vogels, Perrin, Sechopoulos, & Rainie (2021).

² McClain et al. (2021).

³ Kids First Chicago & Metropolitan Planning Council (2020).

⁴ Chicago Public Schools (2020b).

⁵ City of Chicago (2021).

⁶ City of Chicago (2022).

Chicago Connected: An Overview

Chicago Connected is an initiative co-created by the City of Chicago, CPS, Kids First Chicago, philanthropic partners, community-based organizations, and internet service providers. It was announced in June 2020 with the intent to serve families in time for the 2020–21 school year—the first full school year of the COVID-19 pandemic, which began with remote learning for nearly all students. The stated goal was to provide free internet service, for four years, to eligible families with students in CPS (aiming to reach around 100,000 students).

Types of internet access

- Comcast and RCN were providers when the address was wired for service. They provided a wired connection along with the standard modem/router setup.
- T-Mobile provided hotspots in other cases (addresses not wired for internet service, students living in temporary situations, and households with several digital learners that had bandwidth issues).

Student eligibility

- Students were eligible to participate in Chicago Connected based on three categories:
 - **Economic factors**, such as free and reduced-price lunch status, Medicaid qualifications, living in temporary situations, and community area hardship. This reflects the notion that the cost of internet was likely a challenge for these families.
 - **Programmatic factors**, such as being a diverse learner or English Learner. This reflects the fact that CPS found that students with identified disabilities and English Learners were less likely to be engaged with online learning in the 2020 spring.⁷

- **Current internet service**: Families already subscribing to higher-speed internet than what was offered via Chicago Connected were not eligible (initially, internet service speeds were up to 25 Mbps download and 3 Mbps upload through Chicago Connected). Families with similar internet connections to those offered by Chicago Connected were eligible to enroll.
- Eligibility was based on an index score that ranged from 0-9 combining all factors described above,⁸ and students most in need, those who met the most priority indicators were prioritized:
 - Initially, students with an index of 6 or higher were eligible; by August 2020, the criteria expanded to include students with an index of 4 or higher.
 - By November/December 2020, eligibility was expanded to include all students who qualified for free and reduced-price lunch status or Medicaid.⁹

Family outreach

- Thirty-five community-based organizations during the first year supported family outreach and were responsible for facilitating program sign-ups, increasing digital literacy and skills development training, and connecting families with other critical resources.¹⁰ Schools also played a role in disseminating the information and facilitating sign-ups for Chicago Connected.

⁷ Chicago Public Schools (2020b).

⁸ The eligibility index was comprised of 9 possible points: free lunch eligibility was worth 2 points or reduced-price lunch eligibility 1; enrolled in Medicaid was worth 2 points; living in temporary situation 1 point; living in a community in the top one-third of communities based on the community hardship

index was 2 points, or 1 if in the middle one-third; diverse learner 1 point and English Learner 1 point.

⁹ Chicago Public Schools (2020a).

¹⁰ For more details on community partners and their roles, see Digital Bridge K-12 (2020).

Study Details

The study is based on 242,471 students in grades pre-k–12 who were enrolled in a CPS school for 10 days or more in the 2020–21 school year, who were eligible for the Chicago Connected program during that year, and for whom data was available on which community area they resided.¹¹ Students were eligible based on the criteria described earlier, and excluded students in households subscribed to higher-speed internet services.

Of the almost 350,000 pre-k–12 CPS students, 70% of them were eligible at some point during the first year of the program. Given the eligibility index components, nearly all Chicago Connected eligible students qualified for free or reduced-price lunch. Eligible students were also somewhat more likely to be English Learners, have identified disabilities, live in temporary living situations, and live in neighborhoods with a higher hardship index value than the CPS population overall.¹² In addition,

eligible students were more likely to come from households with more CPS students and be Latinx or Black as shown in **Table 1 on p.4**.

To answer the research questions, we use descriptive statistics and multilevel models that take into account the nested structure of the data (students within schools and community areas). Multilevel models that take into account different indicators also allow us to examine whether the relationship of an indicator with participation in the program was statistically significant and could not be explained by any other factors studied here. We report raw participation rates (descriptive statistics) for the findings and figures in this brief. The results of multilevel models are discussed in the text if they provide different conclusions than the simple comparisons of raw participation rates (see **Appendix** for a description of the multilevel models)

Identifying which students participated in Chicago Connected

Families with multiple CPS students did not have to redeem an offer for each eligible student; all students in a home had internet access after an offer redemption. Families could redeem the Chicago Connected offer based on any eligible CPS student in the household. To ensure we identified all students who accessed the internet through Chicago Connected, we determined which CPS students were in the same household in addition to the student whose credentials were used for the application to Chicago Connected.

By May 2021, 39,643 offers were redeemed and we accounted for 77,324 students having access to an internet connection through Chicago Connected.^A Some of these students were not part of our analytical sample because they were not enrolled in CPS for 10 days or more, or were not identified as eligible students (fewer than 5% were not eligible); they were likely in a household with an eligible student and shared the internet access provided by Chicago Connected.

A More than 100,000 CPS students were reported as participating in the Chicago Connected program by the end of the second year of the program (City of Chicago, 2022).

11 There were 2,765 students who were eligible for Chicago Connected and enrolled in CPS for 10 days or more who were not included in the study because information was not available on which community area they resided.

12 The neighborhood hardship index score is calculated by the Great Cities Institute at University of Illinois at Chicago (Great Cities Institute, 2019). It is an average of six variables from the American Community Survey that have been

standardized on a scale from 0 to 100. Higher hardship index scores indicate harder economic conditions. The six variables include: Unemployment (over the age of 16 years), education (over 25 years of age without a high school diploma), per capita income level, poverty (below the federal poverty level), crowded housing (housing units with more than one person per room), and dependency (population under 18 or over 64 years of age).

TABLE 1**Student characteristics among students eligible for Chicago Connected included in the analyses and all CPS students**

	Eligible students included in the study	All CPS students
Number of students	242,471	348,248
Characteristics included in eligibility index		
Free or reduced-price lunch	93%	78%
Medicaid Qualifications	82%	N.A.
Living in temporary situation	5%	4%
Individualized Education Plan (IEP)	17%	16%
English Learner	22%	19%
Community area hardship index value	50	47
Household information		
Students in a household with:		
- no other SY 2021 CPS student	35%	36%
- with 1 other SY 2021 CPS student	31%	33%
- with 2 other SY 2021 CPS students	18%	17%
- with 3 or more SY 2021 CPS students	16%	14%
Race/ethnicity student characteristics		
Latinx	50%	41%
Black	41%	36%
White	4%	11%
Asian	3%	5%

Note: Race/ethnicity categories are shown for groups that represented at least 1% of the 2020–21 CPS student population, based on administrative records. Race/ethnicity categories not shown due to small group sizes include: Native American/Alaskan Native, multiracial, and students whose race/ethnicity was not available. Our Asian category combines three CPS data categories—Asian, Pacific Islander/Hawaiian, and Asian/Pacific Islander categories—due to the small number of students in the latter two categories. N.A. identifies data that is not available to the UChicago Consortium for students CPS-wide.

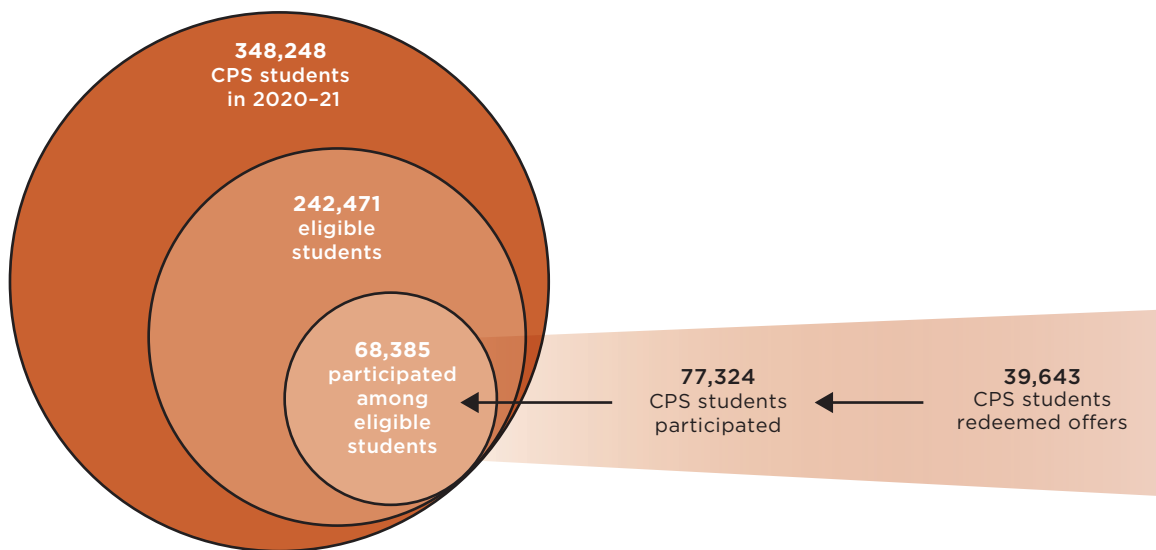
Key Findings

1. To what extent did Chicago Connected eligible students participate in the program?

Twenty-eight percent of eligible CPS students in our sample participated in the program by May 2021, 68,385 of 242,471 eligible students (see Figure 1). As mentioned previously, the estimated need for internet access among children in Chicago prior to the pandemic

was roughly 20%.¹³ When participation is calculated among all CPS students, close to 20% were served by Chicago Connected, a very similar number to the estimated need.

FIGURE 1
Path to participation in Chicago Connected: June 2020–May 2021



Note: Not all students who participated in Chicago Connected are part of the analysis in the report because some were not enrolled in CPS for 10 days or more and some were not identified as eligible students. Students who weren't eligible could be in a household with an eligible student and therefore had access to an internet connection through Chicago Connected when an offer was redeemed using the credentials of the eligible student; this is why the figure identifies 77,324 students who participated vs. 68,385 students who participated and were eligible.

¹³ Kids First Chicago & Metropolitan Planning Council (2020).

2. What were the background characteristics of students who participated in Chicago Connected?

Participation rates were higher for students with higher eligibility index scores, which reflects the priority of the Chicago Connected program. As shown in **Figure 2**, 36% of students with an index of 6 or higher participated in 2020–21, vs. 23% if the eligibility index was 4 or 5, and 12% among eligible students with an index of less than 3.

At the same time, many CPS students with similar index scores as their peers did not sign up. While some may have had prior internet access (with similar or lower-speed internet given that they were eligible for Chicago Connected) or had other means to connect, others may not have gotten connected despite need.

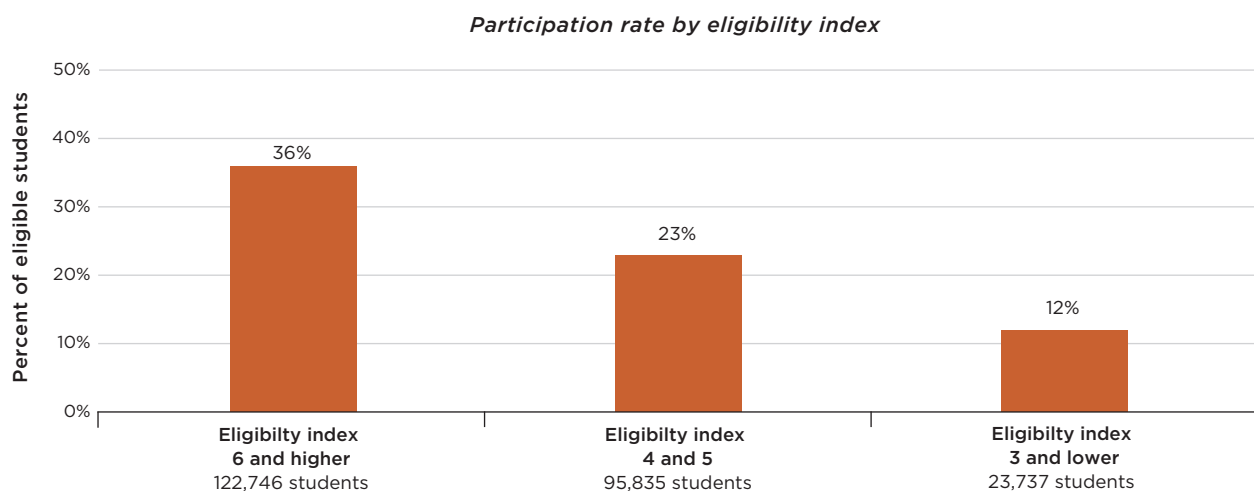
Participation rates were higher for students in households with lower economic means, suggesting that lack of access to quality internet service was due to limited financial means in many cases.¹⁴ As **Figure 3** shows, the participation rate among students living in temporary situations was double that of students not living in temporary situations (57% vs. 27%). Participation rates for students eligible for free or reduced-price lunch status were nearly double the rates of students who were not

eligible (29% vs. 15%), participation rates for students qualifying for Medicaid were 1.5 times higher than students who did not qualify (30% vs. 19%), and students living in community areas with high hardship index values were 1.5 times higher than students living in community areas with low hardship index value (32% vs. 21%).

Yet even among students with indicators that might suggest clear economic needs, large shares of students did not enroll (43% of students in temporary living situations; 71% of students eligible for free or reduced-price lunch; 70% of students qualifying for Medicaid; 68% of students in community areas with high economic needs).

English Learners and students with disabilities were more likely to participate in Chicago Connected—but differences in participation rates for students with disabilities was not statistically significant in our multilevel models. **Figure 4** shows that 36% of students identified as English Learners participated in the program compared to 26% of students who were not English Learners. Participation rates were slightly higher for students with an identified disability, compared to

FIGURE 2
Students with higher eligibility index scores were more likely to participate

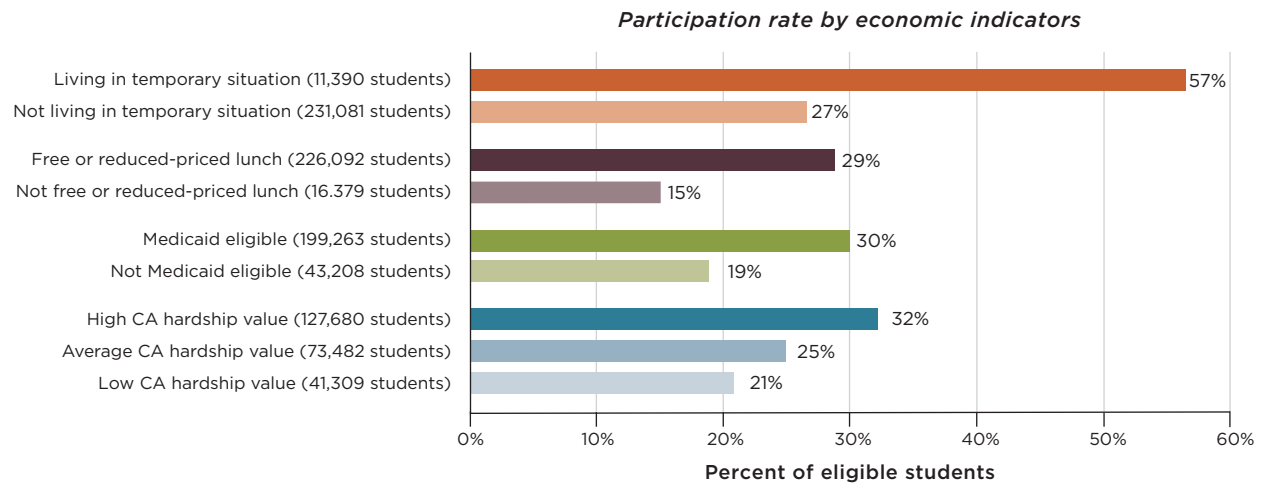


Note: Participation rates shown in the graph are the raw rates (descriptive statistics) among eligible students with an eligibility index score; no data on the eligibility index was available for 153 students (0.06% of the sample). Eligibility index was still related, with statistical significance, to the likelihood of participating in Chicago Connected, even when taking into account other student, neighborhood, and school characteristics. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors.

¹⁴ Perrin (2021).

FIGURE 3

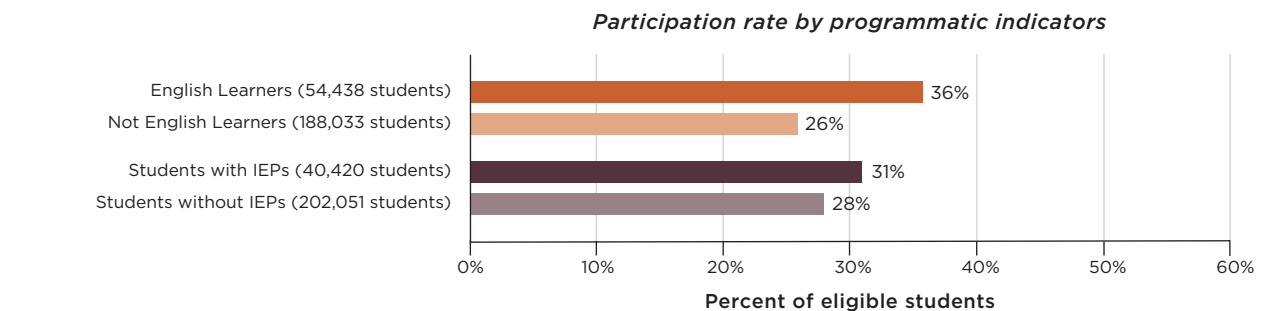
Students living in households with lower economic means were more likely to participate in Chicago Connected



Note: Participation rates shown in the graph are the raw rates (descriptive statistics) among eligible students. These three student characteristics, living in a temporary situation, free or reduced-price lunch and Medicaid qualification, and the community area (“CA”) hardship index value, were still related, with statistical significance, to the likelihood of participating in Chicago Connected even when taking into account other student, neighborhood, and school characteristics. Community areas were divided in three groups based on their hardship index value (high, average, and low) and the figure reports on the students living in those community areas. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors.

FIGURE 4

Students classified as English Learners were more likely to participate; no statistically significant differences for students with an identified disability



Note: Participation rates shown in the graph are the raw rates (descriptive statistics) among eligible students. The English Learners indicator was related, with statistical significance, to the likelihood of participating in Chicago Connected, even when taking into account other student, neighborhood, and school characteristics. That is not the case with students with IEPs—the IEP indicator was not statistically significant. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors.

those who were not (31% vs. 28%), but when comparing students similar in other characteristics, the difference in rates was not statistically significant (see Table A.1 in the Appendix). Both of these indicators were included in the eligibility index because at the beginning of the pandemic, these students were found to be less likely to log into Google Classroom or Google Meet.¹⁵ The smaller, and statistically insignificant, difference in participation rates for students with disabilities may be

because they found it more difficult to engage in remote learning in spring 2020 than students without identified disabilities for reasons other than internet access.

Households with more CPS students were more likely to participate in Chicago Connected. Among households with eligible students, those with just one CPS student had a 16% participation rate, compared to a 42% participation rate among those households with four or

¹⁵ Chicago Public Schools (2020b).

Participation rates in Chicago Connected by community area

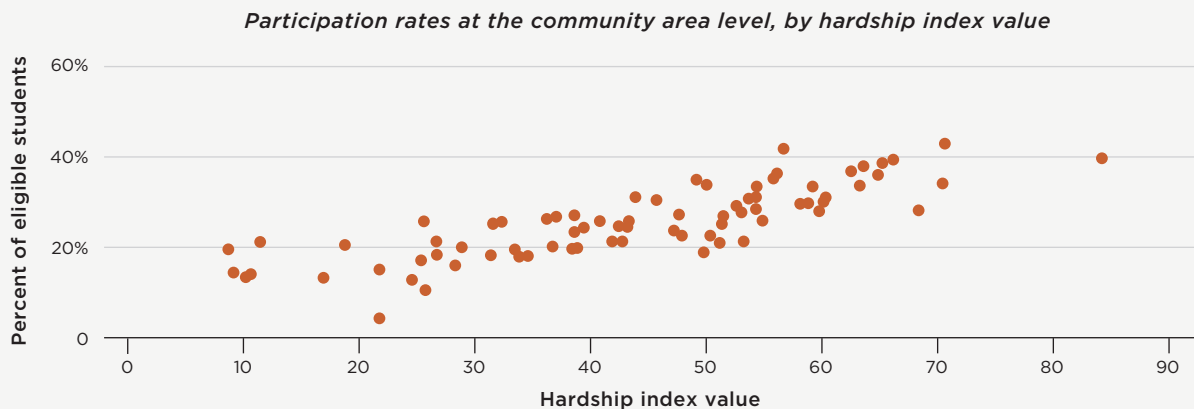
One of the indicators in the eligibility criteria was the community area hardship index, based on where students resided. As shown in **Figure 2 on p.6**, this indicator was related to students' participation rates. Pre-pandemic data indicated that lack of internet access varied by Chicago community areas from 10% or lower to a high of 46%.^B What did Chicago Connected participation look like in different community areas (vs. participation differences at the student level)?

We find that **participation rates in Chicago Connected ranged from 5 to 40% in the 77 community**

areas in Chicago. Variations in participation rates by community area were strongly associated with the neighborhood hardship index. As shown in **Figure A**, community areas with high scores in the hardship index saw higher participation rates among CPS students living in the community (which we would expect to see, as this metric was included in the eligibility index).^C Moreover, community areas with similar hardship index values had very similar rates of participation, tying this indicator strongly to participation rates by community area.

FIGURE A

Students living in community areas with higher hardship index scores were more likely to participate in the program



Note: Every dot represents the participation rates among students living in the community area. The community area hardship index was positively associated with participation rate even when taking into account student and school characteristics. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors. Table A.2 in the Appendix shows how much of the variation in participation rates is at the community area level and how much of it was explained by the hardship index.

B Kids First Chicago & Metropolitan Planning Council (2020).

C The neighborhood hardship index score is calculated by the Great Cities Institute at University of Illinois at Chicago (Great Cities Institute, 2019). It is an average of six variables from the American Community Survey that have been standardized on a scale from 0 to 100. Higher hardship index scores indicate harder economic conditions.

The six variables include: Unemployment (over the age of 16 years), education (over 25 years of age without a high school diploma), per capita income level, poverty (below the federal poverty level), crowded housing (housing units with more than one person per room), and dependency (population under 18 or over 64 years of age).

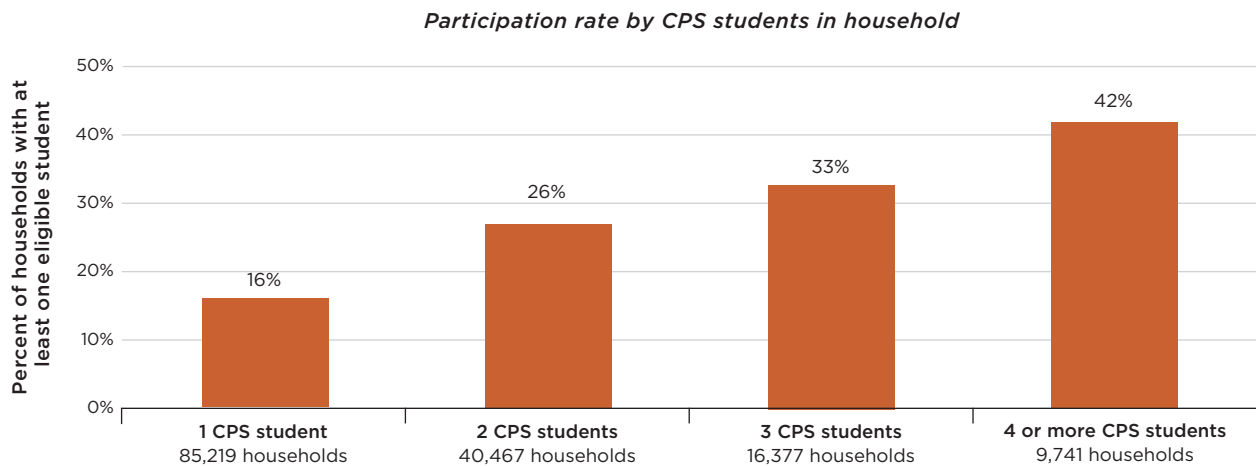
more CPS students (see Figure 5). These differences in participation rates persisted even when comparing students with similar economic and background characteristics, suggesting that the number of students in the household was an important additional factor driving participation in the program. While the number of CPS students was not included in the eligibility index and priority, households with more CPS students were one of the targeted groups in outreach campaigns to inform about the program.¹⁶

White students were less likely to participate in Chicago Connected, even when comparing students with similar student, school, and neighborhood characteristics.

Latinx students had the highest participation rates among eligible students with 32% of them participating

(see Figure 6), followed by Black students with a 26% participation rate, and 24% among Asian students, while only 18% of eligible White students did so. Higher participation rates among Latinx students, compared to Black and Asian students, could be explained by the number of students in the household: the data showed Latinx students were more likely to live in households with other CPS students and households with more students were more likely to participate in Chicago Connected. White students' participation rates were lower even when compared to other students with a similar number of CPS students in the household, eligibility index, all indicators included in the eligibility index, gender, whether students were in different grades, community area hardship index, and school characteristics.

FIGURE 5
Households with more CPS students were more likely to participate in Chicago Connected

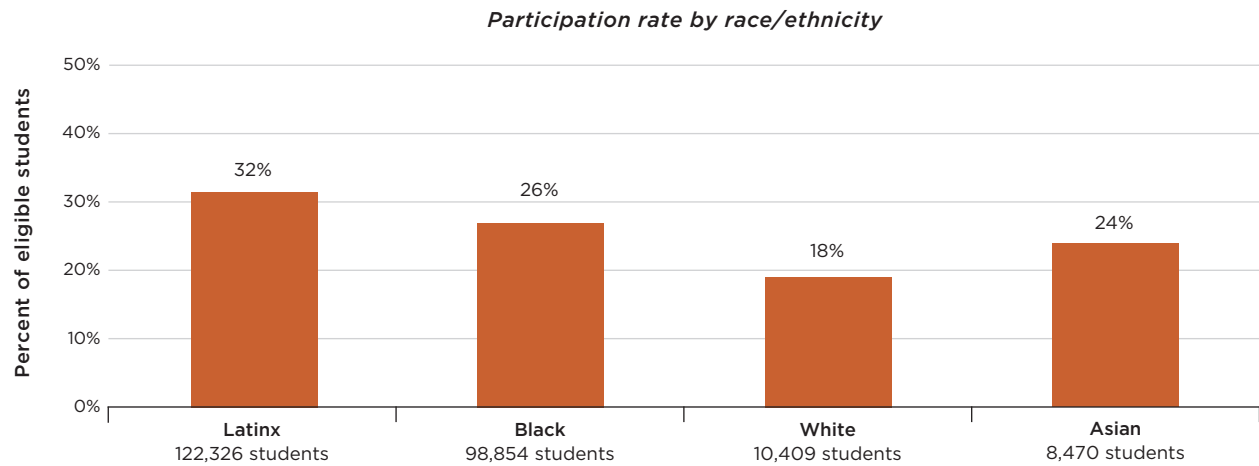


Note: Participation rates shown in the graph are the raw rates (descriptive statistics) among households with eligible students. Living in a household with other CPS students was positively related, with statistical significance, to the likelihood of participating in Chicago Connected, even when taking into account other student, neighborhood, and school characteristics. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors.

¹⁶ Chicago Public Schools (n.d.).

FIGURE 6

Latinx, Black and Asian students participated at higher rates than their White peers



Note: Participation rates shown in the graph are the raw rates (descriptive statistics) among students' different race/ethnicity and they are ordered by the number of students in each category. Race/ethnicity categories are shown for groups that represented at least 1% of the 2020–21 CPS student population, based on administrative records. Race/ethnicity categories not shown due to small group sizes include: Native American/Alaskan Native, multiracial, and students whose race/ethnicity was not available. Our Asian category combines three CPS data categories—Asian, Pacific Islander/Hawaiian, and Asian/Pacific Islander categories—due to the small number of students in the latter two categories. Some of the differences in the participation rates were not statistically significant, when taking into account other student, neighborhood, and school characteristics. Table A.1 in the Appendix shows the results of statistical models that control for all those other factors..

3. Did participation in Chicago Connected differ across schools? Were characteristics of schools related to these differences?

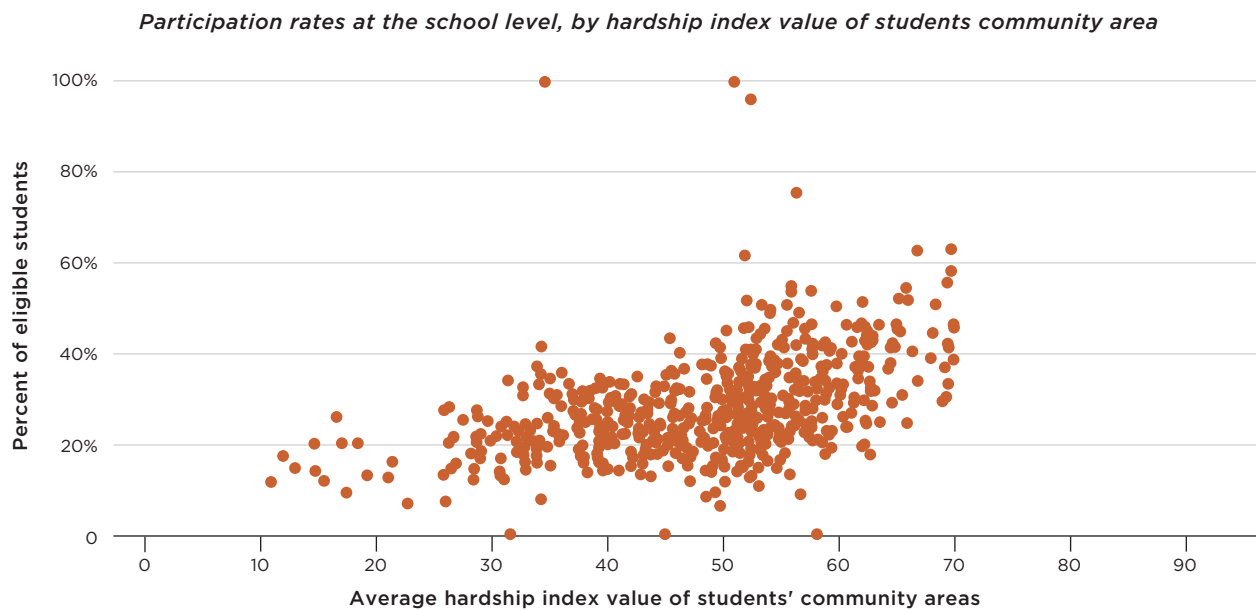
There was notable variation in participation rates among schools, even among schools serving students with similar characteristics. Part of the variation in participation rates was because schools serving students living in community areas with higher values of hardship index tended to have higher participation rates (see Figure 7).¹⁷ But some schools serving similar students had very different participation rates. For example, the schools represented on the far right of Figure 7 had, on average, a population of students from community areas with a hardship index of 70, and the participation rate among students in these schools varied from 29% to 63%.

Participation rates were higher in schools with higher proportions of eligible students, in district-run schools, and in schools with strong family engagement. When comparing schools serving similar students in our multilevel models, those with a higher proportion of eligible students had higher participation rates in Chicago Connected, a statistically significant difference of 2 percentage points from a school with a low proportion of eligible students compared to one with a high proportion of eligible students (see Table 2).¹⁸

When comparing schools serving similar students, charter schools had lower participation rates than district schools, by 4 percentage points. We do not have data on any internet connectivity options provided directly

FIGURE 7

Variation in participation rates among schools was large even when comparing schools with similar student populations



Note: Every dot represents the raw participation rates (descriptive statistics) among students attending a school (649 schools are depicted here, all elementary and high schools, both district-run and charter schools). The school values represented in the x-axis were calculated by averaging the hardship index score of the community area where students resided, among all students enrolled in a school. Table A.2 in the Appendix shows how much of the variation in participation rates is at the school level.

¹⁷ The neighborhood hardship index score is calculated by the Great Cities Institute at University of Illinois at Chicago (Great Cities Institute, 2019). It is an average of six variables from the American Community Survey that have been standardized on a scale from 0 to 100. Higher hardship index scores indicate harder economic conditions. The six variables include: Unemployment (over the age of 16 years), education (over 25 years of age without a high school

diploma), per capita income level, poverty (below the federal poverty level), crowded housing (housing units with more than one person per room), and dependency (population under 18 or over 64 years of age).

¹⁸ We defined a school with a low proportion of eligible students as a school one standard deviation below the mean and a school with a high proportion of eligible students as one standard deviation above the mean.

TABLE 2**Some school characteristics were associated with higher participation rates**

	Difference in participation rates
Percent eligible students (High vs. low)	+2 ppt
District-run school (vs. charter school)	+4 ppt
Involved Families (High vs. low)	+3 ppt

Note: Involved Families data come from teachers' responses to the 2019 5Essentials Survey. The Involved Families category reflects how well the entire school staff builds strong relationships with families and communities to support learning (for more information on the 5Essentials Survey, including sample questions, see <https://consortium.uchicago.edu/surveys>). Schools with high family engagement have a value of 60 or more in the Involved Family essential, while low schools are those with a value of less than 40 (the scale goes from 0 to 99). The numbers shown in the table come from statistical models shown in Table A.1 in the Appendix. All relationships presented in this table were statistically significant. Other school variables included in the models that were not related to participation rates include: grades served in school (elementary grades, combo school, or high school), and Effective Leaders and Collaborative Teachers, as measured by the 5Essentials Survey.

from charter schools to families, so are not able to interpret whether this 4-percentage point difference reflects whether students in charter schools had less internet access.

When comparing schools serving similar students, those with strong family engagement as reported by

teachers on the 5Essentials Survey had 3 percentage points higher participation rates than schools with weak family engagement.¹⁹ In schools where relations and trust were already established among adults, it may have been easier to disseminate the information about the program among families.

¹⁹ We measured family engagement using the Involved Families data from teachers' responses to the 2019 5Essentials Survey; see Table 2 for details.

Implications

Our findings show that economic factors were big drivers for participation in Chicago Connected, which aligns with what was expected, given that eligibility was primarily based on economic need. However, many students identified as priority because of high eligibility index scores did not participate in the program. Participation rates across schools serving similar students showed large variation—some with large participation numbers some with low participation rates. These results from the first year of Chicago Connected can guide the district and the city as they are expanding the program. Chicago’s lessons can also inform similar programs across the country.

Using economic indicators helps identify and prioritize families for service. Many surveys point to economic barriers to pay for internet services as families with lower economic means are more likely to lack internet or rely on services that are not convenient and unreliable. Using economic indicators to prioritize students worked for Chicago Connected; students with lower economic means were more likely to participate in the program. When resources are limited, program leaders in Chicago and elsewhere can identify and prioritize those most in need of the program.

Household size could offer additional information on which families to prioritize. Our work highlighted that there was higher demand for Chicago Connected in households with more students. It is possible that these households had a greater strain on bandwidth and the addition of hotspot to an already-wired connection helped address this issue. Or it might be the case that size of the household among the eligible group of students meant an additional strain on economic resources and the program helped pay for the service. Programs could use the information on household size and prioritize households with more family members in addition to economic indicators.

To eliminate the digital divide, program leaders need to understand what reasons or barriers may keep families from participating. There was a lot of variation in participation rates we could not explain with economic or programmatic factors. For example, more than one-half of the eligible students who qualified for free or reduced-price lunch did not participate in the program. The question is: why not? Did they not know about the program? Efforts were made to reach out to families through direct messages via mail, phone, text messages, and community organizations. But if addresses or phone information are not up to date, reaching families becomes a difficult endeavor. Did they hear about the program, but was there distrust about it? This was a concern that the program tried to address in part by bringing community-based organizations to help with signups. But families might have had other concerns that needed to be addressed by other means. Did they not have a device available for a student to use for remote learning? Even though CPS had already distributed devices available in schools at the beginning of the remote learning period and bought additional ones in the spring of 2020, other programs might face this barrier before an internet connection can be useful to students. Did the program not meet the needs of the

family? Had families already solved their connectivity needs before Chicago Connected was available to them? Or may families have needed more flexibility? For example, Chicago Connected was set up to pay for a particular broadband package; families were not able to use the program to offset the cost of a higher speed package if that is what they felt they needed. In contrast, other programs, such as the Affordable Connectivity Program, allow to use the subsidy to pay for a complete internet package or apply it to get a higher-cost package by paying the difference.

And while more than one-half of the eligible students who qualified for free or reduced-price lunch did not participate in the program, 57% of students in temporary living situations did participate. It would be helpful to learn what drove this relatively high participation rate. For example, did existing channels of direct communication in place to support these students support outreach?

Questions like these can help program leaders know what students and families need in order to provide it, and to ultimately address the digital divide.

Schools might offer opportunities to learn about how to deepen the reach of programs like Chicago Connected.

In Chicago, we found very little variation in participation rates among eligible students by community areas, but quite a bit of variation across schools—even

schools serving similar students. Our findings point to some school characteristics that were related to having higher or lower participation rates; schools with higher levels of family engagement had higher levels of participation. This can be useful to target schools with lower levels of family engagement in the future, as their students are less likely to participate.

But the district could also use the varying degrees of participation in schools to learn more about what barriers families with eligible students faced to participate in the program and how different schools addressed those. Dissemination efforts could be targeted to families in schools with low participation rates, and community-based organizations working in community areas where these families reside could increase their efforts to provide more targeted information and address concerns from these families whether it is an issue of information, trust, a lack of a device, etc.

Ultimately, the goal of Chicago Connected was to remove a barrier to learning by accessing online learning. Here, we have addressed the extent to which families participated, and raised questions about what helped or hindered participation. The next big question is whether access to the internet through Chicago Connected helped students engage in their classes amidst the many challenges they faced in the 2020–21 school year. We will explore that question in a forthcoming report, due out in late 2023.

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Appendix

We used a cross-nested hierarchical linear model to examine the participation in Chicago Connected. These models allow us to examine the relationship of participation in Chicago Connected with each student, community area, and school characteristics, net of the effects of the other characteristics.

Level one in the models represents the student level. Level two represents the nested structure of the data, where we placed students in the community area in which they resided and the school they attended. Our analyses are based on 242,471 students, attending 649 CPS schools and residing in 77 community areas.

Table A.1 shows the estimated coefficients of different models where all variables included in the models are grand mean centered. And **Table A.2** contains the variance components and how much of the variation in participation rates was explained by different variables included in the various models. Each column presents the results of a model with progressively more variables. The first column in each table shows the results from an unconditional model, a model with no explanatory variables. The second column contains the results from a model that includes student characteristics such as the value of the eligibility index, the different indicators that went into the eligibility index, demographic characteristics, and the student grade. The next column includes information about the number of students in a household. Finally, the last two columns show the results from a model with community area characteristics (hardship index value) and school characteristics (percent of the student population that was eligible, grades served at the school, charter, and survey information on collaborative teachers, effective leaders and involved

families). When some variables had missing data—such as survey data—we created missing indicators to account for those missing.

We find strong relationships between the variables included and participation rates (see **Table A.1**). The eligibility index and all indicators that were part of it, with the exception of students with IEPs, were statistically significant. Demographic characteristics were also related to participation rates, but the inclusion of the number of students in a household explained the differences in participation rates between Latinx, Black, and Asian students. Pre-k students were less likely to participate in Chicago Connected than other students. The number of students in the household was also statistically significant.

Most of the variation in participation rates was at the student level, followed by variation across schools and very little variation across community areas (see **Table A.2, first column**). Introducing student characteristics in the model explains almost one-half of the variation in communities areas and 12% at the school level. The addition of community area hardship index explains 65% of the variation between community areas. The addition of school characteristics helps explain 21% of the variation between schools. Although a lot of the variation across schools and community areas is explained by the variables included in the models, very little of the variation at the student level is explained with the variables included.

The community areas hardship index was strongly related to participation and a few of the school characteristics, such as the proportion of eligible students, charter schools, and schools with strong family involvement.

TABLE A.1

Estimated coefficients from different multilevel models

	Unconditional model	Model with student characteristics	Model with household number	Model with community area characteristics	Model with school characteristics
Intercept	0.26***	0.27***	0.27***	0.22***	0.22***
Eligibility index					
• 4 and 5		-0.08***	-0.07***	-0.07***	-0.07***
• 3 and lower		-0.13***	-0.12***	-0.11***	-0.11***
Eligibility indicators					
• Students in temporary living situations		0.32***	0.31***	0.31***	0.31***
• Free/reduced-price lunch eligible		0.06***	0.04***	0.04***	0.04***
• Medicaid		0.03***	0.03***	0.03***	0.03***
• English Learner		0.05***	0.05***	0.05***	0.05***
• Individualized Education Plan (IEP)		-0.00	-0.00	0.00	0.00
Demographic					
• Male		-0.01**	-0.01**	-0.00**	-0.00**
• Black		-0.02***	-0.00	-0.00	-0.00
• White		-0.04***	-0.03***	-0.02***	-0.02***
• Asian		-0.02***	-0.01	-0.01	-0.01
• Other		-0.03***	-0.02**	-0.02**	-0.02**
Grade					
• Pre-k		-0.02***	-0.02***	-0.02***	-0.02***
• 4-8		0.01***	0.01**	0.01**	0.01**
• 9-12		-0.02***	-0.01	-0.01	-0.01
• Other		-0.08	-0.06	-0.06	-0.05
Household					
• 2 CPS students			0.10***	0.10***	0.10***
• 3 CPS students			0.16***	0.16***	0.16***
• 4 or more CPS students			0.26***	0.26***	0.26***
Community area hardship index				0.001***	0.001***
School characteristics					
• % eligible for Chicago Connected					0.05**
• Combo school (elementary and high school grades in one building)					-0.02
• High school					-0.00
• Charter school					-0.04***
• Collaborative Teachers high					0.00
• Collaborative Teachers low					0.01
• Effective Leaders high					-0.01
• Effective Leaders low					0.00
• Involved Families high					0.03***
• Involved Families low					-0.00
• Indicator of missingness: Collaborative Teachers; Effective Leader					0.05
• Indicator of missingness: Involved Families					-0.05*

Note: * indicates that differences are significant at p<0.05; ** indicates that differences are significant at p<0.01 and *** indicates that differences are significant at p<0.001.

TABLE A.2**Variance components**

	Unconditional model	Model with student characteristics	Model with household number	Model with community area characteristics	Model with school characteristics
Community area					
• Standard deviation	0.048	0.026	0.022	0.017	0.017
• Percent variance explained	—	46%	54%	65%	65%
School					
• Standard deviation	0.082	0.072	0.069	0.069	0.065
• Percent variance explained	—	12%	16%	16%	21%
Student level					
• Standard deviation	0.439	0.430	0.421	0.421	0.421
• Percent variance explained	—	2%	4%	4%	4%

Note:* indicates that differences are significant at $p < 0.05$; ** indicates that differences are significant at $p < 0.01$ and *** indicates that differences are significant at $p < 0.001$.

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