



Full Day 4K in Year Two: Understanding Learning Gains for Students

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Executive Summary

Since 2011, the Madison Metropolitan School District (MMSD) has offered free, half-day four-year-old Kindergarten (4K). In 2021-22, the district began phasing in full-day 4K in select schools across the district and has continued to expand its program in subsequent school years. The [Madison Education Partnership](#) (MEP), in collaboration with the MMSD Departments of Early Learning and Research & Innovation, conducted evaluations across two years of the program to understand how enrolling in full-day 4K affects student learning relative to half-day 4K. In the first year of full-day 4K implementation (2021-2022), we find students in full-day and half-day classrooms gained similar amounts of skills in literacy, numeracy, and executive functioning over the course of the year. For a full report on the first-year evaluation, see [here](#). We continued to evaluate the full-day 4K program into its second year of implementation, to unpack changes in student learning as the program matures and expands.

In the second year of implementation (2022-2023), we evaluate differences in learning gains in a second cohort of students in full- and half-day classrooms. We also follow a subsample of five-year-old Kindergarten (5K) students who had attended full- and half-day 4K in 2021-2022 to assess gains in learning once students leave 4K. This report presents findings from the second year evaluation of learning gains. In addition to assessing gains in achievement over the course of the year, we observed in classrooms and interviewed teachers to examine qualitative differences in instruction, time use, and [culturally responsive practices](#) across 4K and 5k. Results from the qualitative analysis are discussed in a separate report.

In year two of the evaluation, we asked:

- Do students gain more literacy, numeracy, and executive functioning skills in full-day 4K relative to half-day 4K?
- Are there differences in skill gains in 5K for students who attended full-day 4K relative to those who attended half-day 4K?

Findings

- Students in **both full-day and half-day sections gained skills** in literacy, numeracy, and executive functioning, as measured by the Phonological Awareness Literacy Assessment (PALS), Woodcock Johnson IV Applied Problems (WJ), and Head-Toes-Knees-Shoulders (HTKS) assessments respectively.
- **We do not find differences** in average gains on assessments in numeracy and executive function between students enrolled in the full- and half-day 4K classrooms in 2022-2023, even after controlling for differences in student demographics across the two groups.
- Full-day 4K students **gained more on average on the assessment in literacy** over the course of the year than half-day 4K students. Once accounting for differences in student demographics across the two groups, however, this difference is **not statistically different** than no difference at all and we therefore should interpret this result with caution.
- In 5K, we do not find a difference in learning gains on assessments in literacy, numeracy, or executive function between students who had attended full-day 4K and those that attended half-day 4K.

MMSD 4K Program



Since 2011, MMSD has offered tuition-free, optional half-day 4K to its residents. The program operates in 4K classrooms in MMSD elementary schools, as well as participating early care and education (ECE) sites. The MMSD 4K program utilizes a play-based curriculum inclusive of all children's culture, race, social class, gender, languages, and needs. All MMSD school sites use Creative Curriculum for Preschool. In MMSD elementary schools, half-day programming is offered Tuesday-Friday for 3 hours and 13 minutes per day.¹ Beginning in 2021, MMSD began offering full-day programming in eight MMSD elementary schools. In 2022, the program expanded to include four additional schools and three ECE sites. Full-day classrooms operate Tuesday-Friday for 7 hours a day. Between 1,400 to 1,500 students enroll in the 4K program each year, and roughly two-thirds of these students attend MMSD elementary schools.²

¹ All 4K ECE and MMSD School sites participating in the MMSD 4K program are required to provide students with 437 hours of 4K classroom time and 87.5 hours of family outreach during the MMSD academic school year. ECE sites may choose how to allocate that time across the year for participating students. ECE sites may also choose to provide care options for students outside of the 437 hours for additional fees as determined by the site.

² Enrollment numbers based on the last three years.

How did we evaluate the program?

We measured achievement in literacy, numeracy, and executive function at the beginning and end of the school year for around 12 randomly chosen students from a sample of 18 full-day sections (18 teachers) and 15 half-day sections (8 teachers).³ In total, we assessed 193 full-day students and 148 half-day students in the fall and spring of the 2022-23 school year. This sample includes students from a mix of full-day 4K classrooms in schools that were in their first year of full-day 4K implementation and those in their second year. As part of an equity strategy to address persistent gaps in outcomes, MMSD chose to initially offer full-day 4K programming at schools that serve relatively high numbers of students of color and students from families that are economically constrained. We therefore selected 15 half-day 4K sections that were most similar to the full-day sections based on demographic characteristics of the students they serve.

We also followed a subsample of 5K students who had participated in the year-one 4K evaluation. In total, we assessed 53 5K students who had enrolled in full-day 4K and 66 students who had enrolled in half-day 4K. We sampled 12 schools with 5K classrooms enrolling students from the year-one evaluation.⁴ Across those 12 schools, we sampled 120 5K students who had been a part of the year-one 4K evaluation.

We measured skill gains in areas of high priority to the 4K program using validated assessments commonly used in evaluations of programs serving three to five-year old students. We leveraged assessment data routinely collected by district teachers and staff, as well as administered additional assessments. Our measured skills include:

- **Phonological Awareness Literacy Assessment (PALS):** (4K only) teachers administer PALS one-on-one with students, evaluating students' alphabet knowledge, sound and print awareness, and writing ability.
- **Woodcock-Johnson IV Achievement (WJ): Applied Problems (WJIV):** MEP graduate students conducted WJIV one-on-one with students to assess their skills in number recognition, counting, and solving basic math problems.
- **Head Toes Knees Shoulders-Revised (HTKS):** MEP graduate students administered the HTKS to assess students' self-regulation, working memory, and attention span.

3 We include 16 full-day sections in MMSD schools and 2 full-day sections in Early Care and Education (ECE) sites. In the Appendix we present results excluding the ECE sites. Results are substantively similar.

4 We used a weighted random sample of 12 schools, weighted by the proportion of 5K students who had been in the year 1 4K evaluation sample.

- **Teaching Strategies-GOLD (TS GOLD):** (4K only) teachers record whether a given student has reached certain objectives in four domains: language, literacy, math, and social-emotional skills, based on observing students in class.
- **FastBridge EarlyReading: (5K only)** teacher-administered assessment of print, phonemic awareness, phonics and fluency.

While we selected half-day classrooms with students who were most similar to full-day students, there were several differences across the two groups. Full-day classrooms in our sample on average include more Black students and fewer White and Asian students. However, differences in fall assessment scores across full- and half-day sections were small. We control for differences in student characteristics and fall assessment scores and we do not believe these differences account for the results described in this report.



What did we find?

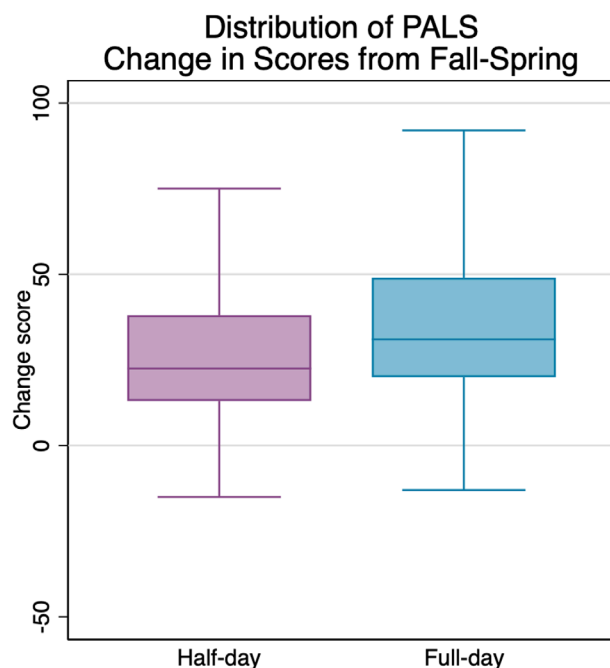
Differences in learning in 4K

In literacy (PALs), full-day students saw greater achievement gains than those in half-day 4K, though the difference is not statistically significant. In literacy, students in full-day classrooms gained an average of 35 points, and students in half-day gained an average of 27 points from fall to spring, a difference of about a quarter of a standard deviation. Once accounting for differences in student demographics across full- and half-day students, we estimate the average effect of full-day 4K is 7.8 pts, though this average effect is not statistically significant. Given the relatively small sample size and relatively high variation in PALs scores across all students, the effect estimate contains a fair amount of uncertainty, even once accounting for differences. Given this uncertainty, the estimated average effect of full-day 4K for literacy ranges between -2.1 pts and 17.7 pts on the PALs assessment (95% confidence interval). Therefore, while we can not say for sure there was a positive effect of full-day 4K on literacy scores, this evidence is promising.

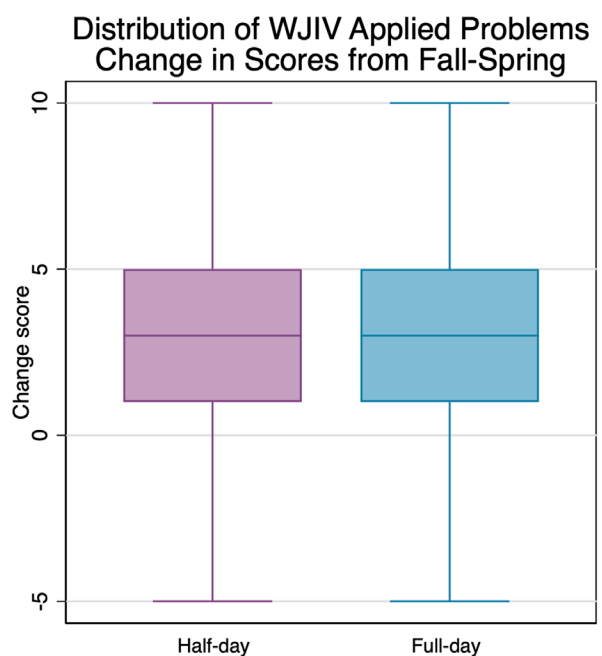
In math and executive functioning, while we see gains for all students, we do not find differences in achievement gains between students in full-day and half-day 4K. In math (WJ), students in both full-day and half-day sections gained 3 points on average from the fall to spring. Similarly, students in both full- and half-day sections gained 13 points on the HTKS measure of executive functioning. After adjusting for differences among students in race, gender, parent education, English language learner status, and free/reduced-price lunch participation, any difference in gains across math and executive functioning are not reliably different from no difference at all.

The figures below plot the range of observed gains for students in half-day (purple, left) and full-day (teal, right) 4K programs. The shaded box indicates the range of growth in literacy, math, and executive functioning scores (figures 1, 2, and 3 respectively) for the middle 50% of students. The line in the middle of the box indicates the expected growth for the typical student (the median) by program type. The median level of growth, as well as the range of growth for the middle 50% of students, are essentially identical across groups in math and executive functioning. For literacy, the typical full-day student gained more points in literacy than the typical half-day student.

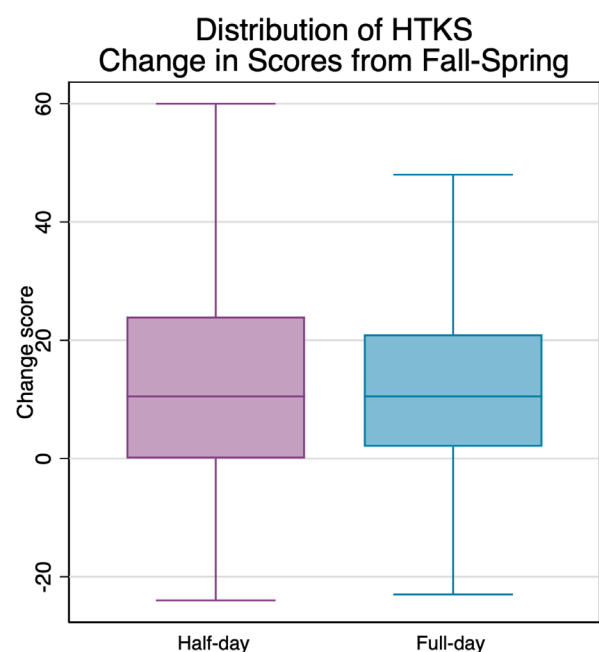
Figure 1, 2, 3: Distribution of gain scores in PALs, WJ, HTKS across full- and half-day students



Excludes outliers.
Estimated effect of full-day (and standard error of estimate): 7.8 (5.05).



Excludes outliers.
Estimated effect of full-day (and standard error of estimate): -.22 (.66).

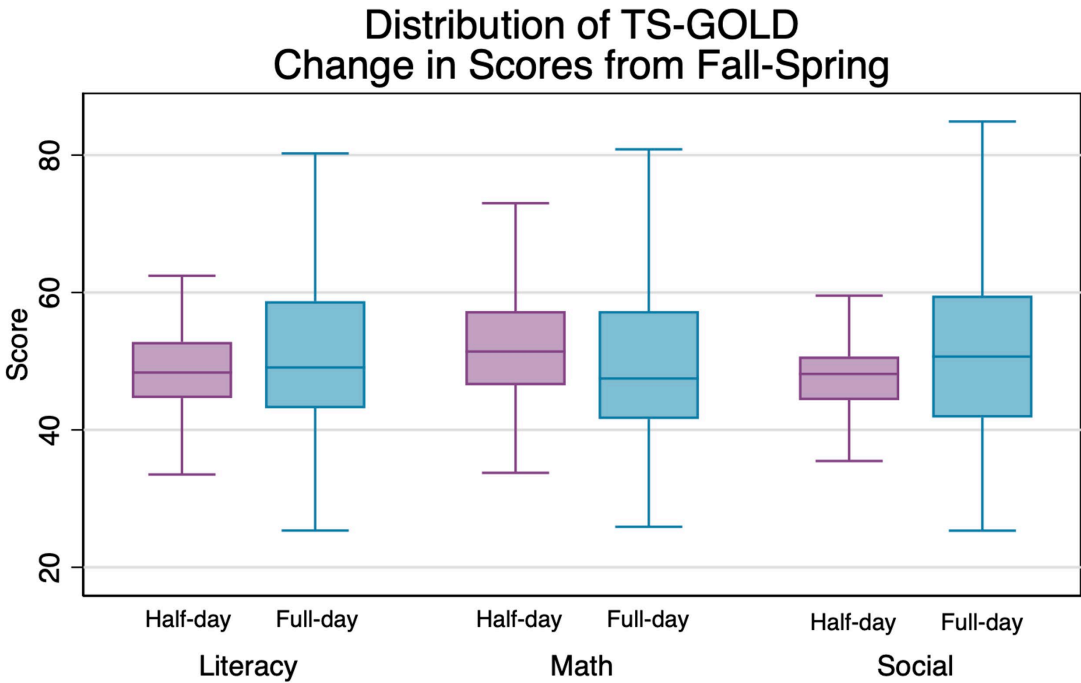


Excludes outliers.
Estimated effect of full-day (and standard error of estimate): -.62 (3.32).

Figures 1, 2, and 3, each show two box plots of the distribution of student assessment gains - one showing students in the full-day 4K sample and the second of students in the half-day 4K sample. Figure 1 shows these box plots for PALS score gains with the following points for full-day: minimum (min) = -13, quartile 1 (Q1) = 20, median (med) = 31, Q3 = 49, maximum (max) = 92; the following points for half-day: min=-12, Q1 = 13, med= 22.5, Q3=38, max=101. Figure 2 shows these box plots for WJ gains. For full-day: min= -7, Q1=1, med=3, Q3= 5, max= 10; For half-day: min = -5, Q1= 1, med = 3, Q3: 5, max= 23. Figure 3 shows these box plots for HTKS gains. For full-day: min = -56, Q1=2, med= 11, Q3= 23, max = 57; for half-day: min = -45, Q1: 0, med = 10.5, Q3= 24, max = 67. These box plots show that on PALS, students in the full-day sample tended to gain more over the course of the year than half-day students. On WJ and HTKS, students in full and half-day classrooms gained similar amounts.

When looking at teacher rated skills in literacy, math, and social emotional using Teaching-Strategies GOLD, these findings are similar. Students in full- and half-day classrooms had similar achievement skill gains on average even once accounting for differences among student characteristics.

Figure 4: Distribution of Teacher Strategies GOLD across full- and half-day students.



Scores standardized to a mean of 50, standard deviation of 10.
Excludes outliers.

Figure 4 shows box-plots of the distribution of student assessment gains on TS-GOLD for literacy, math, and social subsections. On all subsections, the typical full-day student gained similar on the assessment as the typical half-day student. Full-day students vary more widely in terms of the raw points gained on these assessments. On literacy, the following points are shown for full-day: min=25, Q1 = 43, med= 49, Q3=59, max=84; for half-day: min=31, Q1 = 45, med= 48, Q3=53, max=86. On math, the following points are shown for full-day: min=26, Q1 = 42, med= 47, Q3=57, max=91; for half-day: min=30, Q1 = 46, med= 51, Q3=57, max=73. On social skills, the following points are shown for full-day: min=25, Q1 = 42, med= 51, Q3=60, max=104; for half-day: min=35, Q1=44, med=48, Q3=51, max=68.

There are no differences in these effects by race/ethnicity. As with White students, among Black and Hispanic students, those in full-day 4K students did not see larger gains in literacy, numeracy, or executive functioning than those in half-day classrooms. Similarly, we do not find differences in the effect of full-day across student sex, English Language Learner status, and free- and reduced-price lunch status. For detailed tables of the results see [here](#).

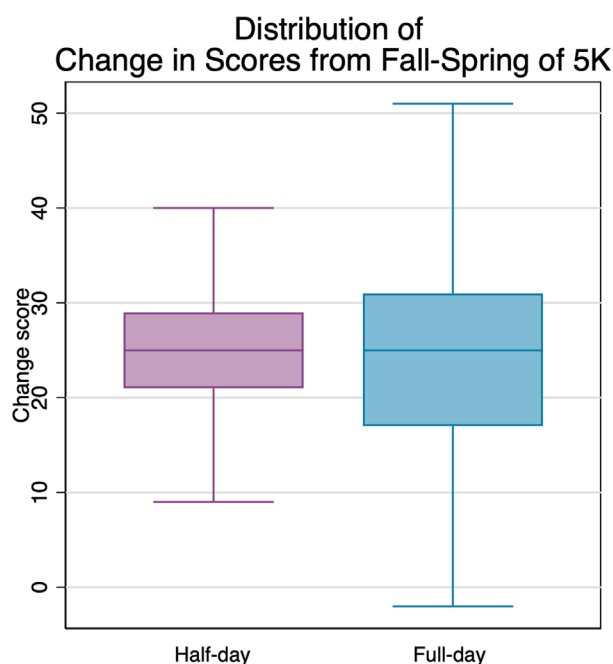


Differences in learning in 5K

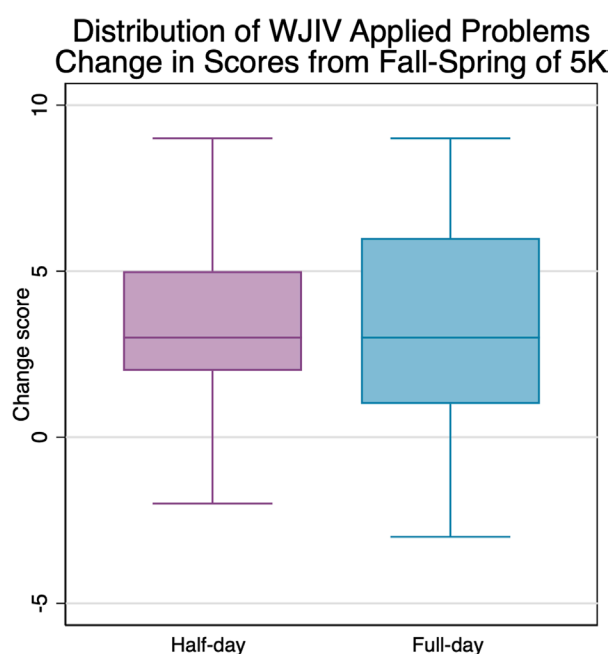
Following a sample of the cohort 1 into 5K, we do not find any differences in learning gains on the assessments given in 5K between students who attended full-day 4K and those who attended half-day 4K.

- **Math:** During their year in 5K, students who had attended full-day 4K gained on average 3 points, and those who had attended half-day 4K gained on average 3 points.
- **Executive functioning:** those 5K students from full-day 4K gained on average 7 points full and those from half-day 4K, 8 points.
- **Literacy:** Using the FastBridge assessment, students from full-day 4K gained on average 26 points from fall to spring, and students from half-day 4K gained 25 points on average.

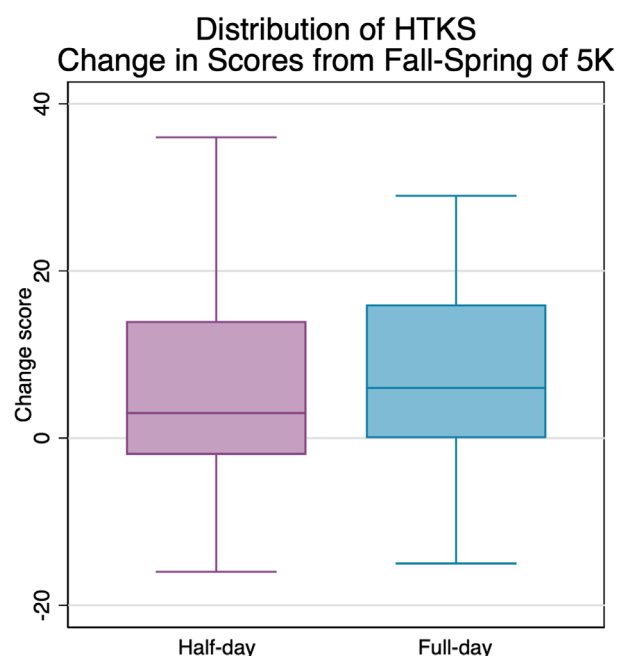
Figure 5, 6, 7: Distribution of gain scores in 5K in Fastbridge, WJ, and HTKS across full- and half-day students



Excludes outliers.
Estimated effect of full-day (and standard error of estimate): .04 (2.38).



Excludes outliers.
Estimated effect of full-day (and standard error of estimate): -.1 (.78).



Excludes outliers.
Estimated effect of full-day (and standard error of estimate): 1.1 (3.97).

Figures 5, 6, and 7, each show two box plots of the distribution of student assessment gains - one showing the sample of 5K students who had attended full-day 4K in year 1 and the second the sample of 5K students who had attended half-day 5K in year 1. All show that 5K students who had attended full-day 4K gained similar on assessments as those who had attended half-day 4K. Figure 5 shows these box plots for FastBridge reading score gains with the following points for full-day: min=-2, Q1=17, med=25, Q3=31, max=51; for half-day: min = 8, Q1=21, med=25, Q3=29, max= 57. Figure 2 shows these box plots for WJ gains. For full-day: min=-3, Q1=1, med=3, Q3=6, max=9; for half-day: min =-8, Q1=2, med=3, Q3=5, max=9. Figure 3 shows these box plots for HTKS gains. For full-day: min=-26, Q1=0, med=6, Q3=16, max=50; for half-day: min=-33, Q1=-2, med=3, Q3=14, max=57.

What do these results mean for the full-day 4K program?

In the first year of the program, we found no differences in learning gains on assessments given across full- and half-day 4K. A second year of implementation allowed us additional insight into the potential and room for growth of the full-day 4K program. In the second year, we see differences in gains in literacy, though the estimates are imprecise. While we cannot say for certain these differences are due to attending full-day 4K, these findings point to promising potential benefits of full-day 4K for learning gains in literacy.

As in year 1, we find no difference in gains in numeracy and executive functioning between full- and half-day sections. There may be several reasons that we do not see growth in these areas. First, the assessment measures, though commonly used in early education evaluations, may not perfectly capture the types of differences we would expect to see with the additional time in half-day classrooms. Second, teachers may be spending the extra time in full-day classrooms on different types of learning activities. For example, in the qualitative study, teachers reported using extra time for creative, hands-on learning activities, such as visiting the public library (Love et al., 2023). These activities may be beneficial for students' in ways we are unable to measure in this evaluation.

It is important to take these findings in the context of other full-day 4K programs. While several rigorous studies have provided evidence that attending full-day 4K improves student learning in literacy, numeracy, social emotional skills, and motor skills (Atteberry et al., 2019; Herry et al., 2007; Reynolds et al., 2014; Robin et al., 2006), other studies found no effects of full-day 4K on academic growth (Leow & Wen, 2017; Valenti & Tracey, 2009). Differences in programmatic features, such as curricula and teacher professional development, as well as differences across the overall context of early childhood programs offered in these locations, may affect the relative efficacy of a full-day program.



Limitations of the study

There are several limitations of the study design. First, while we account for differences in demographic attributes across the full- and half-day 4K students in the sample, there may be unobserved differences between full- and half-day 4K students that affect learning growth. For instance, we are unable to adjust for differences in family income, beyond free-/reduced-price lunch participation, or access to quality care arrangements outside of the 4K program. If students in full-day are different on average than those in half-day on these characteristics, this may affect our ability to draw comparisons across the two groups. However, we do not believe unobserved differences would substantially change our interpretation of the results.

Second, we are unable to observe education and care options students to which students may have access outside of the MMSD 4K program. If, on average, students in half-day classes enjoy higher quality early learning programming outside of MMSD 4K during the second half of the day than those in full-day would have had they not been enrolled in full-day 4K, this may bias our results.

Third, it is possible that the relatively small sample size and random error in measurement of skills may limit our ability to identify precise effects, for literacy in particular, given the general trend in which full-day students gain more on average than half-day students. While we are unable to account for this fully in this analysis, we highlight the potential benefits to students in literacy and note the importance of continuing to monitor trends in skill gains across the program.

Finally, it is possible that full-day 4K provides additional benefits beyond the skills measured in this evaluation. For instance, teachers have pointed out that full-day gives them additional time to connect with students and families and tailor instruction to a single group of students. In addition, full-day 4K may provide parents and caregivers increased flexibility to pursue better jobs or additional educational opportunities. Expansion of full-day 4K may also provide access to 4K programming for those who may not otherwise have been able to attend. Logistical constraints of attending a 4K program for just half of the school day may have prevented some students from attending at all. Therefore rolling out full-day programming may increase access to classroom programming for some students who otherwise may not have had access. In this evaluation, we are unable to measure all these potential benefits of full-day 4K, though we recognize their importance for child and family well-being.

Next steps

MMSD continues to expand access to full-day 4K for families across Madison because of the demand for full-day programming. In light of these results, MEP continues to work closely with the MMSD Departments of Research, Assessment & Improvement and Early Learning to understand what these findings mean for the district. In combination with the qualitative evaluation, the team has discussed potential next steps to continue improving the program, including potential professional development for teachers or staff and discussion on allocation of staff for full-day programming. MEP will work closely with MMSD to continue monitoring successes and challenges of its 4K program as it expands and changes.



Appendix

Differences in the effects of full- and half-day 4K across race/ethnicity

Figures 8-10 show the distribution of changes in assessment scores from fall to spring across students of different racial/ethnic backgrounds. On average, we do not see differences in gains across full- and half-day classes among White students, among Black students, and among Hispanic students.

Figure 8: Distribution of gain scores in literacy (PALS) among full- and half-day students of different racial/ethnic groups

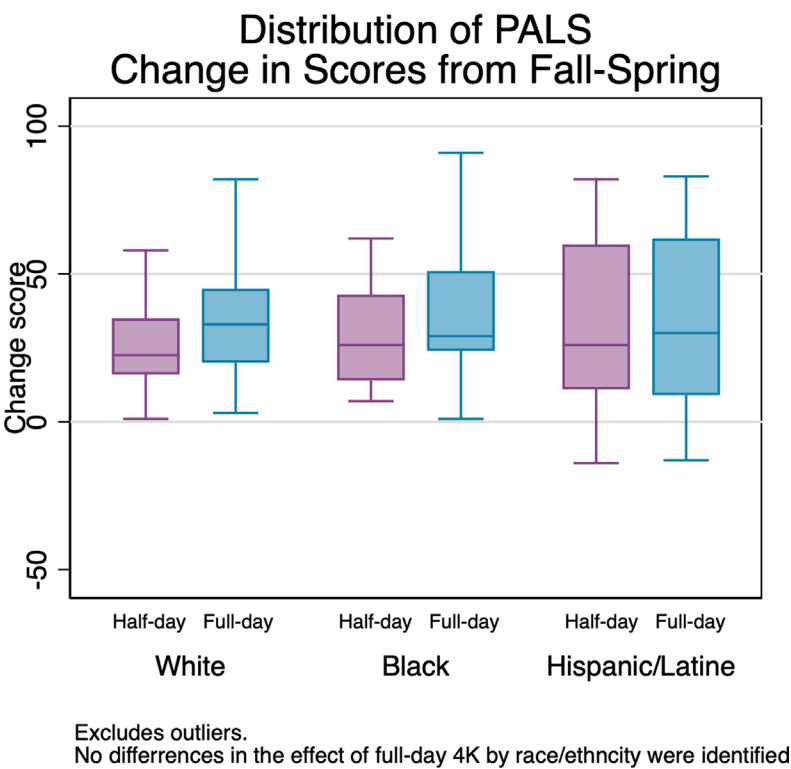
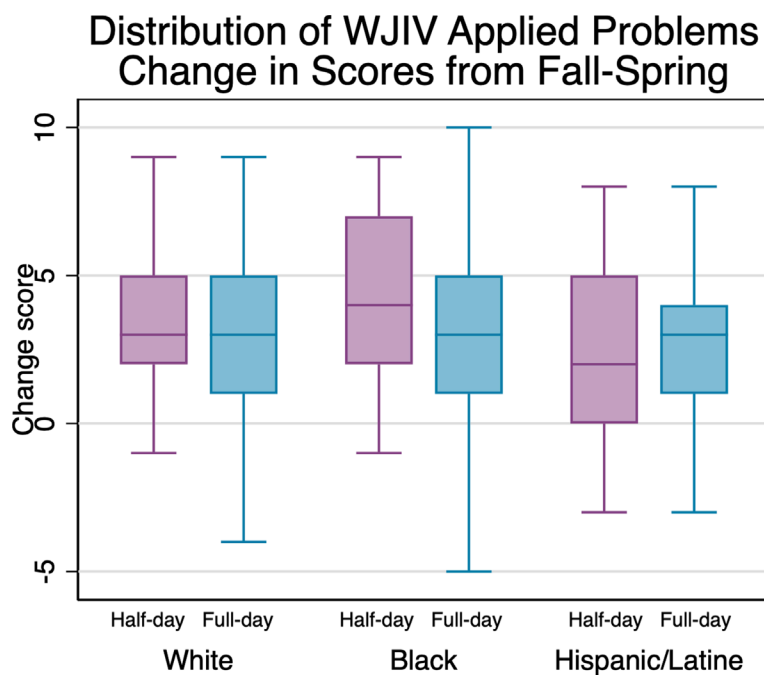


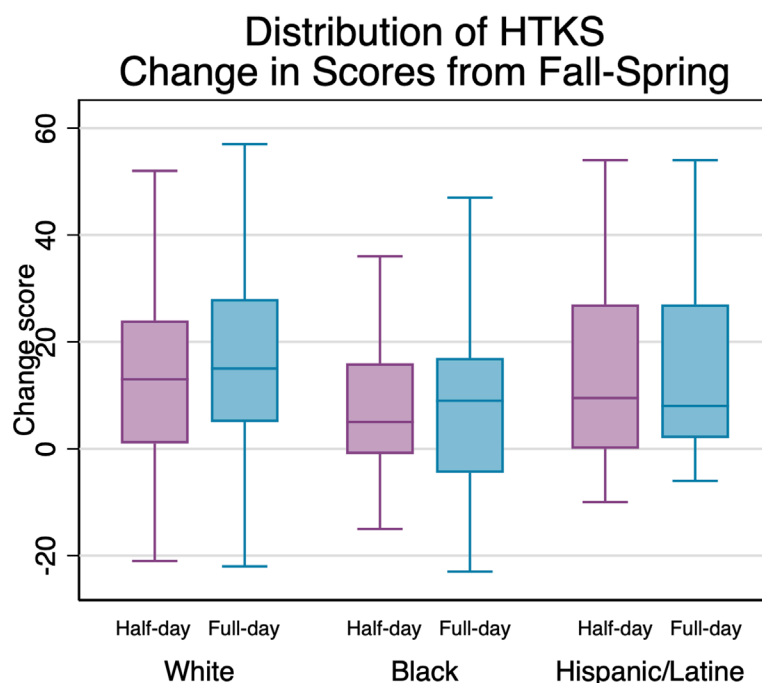
Figure 9: Distribution of gain scores in numeracy (WJ) among full- and half-day students of different racial/ethnic groups



Excludes outliers.

No differences in the effect of full-day 4K by race/ethnicity were identified

Figure 10: Distribution of gain scores in executive functioning (HTKS) among full- and half-day students of different racial/ethnic groups



Excludes outliers.

No differences in the effect of full-day 4K by race/ethnicity were identified

Figures 8, 9, and 10, each show three pairs of box plots for White, Black, and Latinx students. One plot shows the distribution learning gains for students of that group (say, Latinx) who attended half-day 4K and the net the distribution of learning gains for members of the same group who attended full-day 4K. Of the distribution of student assessment gains in year 2 *but restricted to MMSD school sites*- one showing the sample of students who attended half-day 4K and the other the sample of students who had full-day 4K. All show that students who had attended full-day 4K gained similarly on assessments as those who had attended half-day 4K. Although Figure 8 shows a modest advantage in literacy growth for full-day over half-day students, the difference is not statistically distinguishable from 0.

Differences in the effects of full- and half-day across socioeconomic indicators, special education designation, and student sex

Below we present the average effect of full-day 4K on achievement for all sampled students, and the effect of full-day 4K for different subgroups of students relative to other students (third column). For example, in Table 1, the first row (Free/reduced-priced lunch) and the third column (Subgroup effect) shows the effect of enrolling in full-day 4K on literacy for students participating in free/reduced-priced lunch relative to the effect of enrolling in full-day 4K for those not participating. In this case there is no meaningful difference in the effect of full-day 4K on literacy scores for these two groups. We include standard errors (se) in parentheses.

Table 1: Subgroup analysis on literacy (PALS)

Subgroup	Average effect (se)	Subgroup effect (se)
Free/reduced-priced lunch participation	6.18 (5.88)	3.08 (8.48)
English language learner	10.96 (5.75)	-10.96 (10.78)
Special education status	8.243 (5.392)	-6.822 (19.12)
Sex = female	6.693 (5.878)	1.695 (7.275)

No effects are statistically significant at the 5% confidence level.

Table 2: Subgroup analysis on numeracy (WJ)

Subgroup	Average effect (se)	Subgroup effect (se)
Free/reduced-priced lunch participation	-0.097 (0.97)	-0.27 (1.38)
English language learner	-0.42 (0.70)	0.67 (1.42)
Special education status	-0.249 (0.680)	0.292 (3.554)
Sex = female	0.203 (1.063)	-0.799 (1.393)

No effects are statistically significant at the 5% confidence level.

Table 3: Subgroup analysis on executive function (HTKS)

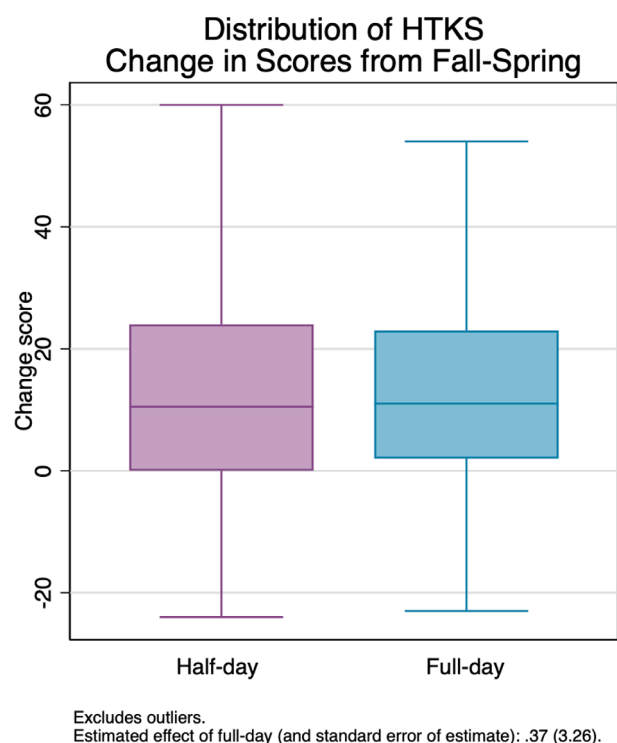
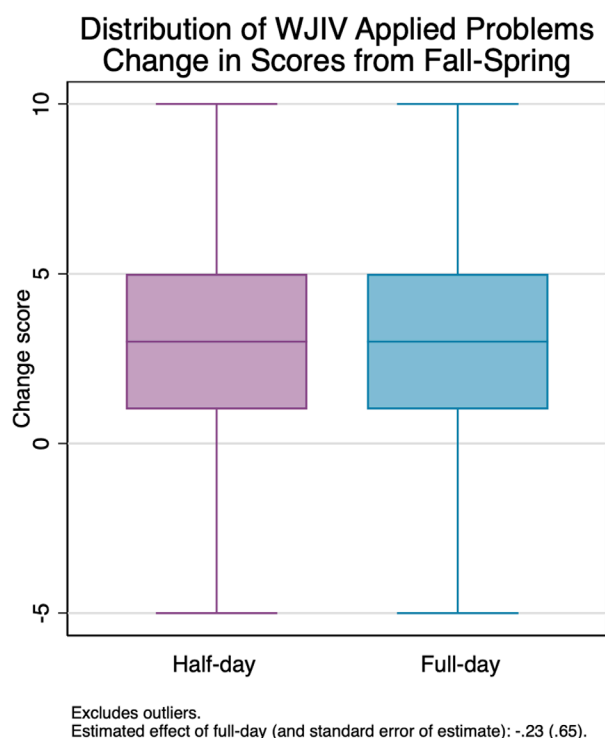
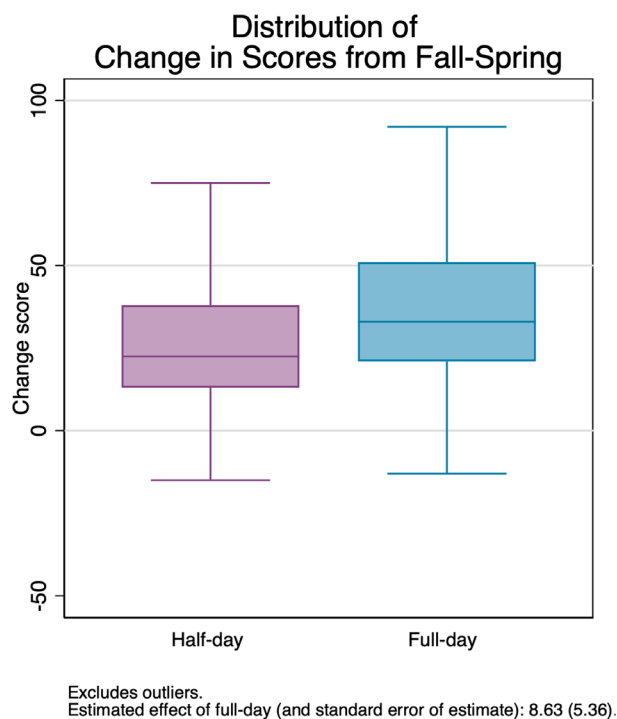
Subgroup	Average effect (se)	Subgroup effect (se)
Free/reduced-priced lunch participation	3.90 (4.24)	-7.05 (5.34)
English language learner	2.45 (4.03)	-7.13 (6.190)
Special education status	-0.529 (3.150)	13.00 (12.78)
Sex = female	2.594 (5.535)	-3.932 (6.804)

No effects are statistically significant at the 5% confidence level.

Analyses only with MMSD school sites

In the second year of the full-day 4K program, three ECE sites began participating in the full-day program. We include two ECE sites in the main evaluation. However, given potential differences between MMSD school sites and ECE sites, including the availability of wrap-around care in the latter, we conduct supplemental analysis including only MMSD school sites. We present the overall distribution of gains for this analysis below.

Figure 11, 12, 13: Distribution of gain scores in 4K across full- and half-day students in MMSD sites



Figures 11, 12, and 13, each show two box plots of the distribution of student assessment gains in year 2 **but restricted to MMSD school sites**—one showing the sample of students who attended half-day 4K and the other the sample of students who had full-day 4K. All show that students who had attended full-day 4K gained similarly on assessments as those who had attended half-day 4K. Although Figure 11 shows a modest advantage in literacy growth for full-day over half-day students, the difference is not statistically distinguishable from 0.



MEP brings together the Madison Metropolitan School District (MMSD) and the Wisconsin Center for Education Research (WCER) at the University of Wisconsin-Madison in a locally based, nationally relevant, research-practice partnership. MEP joins research and practice by engaging in mutually defined, high-quality, problem-based research that contributes to policy, builds capacity, and strengthens practice.

Collaborating on MEP are UW Madison researchers and faculty; MMSD administration, teachers and staff; and stakeholders from the broader Madison community. The partnership enables research to be conducted more quickly and results released more efficiently—to advance strategies that benefit Madison students, families, and schools.

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