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Potential Remediation Strategies in the Wake of COVID-19 School Closures: A Review of the Literature

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Metro Atlanta Policy Lab for Education
Georgia Policy Labs

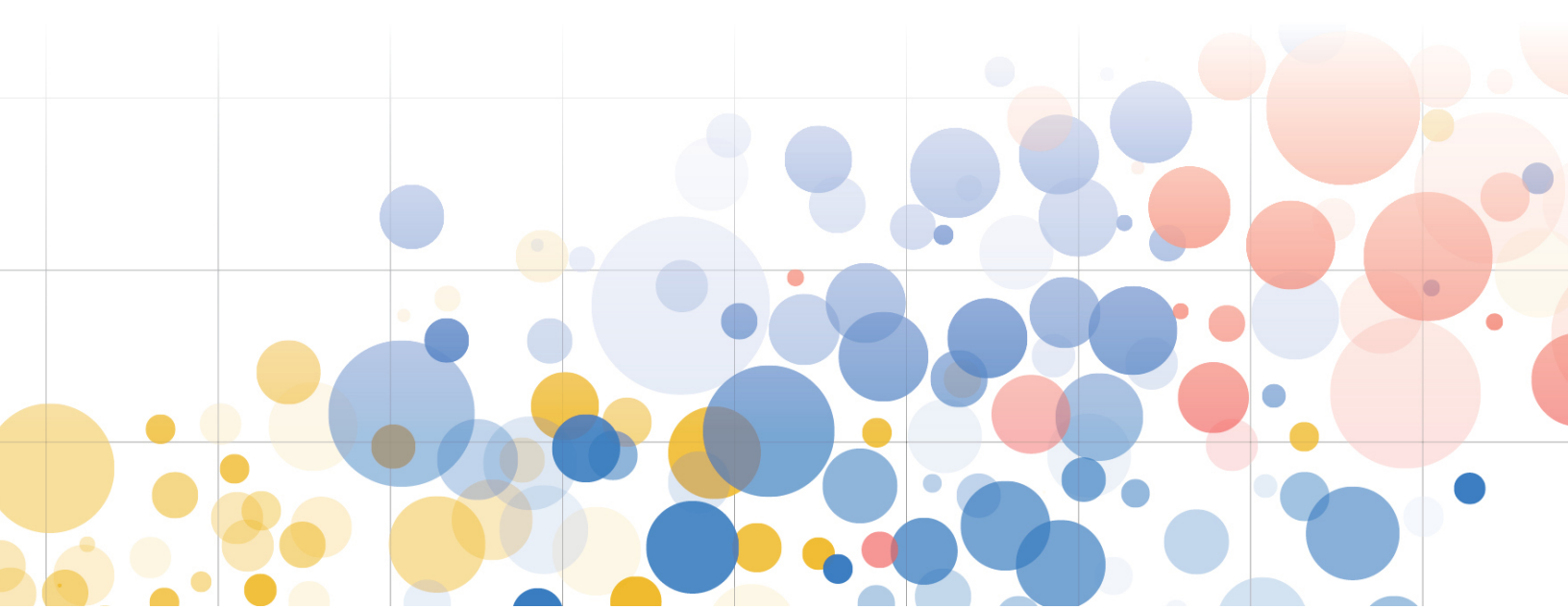
**Potential Remediation Strategies in the
Wake of COVID-19 School Closures: A
Review of the Literature**

July 2020

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DISCLAIMER: All opinions expressed herein are those of the authors and do not necessarily represent the opinions of any school district partner.



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HIGHLIGHTS

- Extending the school day by an hour for an entire school year or instituting summer school programs could eliminate up to one-third of expected learning losses but would likely cost at least \$800 to \$1,100 per student to implement.
- High-intensity tutoring programs could virtually eliminate expected learning losses brought about by COVID-19 school closures, but this strategy would come with a hefty price tag—as much as \$3,800 per student.
- Extending the school year, employing low-intensity tutoring programs during school breaks, or assigning students to the same teacher for multiple years are unlikely to substantially mitigate learning losses brought about by school closures during the pandemic.

BACKGROUND AND MOTIVATION

As a result of reported cases of COVID-19, schools in the metro-Atlanta area began closing on March 12. On March 16, Georgia Governor Brian Kemp signed an executive order closing all public schools in Georgia. On April 1, the order was extended to keep all public schools closed through the end of school year (SY) 2019-20. Following school closures, districts began to offer a variety of remote learning opportunities for students. The ability of students to engage in online learning varied considerably, depending in part on the availability of internet connectivity and access to computers (Herold, 2020; Tagami, 2020; Walker, 2020). The combination of family disruptions due to the COVID-19 pandemic, as well as the closure of schools and transition to remote learning, undoubtedly reduced achievement growth for many students. It is estimated that average learning losses in grades three through seven could be as much as 34 percent of typical school-year learning gains in reading and 63 percent in math (Kuhfeld et al., 2020), which translates to 0.17 standard deviations (SD) in reading test scores and 0.46 SD in math test scores (Thum & Kuhfeld, 2020). These are projections based on typical summer learning loss; the true impact of COVID-19-induced school closures on student achievement will not be known until students are tested in the fall of 2020.

Metro-Atlanta school districts are currently preparing for SY 2020-21, and there is much uncertainty about how the mix of in-person and remote learning will occur. Once schools reopen, they will face the challenge of compensating for the learning losses that occurred while schools were closed.¹ Districts must decide what remediation strategies to pursue and for which students. Given limited resources (which will no doubt be further constrained by the economic fallout from the pandemic), districts will also need to decide the intensity of remediation services, how those services are allocated across students, and for how long remediation should occur.

This report is intended to summarize what is known about the efficacy of potential remediation strategies, thereby providing guidance for districts as they formulate their plans for dealing with COVID-19-related achievement losses. Of course, context is important, and each district faces unique challenges and constraints. Thus, this summary is not intended as a “one-size-fits-all” prescription for dealing with

¹ Many students will likely be facing other challenges, especially related to mental health, economic challenges, and housing changes, but we focus this brief on academic challenges.

learning losses brought about by the pandemic and associated school closures. Rather, the goal is to provide districts with a curated summary of the most relevant research that can help inform individual-district decision making.

APPLICABILITY OF PRIOR RESEARCH

An important consideration in reviewing existing research is that the current COVID-19 pandemic is unique. Schools have been closed since mid-March, resulting in a loss of approximately nine weeks of typical instruction. There are few historical examples of such long-term closures; when schools close mid-year, it is typically due to inclement weather that only lasts for a few days. The one prominent case of long-term school closures in recent times is the shuttering of schools in New Orleans due to Hurricane Katrina. The parallels between closures induced by COVID-19 and those resulting from Hurricane Katrina are far from perfect, however. In New Orleans, Hurricane Katrina led to an exodus from the area, with many students and their families relocating to Houston and Baton Rouge. When students returned to New Orleans, the public-school system was very different, having been transformed into a citywide choice system dominated by charter schools. The available evidence suggests that while students suffered significant achievement losses (0.10 SD) in the year following the hurricane (Sacerdote, 2012), affected students bounced back academically within a few years and appeared to have better outcomes in the long-run than they would have had if Hurricane Katrina and the subsequent school system restructuring had not occurred (Sacerdote, 2012; Deryugina, Kawano, and Levitt, 2018; Harris & Larsen, 2019). While the research on the educational impacts of Hurricane Katrina provides some hope for the long-run educational outcomes of children affected by COVID-19-based school closures, it does not yield much guidance on how to improve student achievement in the short run.

Conversely, there is a significant amount of prior research on the efficacy of various strategies to improve achievement for low-performing students. Below, we review the strategies that appear most relevant to the current pandemic, including increasing instructional time, tutoring, and teacher-student matching or “looping.” It is important to keep in mind, however, that evidence on past remediation efforts is based on situations where schools were open, and families and society had not been disrupted by a public health crisis and economic recession.

EVIDENCE-BASED REMEDIATION STRATEGIES

We focus on three remediation strategies based on their relevance to school-closure-induced learning losses, feasibility of implementation, and the amount of available evidence on their efficacy. Given that the pandemic reduced in-person instructional time by nine weeks in SY 2019-20, the most obvious remediation approach is to provide additional instructional time to make up for the in-class time that was lost. This can come in a variety of forms, from extended school days to instruction during the summer. A popular alternative for helping low-achieving students is to increase the intensity of instruction by offering tutoring services to students. In addition to these two strategies, we also consider teacher-student matching or “looping” strategies as a possible way of mitigating learning losses associated with the COVID-19 pandemic. The implementation of each of these strategies may depend in part on when schools return to fully in-person instruction, which is unknown at this time.

INCREASING INSTRUCTIONAL TIME

The amount of instructional time can be increased by either lengthening the school day or by adding additional instructional days. We consider each strategy in turn.

LENGTHENING THE SCHOOL DAY

There have been a handful of analyses that measured the causal effects of programs designed to lengthen the school day for various student groups outside the United States (e.g., Bellei, 2009; Jensen, 2013; and Battistin & Meroni, 2016). The most rigorous U.S.-based study is an analysis of Florida's "Extended School Day" (ESD) program, which provided an additional hour of literacy instruction in low-performing elementary schools throughout an entire school year (Figlio et al., 2018). The study finds that reading test scores rose by 0.05 standard deviations in the first year of the ESD program, equivalent to about one-third of the currently projected COVID-19 learning loss. Given changes to the program over time, longer-run effects were not clear. The authors estimated that the present value of program benefits from enhanced lifetime earnings for students far exceeded the cost of implementing the program. The expenditure per student was substantial, however, at about \$800 per school year.

INCREASING THE NUMBER OF INSTRUCTIONAL DAYS

One approach to estimating the gains from adding instructional days is to determine the loss in achievement from a reduction in the number of days of instruction. Two studies have examined the reduction in achievement associated with weather-related school closures in Colorado, Maryland, and Massachusetts (Hansen, 2011; Goodman, 2014). The findings varied by location and grade level. Estimated impacts were not significantly different from zero in Massachusetts. In Colorado, there were large losses, ranging from -0.013 SD to -0.039 SD per day for eighth-grade math achievement. In Maryland, results were not significantly different from zero for third graders in math but were significant in fifth- and eighth-grade math, with daily losses ranging from -0.009 SD to -0.016 SD. Like the literature on the impacts of Hurricane Katrina, these studies may not be applicable to the case of adding instructional days to the normal school calendar. They could overestimate the achievement loss if there were other associated disruptions that affected student learning and underestimate the loss if students received remote instruction while away from school. We therefore focus on studies that directly measure the impact of increases in the number of instructional days on student achievement within the context of normal school operations in the United States.²

Sims (2008) studied the impact of a law in Wisconsin that required districts to start school after September 1, effectively reducing the number of class days before spring summative assessments. He found that an additional week of class was associated with a 0.026 SD increase in fourth-grade math scores. However, increasing pre-test instructional time by a week had no effect on average reading and English language scores.

² Pischke (2007) studied the impact of shortened school years in Germany on educational attainment, employment, and earnings, while Parinduri (2014) estimated the effect of longer school years in Indonesia on educational attainment and earnings. Carlsson et al. (2015) analyzed the effect of the number of school days on cognitive test outcomes for young men in Sweden. Finally, Lavy (2015) studied variation in instructional time across countries and its relationship to student test scores.

In North Carolina, districts have had discretion on the exact timing of state assessments (within an allowed window). Aucejo and Romano (2016) leveraged this cross-district variation to determine the effect of additional instructional days prior to testing on measured student achievement. They found that extending the school calendar prior to testing by 10 instructional days led to increases in math scores by 0.017 SD and reading scores by 0.008 SD. If current projections are correct, this would only make up for 10 percent of the COVID-19-induced learning loss in reading and less than 2 percent of the loss in math.

It may matter when extra instructional time is offered and whether it is voluntary. Augustine et al. (2016) conducted a randomized controlled trial to evaluate the efficacy of a voluntary summer learning program. In spring 2013, third-grade students were recruited for the program and randomly assigned into a “treatment” group that was offered two summers of programming and a “control” group that was not offered any summer programming. Students in the treatment group generated greater gains in math achievement (0.08 SD) in the fall immediately after the first summer of programming relative to students in the control group. There were no corresponding gains in language arts achievement. Later in the school year, there were no statistically significant differences in outcomes in either subject, and there were no differences after the second summer of programming. The lack of sizable and sustained impacts is likely due in part to poor attendance. Twenty-one percent of students in the treatment group did not participate at all during the first summer and another 29 percent exhibited low attendance, showing up for 19 or fewer days during the summer. Attendance was even worse the second summer, with only 31 percent of treatment-group students having high attendance.

Whether adding days to the regular school calendar or creating instructional days in the summer, increasing instructional time is costly. Silva (2007) reports that a project to expand learning time in Massachusetts by 30 percent increased per-student costs by about 20 percent (or \$1,300 per school year).

TUTORING

An alternative to increasing the number of instructional hours is to increase the intensity of instruction by employing small-group instruction or tutoring. The existing literature provides strong evidence that tutoring can substantially increase student achievement, especially among low-achieving students and students disadvantaged by other inequities such as race and economic status, but the efficacy of this approach depends critically on group size and the frequency of sessions.

Fryer (2016) defined “high-dosage” tutoring as being tutored in groups of six or fewer students that meet four or more times per week—equivalent to 50 hours or more over 36 weeks. Summarizing the results of multiple experimental studies, he found that tutoring programs meeting the high-dosage criteria yielded substantial increases in test scores, raising math achievement by 0.31 SD and reading achievement by 0.23 SD. In contrast, the effect of low-dosage tutoring was not statistically significant for either subject.

Cook et al. (2015) described a randomized controlled trial of the MATCH tutorial system in 12 high schools in the south and west sides of Chicago in which students were predominately Black or Hispanic and over 90 percent of students were eligible for free or reduced-price lunch. MATCH provided two-to-one individualized instruction in math for one 55-minute class period per day—the equivalent of 165 hours per year. The randomization sample included over 2,700 rising ninth grade male students. Recent college

graduates with strong math and interpersonal skills were recruited to act as tutors. The intervention produced sizable gains in math achievement, raising test scores by 0.19 SD to 0.31 SD. Costs, however, were substantial at about \$3,800 per student per year.

Kraft (2015) studied a similar tutoring model employed by the MATCH charter school in Boston. In SY 2004-05, MATCH Charter extended its school day by two hours for four days a week. The additional time was used to integrate two hours of individualized tutoring classes throughout the school day. Tutors were high-achieving recent college graduates. Based on a difference-in-differences design, Kraft (2015) found that the tutoring program increased achievement on tenth-grade English language arts exams by 0.15 SD to 0.25 SD per year but had no effect on math test scores. However, the tutoring program did raise math achievement for students at the lowest end of the achievement distribution.

Fryer and Howard-Noveck (2020) used a school-level randomized experiment to estimate the effects of a high-dosage reading tutoring program in New York City public schools. Across three years, schools offered at least 130 hours of four-to-one tutoring. Treatment schools provided two and a half hours of daily after-school programming, which included 45-60 minutes of four-to-one reading tutoring for a subset of students. The availability of tutoring substantially improved attendance in the after-school program and yielded a modest improvement in school attendance of 0.3 percentage points. However, it did not have a statistically significant impact on ELA test scores.

Schueler (2020) provided experimental evidence on the effectiveness of “Vacation Academies,” a program designed to provide struggling sixth and seventh graders with intensive math instruction over weeklong vacation breaks. The program was implemented in a set of nine low-performing middle schools in Springfield, Massachusetts, that were undergoing turnaround reforms. Instruction was provided by regular classroom teachers who were selected based on principal recommendations and a sample math lesson. The student-teacher ratio was about 10 to one and instruction focused solely on math. Attendance at “Vacation Academies” increased the probability that students scored proficient or higher on Common Core-aligned math exams by 10 percentage points. However, there were no statistically significant effects on a continuous measure of standardized math test scores.

TEACHER/CLASSMATE ASSIGNMENTS

A potentially low-cost remediation strategy is assigning the same teacher to students for multiple years, known as “looping.” Hill and Jones (2018) studied students in grades three to five in North Carolina and compared outcomes for students who were assigned to the same teacher at least twice in different grades with students who always had different teachers in each grade. While students were not randomly assigned to teachers, the authors controlled for time-invariant teacher and student characteristics with a set of teacher and student “fixed effects.” They found that students with a repeated student-teacher match scored higher on standardized math exams by 0.018 SD to 0.020 SD. Gains from looping were smaller in reading: 0.012 SD to 0.013 SD.³

³ A study of Chinese elementary students (Wang et al., 2017) also found positive effects of looping. Employing models that controlled for teacher quality with a set of observable teacher characteristics, they estimated looping effects of 0.17 SD to 0.19 SD. Kirksey and Gottfried (2018) showed that having classmates from the previous school year also helped to reduce unexcused absences and chronic absenteeism.

SUMMARY AND CONCLUSIONS

In the wake of school closures brought about by the COVID-19 pandemic, many students have undoubtedly suffered decreases in student achievement growth and will start SY 2020-21 behind where they would have been had the pandemic not occurred. Schools are faced with the challenge of how to remediate those learning losses as best they can.

In this report, we reviewed the existing causal evidence on the efficacy of three potential remediation strategies: increasing instructional time (though extending the school day, lengthening the school year, or adding instructional time during the summer), various forms of small group instruction or tutoring, and “looping” strategies whereby students are paired with the same teacher for multiple years. Table 1 provides a summary of the impacts and costs of these strategies.

Table 1. Projected Learning Loss and Estimated Impacts of Alternative Remediation Strategies (Months of Learning)

Loss/Remediation Strategy	Math (months of learning)	Reading/ Language Arts (months of learning)	Cost per Student per School Year (dollars per school year)
<i>Projected learning loss</i>	-5.93	-3.19	
Lengthen school day by one hour for entire year (reading instruction only)		0.97	\$800
Lengthen school year by two weeks	0.20 – 0.62	0.00 – 0.15	
Voluntary summer program (five days per week, min. five weeks, max. 15 students)	0.95		\$1,070 to \$1,700
High-intensity tutoring (groups of six or fewer students per tutor that meet 4 or more times per week)	2.26 – 3.69	2.90 – 4.83	Up to \$3,800
“Vacation Academies” (week-long single subject instruction with groups of approximately 10 students)	0.00		
“Looping” (assigning the same teacher to students for multiple years)	0.21 – 0.24	0.23 – 0.25	

Notes. Learning loss projections are from Kuhfeld et al. (2020) and are averages over grades three through seven. Gains from potential remediation strategies are converted from standard deviation units into months of learning in a 9.5-month school year based on typical learning gains and standard deviations presented in Thum and Kuhfeld (2020) for grades three through seven. No adjustment has been made for differences in the grades analyzed in various studies. Statistically insignificant impacts are treated as zero values. Costs have not been adjusted for inflation. Impacts are measured immediately following the end of the intervention and may fade out over time.

Among the various methods to increase instructional time considered herein, lengthening the school year by two weeks produces only modest improvements to student achievement and would do little to ameliorate learning losses caused by pandemic-induced school closures. In contrast, lengthening the school day by an hour or instituting summer school programs could reduce anticipated learning losses by as much as one-third. Districts could expect even greater gains in achievement from implementing high-intensity tutoring programs where at most a handful of students work daily with a tutor. Such programs could be extremely expensive to implement, however, and thus would likely only be feasible for the students who were most severely impacted by school closures. Other less expensive strategies, such as low-intensity tutoring through “Vacation Academies” or placing students with the same teacher for multiple years (i.e., “looping”), appear unlikely to do much to make up for learning losses incurred while students were away from school.

REFERENCES AND ABSTRACTS

HURRICANE KATRINA

Deryugina, Tatyana, Laura Kawano, and Steven Levitt (2018). “The Economic Impact of Hurricane Katrina on Its Victims: Evidence from Individual Tax Returns,” *American Economic Journal: Applied Economics*, 10(2):202–233.

ABSTRACT—Hurricane Katrina destroyed over 200,000 homes and led to massive economic and physical dislocation. Using a panel of tax return data, we provide one of the first comprehensive analyses of the hurricane’s long-term economic impact on its victims. Hurricane Katrina had large and persistent impacts on where people live, but small and surprisingly transitory effects on employment and income. Within just a few years, Katrina victims’ incomes actually surpass that of controls from similar unaffected cities. The strong economic performance of Hurricane Katrina victims is particularly remarkable given that the hurricane struck with essentially no warning.

Harris, Douglas N. and Matthew F. Larsen (2019). “The Effects of the New Orleans Post-Katrina Market-Based School Reforms on Medium-Term Student Outcomes.” Education Research Alliance for New Orleans Technical Report. Available at educationresearchalliancenola.org/files/publications/Harris-Larsen-Reform-Effects-2019-08-01.pdf

ABSTRACT—The post-Katrina New Orleans school reforms created the nation’s most intensive market-based school system. Non-profit charter schools operate almost all schools under performance-based contracts. With the end of teacher collective bargaining and tenure, schools have authority over personnel decisions. Families choose their schools. The reforms also attracted additional funding. Using matched difference-in-differences, we find that these reforms increased test scores, high school graduation, college attendance, and college graduation. While the precise magnitudes are difficult to establish, even the lower end of these ranges are economically large. The policies also appear to have reduced most achievement gaps by race and income.

Sacerdote, Bruce (2012). "When the Saints Go Marching Out: Long-Term Outcomes for Student Evacuees from Hurricanes Katrina and Rita," *American Economic Journal: Applied Economics*, 4(1):109–135.

ABSTRACT—I examine long-term academic performance and college going for students affected by Hurricanes Katrina and Rita. Students who are forced to switch schools due to the hurricanes experience sharp declines in test scores in the first year following the hurricanes. However, by the third and fourth years after the disaster, evacuees displaced from Orleans Parish see a 0.18 standard deviation improvement in scores. Gains are concentrated among students initially in the lowest quintiles of the test score distribution. Katrina evacuees do not show gains in college going relative to earlier cohorts from their same pre-hurricane high schools.

LEARNING LOSS AND DIGITAL ACCESS

Herold, Benjamin (2020). "The Disparities in Remote Learning Under Coronavirus (in Charts)," *Education Week*, April 10, 2020.

Kuhfeld, Megan, James Soland, Beth Tarasawa, Angela Johnson, Erik Ruzek, and Jing Liu (2020). "Projecting the potential impacts of COVID-19 school closures on academic achievement." EdWorkingPaper: 20-226. Available at doi.org/10.26300/cdrv-yw05

ABSTRACT—With 55 million students in the United States out of school due to the COVID-19 pandemic, education systems are scrambling to meet the needs of schools and families, including planning how best to approach instruction in the fall given students may be farther behind than in a typical year. Yet, education leaders have little data on how much learning has been impacted by school closures. While the COVID-19 learning interruptions are unprecedented in modern times, existing research on the impacts of missing school (due to absenteeism, regular summer breaks, and school closures) on learning can nonetheless inform projections of potential learning loss due to the pandemic. In this study, we produce a series of projections of COVID-19-related learning loss and its potential effect on test scores in the 2020-21 school year based on (a) estimates from prior literature and (b) analyses of typical summer learning patterns of five million students. Under these projections, students are likely to return in fall 2020 with approximately 63-68% of the learning gains in reading relative to a typical school year and with 37-50% of the learning gains in math. However, we estimate that losing ground during the COVID-19 school closures would not be universal, with the top third of students potentially making gains in reading. Thus, in preparing for fall 2020, educators will likely need to consider ways to support students who are academically behind and further differentiate instruction.

Tagami, Ty (2020). "Time will tell the toll on schools closed for virus," *Atlanta Journal Constitution*, April 12, 2020, p.1.

Thum, Yeow Meng and Megan Kuhfeld (2020). "Achievement Status and Growth Norms: Tables for Students and Schools," NWEA Research. Available at teach.mapnwea.org/impl/NormsTables.pdf

Walker, Marlon A. (2020). "Some students locked out of virtual classes," *Atlanta Journal Constitution*, April 26, 2020, p.1.

INCREASED LEARNING TIME

Aucejo, Esteban M. and Teresa Foy Romano (2016). "Assessing the effect of school days and absences on test score performance." *Economics of Education Review* 55: 70-87.

ABSTRACT—While instructional time is viewed as crucial to learning, little is known about the effectiveness of reducing absences relative to increasing the number of school days. Using administrative data from North Carolina public schools, this paper jointly estimates the effect of absences and length of the school calendar on test score performance. We exploit a state policy that provides variation in the number of school days prior to standardized testing and find substantial differences between these two effects. Extending the school calendar by ten days increases math and reading test scores by only 1.7% and 0.8% of a standard deviation, respectively. A similar reduction in absences would lead to gains of 5.5% in math and 2.9% in reading. We perform a number of robustness checks including utilizing flu data to instrument for absences, family-year fixed effects, distinguishing between excused and unexcused absences, and controlling for a contemporaneous measure of student disengagement. Our results are robust to these alternative specifications. In addition, our findings indicate considerable heterogeneity across student ability, suggesting that targeting absenteeism among low performing students could aid in narrowing current gaps in performance.

Augustine, Catherine H., Jennifer Sloan McCombs, John F. Pane, Heather L. Schwartz, Jonathan Schweig, Andrew McEachin, Kyle Siler-Evans (2016). "Learning from Summer: Effects of Voluntary Summer Learning Programs on Low-Income Urban Youth." Santa Monica, CA: RAND Corporation, 2016. Available at www.rand.org/pubs/research_reports/RR1557.html

ABSTRACT—The National Summer Learning Project, launched by the Wallace Foundation in 2011, includes an assessment of the effectiveness of voluntary, district-led summer learning programs offered at no cost to low-income, urban elementary students. The study, conducted by RAND, uses a randomized controlled trial and other analytic methods to assess the effects of district-led programs on academic achievement, social-emotional competencies, and behavior over the near and long term. All students in the study were in the third grade as of spring 2013 and enrolled in a public school in one of five urban districts: Boston; Dallas; Duval County, Florida; Pittsburgh; or Rochester, New York. The study follows these students from third to seventh grade; this report describes outcomes through fifth grade. The primary focus is on academic outcomes but students' social-emotional outcomes are also examined, as well as behavior and attendance during the school year. Among the key findings are that students with high attendance in one summer benefited in mathematics and that these benefits persisted through the following spring; students with high attendance in the second summer benefited in mathematics and language arts and in terms of social-emotional outcomes; and that high levels of academic time on task led to benefits that persisted in both mathematics and language arts.

Battistin, Erich and Elena Claudia Meroni (2016). "Should we increase instruction time in low achieving schools? Evidence from Southern Italy." *Economics of Education Review* 55: 39-56.

ABSTRACT—This paper investigates the short term effects of a large scale intervention, funded by the European Social Fund, which provides additional instruction time to selected classes of low secondary schools in Southern Italy. Selection is addressed using institutional rules that regulate class formation: first

year students are divided into groups distinguished by letters, they remain in the same group across grades at the school, and the composition of teachers assigned to groups is stable over time. Using a difference-in-differences strategy, we consider consecutive cohorts of first year students enrolled in the same group. We compare participating groups to non-participating groups within the same school, as well as to groups in non-participating schools. We find that the intervention raised scores in mathematics for students from the least advantaged backgrounds. We also find that targeting the best students with extra activities in language comes at the cost of lowering performance in mathematics. We go beyond average effects, finding that the positive effect for mathematics is driven by larger effects for the best students.

Bellei, Cristián (2009). "Does lengthening the school day increase students' academic achievement? Results from a natural experiment in Chile." *Economics of Education Review* 28(5): 629-640.

ABSTRACT—This study (an impact evaluation of the Chilean full school day program) uses difference-in-differences to estimate the effect of a large increase in instructional time on high school students' academic achievement. The main findings are (i) the program had a positive effect on students' achievement in both mathematics and language; (ii) the effect-size on language achievement was 0.05–0.07 standard deviations and not sensitive to control for covariates, different control groups, and historical trends; (iii) the effect on mathematics achievement was not sensitive to control for covariates, but was sensitive to use different control groups, and historical trends; the effect-size on mathematics achievement ranged from 0.00 to 0.12 standard deviations; and (iv) the program effect has been constant over time. Finally, there is evidence suggesting that the program had larger positive effects on rural students, students who attended public schools, and students situated in the upper part of the achievement distribution.

Carlsson, Magnus, Gordon B. Dahl, Björn Öckert and Dan-Olod Rooth (2015). "The Effect of Schooling on Cognitive Skills." *Review of Economics and Statistics* 97(3): 533–547.

ABSTRACT—To identify the causal effect of schooling on cognitive skills, we exploit conditionally random variation in the date Swedish males take a battery of cognitive tests in preparation for military service. We find an extra ten days of school instruction raises scores on crystallized intelligence tests (synonyms and technical comprehension tests) by approximately 1% of a standard deviation, whereas extra nonschool days have almost no effect. In contrast, test scores on fluid intelligence tests (spatial and logic tests) do not increase with additional days of schooling but do increase modestly with age.

Figlio, David, Kristian Holden and Umut Ozek (2018). "Do Students Benefit from Longer School Days? Regression Discontinuity Evidence from Florida's Additional Hour of Literacy Instruction." *Economics of Education Review*, 67:171-183.

ABSTRACT—Instructional time is a fundamental educational input, yet we have little causal evidence about the effect of longer school days on student achievement. This paper uses a sharp regression discontinuity design to estimate the effects of lengthening the school day for low-performing schools in Florida by exploiting an administrative cutoff for eligibility. Our results indicate significant positive effects of additional literacy instruction on student reading achievement. In particular, we find effects of 0.05 standard deviations of improvement in reading test scores for program assignment in the first year, though long-run effects are difficult to assess.

Hansen, Benjamin (2011). "School year length and student performance: Quasi-experimental evidence." *Available at SSRN 2269846*.

ABSTRACT—This paper investigates the impact of instructional days on student performance. Because school year length is endogenously determined, I estimate the causal impact of school year length through two quasi-experiments that exploit different sources of variation in instructional days. The first identifies school year length's effect through weather-related cancellations in Colorado and Maryland. Weather-related cancellations are made up at the end of school years, allowing relatively large fluctuations in instructional days within school districts prior to test administration. Because school cancellations are not recorded for past school years, this data limitation is overcome by using two-sample indirect least squares. The second identification strategy takes advantage of state-mandated changes in test-date administration in Minnesota, which moved 5 times in 5 years. The results are similar for either source of instructional day variation: more instructional time prior to test administration increases student performance. The effects are consistent across various thresholds of performance and grade levels.

Goodman, Joshua. (2014). "*Flaking out: Student absences and snow days as disruptions of instructional time* (No. w20221)." National Bureau of Economic Research.

ABSTRACT—Despite the fact that the average American student is absent more than two weeks out of every school year, most research on the effect of instructional time has focused not on attendance but on the length of the school day or year. Student and school fixed effects models using Massachusetts data show a strong relationship between student absences and achievement but no impact of lost instructional time due to school closures. I confirm those findings in instrumental variables models exploiting the fact that moderate snowfall induces student absences while extreme snowfall induces school closures. Prior work ignoring this non-linearity may have mis-attributed the effect of absences to such snow days. Each absence induced by bad weather reduces math achievement by 0.05 standard deviations, suggesting that attendance can account for up to one-fourth of the achievement gap by income. That absences matter but closures do not is consistent with a model of instruction in which coordination of students is the central challenge, as in Lazear (2001). Teachers appear to deal well with coordinated disruptions of instructional time like snow days but deal poorly with disruptions like absences that affect different students at different times.

Jensen, Vibeke Myrup (2013). "Working longer makes students stronger? The effects of ninth grade classroom hours on ninth grade student performance." *Educational Research* 55(2): 180-194.

ABSTRACT—Despite much discussion on the role of education policy on school and student performance, we know little about the effects of school spending at the margin on student cognitive achievement beyond the effects of class size. Thus this paper examines the effects of annual ninth grade classroom hours in literacy and maths on ninth grade (aged 16) student performance in writing and maths, respectively. Using population data for Denmark in 2003-2006, I exploit unique policy-induced variation in classroom hours. On average, the reform changed classroom hours by 2.2-3.3% in literacy and maths, with an impact on student achievement. For literacy I find no significant effects of classroom hours, but for maths I find stronger effects. One additional hour per year increases the maths score by 0.21% of a standard deviation.

Lavy, Victor (2015). "Do Differences in Schools' Instruction Time Explain International Achievement Gaps? Evidence from Developed and Developing Countries." *Economic Journal* 125:F397-F424.

ABSTRACT—The time that children spend in school varies across countries. Do these differences explain international gaps in pupils' academic achievements? In this article I estimate the effects of instructional time on students' achievement using PISA 2006 data, which include data samples from over 50 countries. I find that instructional time has a positive and significant effect on test scores, and that the effect is much lower in developing countries. Evidence also suggests that the productivity of instructional time is higher in countries which implemented school accountability measures or that gave schools autonomy in budgetary decisions and in hiring/firing teachers.

Parinduri, Rasyad A. (2014). "Do children spend too much time in schools? Evidence from a longer school year in Indonesia," *Economics of Education Review* 41:89-104.

ABSTRACT—I examine the effects of a longer school year in Indonesia on grade repetition, educational attainment, employability, and earnings. I exploit an arbitrary rule that assigned students to a longer school year in Indonesia in 1978–1979, which fits a fuzzy regression discontinuity design. I find the longer school year decreases the probability of grade repetition and increases educational attainment; it also increases the probability of working in formal sectors and wages later in life. These results suggest the length of school years in Indonesia is not too long.

Pischke, Jörn-Steffen (2007). "The impact of length of the school year on student performance and earnings: Evidence from the German short school years," *The Economic Journal* 117(523): 1216-1242.

ABSTRACT—This article investigates how changing the length of the school year, leaving the basic curriculum unchanged, affects learning and subsequent earnings. I use variation introduced by the West German short school years in 1966–7, which exposed some students to a total of about two thirds of a year less of schooling while enrolled. I find that the short school years increased grade repetition in primary school and led to fewer students attending higher secondary school tracks. On the other hand, the short school years had no adverse effect on earnings and employment later in life.

Silva, Elena (2007). "On the clock: Rethinking the way schools use time," Washington, DC: Education Sector.

Sims, David P. (2008). "Strategic responses to school accountability measures: It's all in the timing." *Economics of Education Review* 27(1): 58-68.

ABSTRACT—The adoption of state accountability testing in the 1990s coincided with the movement of some school start dates from September into August. Using data from Wisconsin, this paper connects these phenomena, showing that some low-scoring districts advanced their school start dates to allow their students more time to prepare for exams. I use a 2001 Wisconsin state law that restricted districts to start dates after September 1st to identify the effects of this extra time on student achievement. Extra classroom days are associated with small increases in Math scores for 4th graders, but not average reading or language scores. Extra classroom time may also have increased third grade reading scores for students in the upper portion of the ability distribution.

TUTORING

Cook, Philip J., Kenneth A. Dodge, George Farkas, Roland G. Fryer, Jonathan Guryan, Jens Ludwig, Susan E. Mayer, Harold A Pollack and Laurence Steinberg. "Not Too Late: Improving Academic Outcomes for Disadvantaged Youth (WP-15-01)." (2015).

ABSTRACT—There is growing concern that improving the academic skills of children in poverty is too difficult and costly once they reach adolescence, and so policymakers should instead focus either on vocationally oriented instruction or else on early childhood education. Yet this conclusion might be premature given that so few previous interventions have targeted a key barrier to school success: "mismatch" between what schools deliver and the needs of youth, particularly those far behind grade level. The researchers report on a randomized controlled trial of a school-based intervention that provides disadvantaged youth with intensive individualized academic instruction. The study sample consists of 2,718 male ninth and tenth graders in 12 public high schools on the south and west sides of Chicago, of whom 95 percent are either black or Hispanic and more than 90 percent are free- or reduced-price lunch eligible. Participation increased math achievement test scores by 0.19 to 0.31 standard deviations (SD), depending on how the researchers standardize, increased math grades by 0.50 SD, and reduced course failures in math by one-half in addition to reducing failures in non-math courses. While some questions remain, these impacts on a per-dollar basis—with a cost per participant of around \$3,800, or \$2,500 if delivered at larger scale—are as large as those of almost any other educational intervention whose effectiveness has been rigorously studied.

Fryer, Roland G., Jr. (2016). "The Production of Human Capital in Developed Countries: Evidence from 196 Randomized Field Experiments (No. w22130)." National Bureau of Economic Research.

ABSTRACT—Randomized field experiments designed to better understand the production of human capital have increased exponentially over the past several decades. This chapter summarizes what we have learned about various partial derivatives of the human capital production function, what important partial derivatives are left to be estimated, and what – together – our collective efforts have taught us about how to produce human capital in developed countries. The chapter concludes with a back of the envelope simulation of how much of the racial wage gap in America might be accounted for if human capital policy focused on best practices gleaned from randomized field experiments.

Fryer, Roland G., Jr and Meghan Howard-Noveck, (2020). "High-Dosage Tutoring and Reading Achievement: Evidence from New York City," *Journal of Labor Economics* 38(2): 421-452.

ABSTRACT—This study examines the impact on student achievement of high-dosage reading tutoring for middle school students in New York City public schools, using a school-level randomized field experiment. Across 3 years, schools offered at least 130 hours of four-on-one tutoring based on a guided reading model. At the mean, tutoring had a positive and significant effect on school attendance, a positive but insignificant effect on English language arts (ELA) state test scores, and no effect on math state test scores. For black students, our treatment increased attendance by 2.0 percentage points and ELA scores by 0.09 standard deviations per year.

Kraft, Matthew (2015). How to Make Additional Time Matter: Integrating Individualized Tutorials into an Extended Day. *Education Finance and Policy*, 10(1), 81-116.

ABSTRACT—Support for extending the school day has gained substantial momentum despite limited causal evidence that it increases student achievement. Existing evidence is decidedly mixed, in part, because of the stark differences in how schools use additional time. In this paper, I focus on the effect of additional time in school when that time is used for individualized tutorials. In 2005, MATCH Charter Public High School integrated two hours of individualized tutorials throughout an extended school day. The unanticipated implementation of this initiative and the school's lottery enrollment policy allow me to use two complementary quasi-experimental methods to estimate program effects. I find that providing students with two hours of daily tutorials that are integrated into the school day and taught by full-time, recent college graduates increased achievement on 10th grade English language arts exams by 0.15- 0.25 standard deviations per year. I find no average effect in mathematics beyond the large gains students were already achieving, although quantile regression estimates suggest that the tutorials raised the lowest end of the achievement distribution in mathematics.

Schueler, Beth E. (2020). "Making the Most of School Vacation: A Field Experiment of Small Group Math Instruction," *Education Finance and Policy*, 15(2):310-331.

ABSTRACT—Catching students up who have fallen behind academically is a key challenge for educators, and can be difficult to do in a cost-effective manner. This field experiment examines the causal effect of a program designed to provide struggling sixth and seventh graders with math instruction delivered in small groups of roughly ten students by select teachers over weeklong vacation breaks. The program was implemented in a set of low-performing Massachusetts middle schools undergoing turnaround reforms. Attendance at these "Vacation Academies" increased the probability that students scored proficient or higher on Common Core-aligned math exams by 10 percentage points and reduced students' exposure to exclusionary discipline by decreasing out-of-school suspensions post-Academy. I find suggestive evidence of positive spillover effects on English Language Arts achievement and end-of-course grades in math and reading. Participants assigned to a single primary teacher for the entire week saw larger reductions in out-of-school suspensions than did students who rotated through teachers specializing in particular lessons. However, teacher specialization was associated with greater test score gains, suggesting a trade-off in outcomes depending on program design. Overall, the program's low cost and lack of a highly competitive teacher selection process make it a scalable approach to individualizing instruction.

LOOPING

Hill, Andrew J. and Daniel B. Jones (2018). "A teacher who knows me: The academic benefits of repeat student-teacher matches," *Economics of Education Review*, 64:1-12.

ABSTRACT—We provide new empirical evidence that increased student-teacher familiarity improves academic achievement in elementary school. Drawing on rich statewide administrative data, we observe small but significant test score gains for students assigned to the same teacher for a second time in a higher grade. We control for selection into repeat student-teacher matches with teacher fixed effects and either student fixed effects or flexible controls for student past achievement. The effects are largest for minorities, and there is some evidence that gains are most evident for students with generally less

effective teachers (as measured by value-added). We also provide suggestive evidence of spillover benefits: students assigned to classes in which a large share of classmates are in repeat student-teacher matches experience gains even if not previously assigned to that teacher themselves. This suggests that effects at least partly operate through improvements in the general classroom learning environment. Overall, our findings indicate that there may be potential low-cost gains from the policy of “looping” in which students and teachers progress through early school grades together, and may explain the recent experimental evidence that teacher specialization has negative effects on student achievement given that this likely decreases student-teacher familiarity.

Kirksey, J. Jacob and Michael A. Gottfried, "Familiar Faces: Can Having Similar Classmates from Last Year Link to Better School Attendance This Year?" *The Elementary School Journal* 119(2):223-243.

ABSTRACT—Identifying driving factors of school attendance in elementary grades has come to the forefront of policy discussion. Little research has been dedicated to understanding the role of classroom context, and no studies have examined whether having classmates from the previous school year who are also present in the current classroom might influence absenteeism (i.e., familiar faces). This study uses district data to explore whether the percentage of familiar faces is associated with absence outcomes for students. The findings suggest that having familiar faces from the previous school year was linked to lower numbers of unexcused absences and lower odds of chronic absenteeism. This suggests that elementary school students might benefit from peer stability, and policy makers and educational stakeholders might help students maintain some degree of familiarity by considering the role of consistent classmates.

Wang, Lei, Mengying Wu, Yaojing Shi, Yazhuo Cheng, Prashant Loyalka, James Chu, Kaleigh Kenny, and Scott Rozelle (2017). “The Effect of Teacher Looping on Student Achievement: Evidence from Rural China,” Stanford University, Rural Education Action Program Working Paper 318.

ABSTRACT—One form of classroom organization that may influence student achievement is teacher looping – a classroom arrangement in which teachers stay with the same group of students for two or more consecutive years. We employ a student fixed-effects model to estimate the impact of teacher looping on student achievement in rural China. We find that students in looping classrooms perform significantly better than their peers in non-looping classrooms. We also find that poor and boarding students, in particular, benefit from looping classroom organization. The gender of the looping teacher does not appear to impact student outcomes.

ABOUT THE AUTHORS

Weixiang Pan is a postdoctoral research associate with the Georgia Policy Labs. His fields of interest include labor economics, education, and applied econometrics. His research examines topics such as the labor market returns to higher education and the effects of job losses on education investment. His research is published in the *Journal of Labor Economics*, *Labour Economics*, and the *Economics of Education Review*. He received his Ph.D. in economics from the University of Illinois at Chicago. In the fall, he will join the Shanghai University of Finance and Economics as a faculty member.

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ABOUT THE GEORGIA POLICY LABS

The Georgia Policy Labs (GPL) is a collaboration between Georgia State University and a variety of government agencies to promote evidence-based policy development and implementation. Housed in the Andrew Young School of Policy Studies, GPL works to create an environment where policymakers have the information and tools available to improve the effectiveness of existing government policies and programs, try out new ideas for addressing pressing issues, and decide what new initiatives to scale. The goal is to help government entities more effectively use scarce resources and make a positive difference in people's lives. GPL has three components: The Metro Atlanta Policy Lab for Education works to improve K-12 educational outcomes; the Career & Technical Education Policy Exchange focuses on high-school-based career and technical education in multiple U.S. states; and the Child & Family Policy Lab examines how Georgia's state agencies support the whole child and the whole family. In addition to conducting evidence-based policy research, GPL serves as a teaching and learning resource for state officials and policymakers, students, and other constituents. See more at gpl.gsu.edu.