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Implementation and Outcomes of the Four-Day School Week

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Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN: 978-1-9774-0776-4

Cover image: vitalyzorkin/stock.adobe.com.

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About This Report

This report provides information on the implementation and outcomes of the four-day school week (4dsw) using quantitative and qualitative data from a variety of sources. We administered surveys of parents and students in 36 districts in three states that have substantial numbers of 4dsw districts: Idaho, New Mexico, and Oklahoma. We visited 12 of those 36 districts and conducted interviews and focus groups with parents, students, teachers, school administrators, and other stakeholders. We also obtained administrative data for six states with high numbers of 4dsw districts. This report adds to the literature by providing the richest qualitative data on the 4dsw to date, analyzing the broadest set of outcomes for a variety of stakeholders, and using the most up-to-date data available. We aim to provide objective evidence to help families, legislators, school boards, districts, and states' departments of education make decisions about the 4dsw. A separately available Appendix C (Kilburn et al., 2021) presents related materials.

This study was undertaken by two divisions of the RAND Corporation: RAND Education and Labor and RAND Social and Economic Well-Being. RAND Education and Labor conducts research on early childhood through postsecondary education programs, workforce development, and programs and policies affecting workers, entrepreneurship, and financial literacy and decisionmaking. Questions about RAND Education and Labor should be directed to educationandlabor@rand.org. RAND Social and Economic Well-Being is a division of the RAND Corporation that seeks to actively improve the health and social and economic well-being of populations and communities throughout the world. For more information, email sbp@rand.org.

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Summary

Moving from a traditional five-day to a shorter, four-day school week (4dsw) is a growing trend, especially across states west of the Mississippi River. States with large rural areas that have smaller school districts are leading the change; these include Colorado, Idaho, Missouri, Montana, Oklahoma, Oregon, New Mexico, and South Dakota. Other states, too, have adopted or expressed interest in the 4dsw in recent years. Among these are Iowa and Texas, as well as Florida. The most popular 4dsw schedule holds classes Monday through Thursday, with a Tuesday-through-Friday schedule being the second most popular (Thompson et al., 2020). To meet state regulations on minimum instructional time, the 4dsw districts typically have longer school days compared with the number of hours each day that districts with a five-day school week (5dsw) meet.

Why are some districts embracing this change? Studies have noted that shifts to the 4dsw appear to increase during financial downturns (National Conference of State Legislatures, 2020; Thompson et al., 2020), and a primary motive for making the shift is to save money on school-related costs such as hourly staff salaries and student transportation (Thompson et al., 2020). One recent surge in 4dsw adoptions came on the heels of the Great Recession, which coincided with a large real decline in state funding per pupil (Leachman and Figueroa, 2019). In addition to financial savings, districts also see the 4dsw as offering other merits: the extra day out of school could serve as a benefit to help attract and retain quality teachers, could increase student and teacher attendance, could provide greater time for professional development, and could give students and teachers more time to spend with family (Missouri State University, 2020; Thompson et al., 2020). Thus far, the 4dsw is very popular among parents (Turner, Finch, and Uribe-Zarain, 2019) and teachers (Turner, Finch, and Uribe-Zarain, 2018b), with views on it among other members of the community being split (Turner, Finch, and Uribe-Zarain, 2018a).

To date, however, information on how schools implement the 4dsw and its effects on students, teachers, families, and communities is mixed or based on studies of individual states. Despite uncertainty, however, school, district, and state education leaders are still charged with making choice about the 4dsw.

While some states have welcomed the switch, others have started moving away from the model. In February 2018, for example, New Mexico used a funding bill to put a moratorium on 4dsw expansion throughout the state.

To fill in gaps regarding the ways in which the 4dsw is implemented and to better understand the effects of its implementation, the RAND Corporation has conducted the largest study to date of its implementation and outcomes. This study employed both qualitative and quantitative analysis, and we analyzed data collected explicitly for this study (original data) as well as existing data from publicly available sources (administrative data). We collected our original data in Idaho, New Mexico, and Oklahoma. We interviewed more than 465 students, parents, teachers, principals, and other stakeholders during in-person visits to 12 4dsw district in these states. More than 6,000 middle and high school students and more than 1,200 parents of elementary school students completed our online surveys, representing 18 4dsw and 18 5dsw districts distributed across the three states as well as Colorado, Missouri, and South Dakota. The team sought answers to two key questions:

- How is the 4dsw implemented? How do 4dsw school districts and schools structure their weeks, and how do students, teachers, and staff use their time on the "fifth day" of the week when school is not in session?
- What are the benefits and drawbacks of the 4dsw for different stakeholders? What motivates different districts to adopt a 4dsw, and are they meeting those goals? How are students, teachers, families, schools, and communities affected by the 4dsw?

This report provides findings that can assist school, district, and state education leaders seeking to make informed choices about the 4dsw model and develop policies or guide change as needed.

Data Collection and Methods

This study used both using quantitative and qualitative methods and collected original survey and interview data on the 4dsw experience in Idaho,

Data Source	Number of Districts						
	Idaho		New Mexico		Oklahoma		
	4dsw	5dsw	4dsw	5dsw	4dsw	5dsw	Total
Interviews and focus groups with students, parents, teachers, and school and district leaders	4		4		4		12
Survey of students (grades 7–12)	6	6	6	6	6	4 ^a	34
Survey of parents of elementary-aged students (K–grade 6)	6	6	6	6	6	6	36
Schedule and related data from districts	6	6	6	6	6	6	36

TABLE S.1 Data Sources by State and Days in School Week

^a Six 5dsw districts in Oklahoma were included in the survey sample. Two of these six districts did not complete the youth survey before the COVID-19 pandemic school shutdowns in the state.

New Mexico, and Oklahoma. These states were chosen for three reasons: (1) they have numerous 4dsw districts as well as those that follow the traditional 5dsw, (2) they had large numbers of districts switching to the 4dsw in the last decade, and (3) they had accurate state administrative data on when districts made the switch. We conducted surveys of more than 1,200 elementary students' parents and 6,000 high school students in six 4dsw and six matched 5dsw districts in each of these three states. One of the main contributions of this study to research about 4dsw is richer and systematically collected qualitative information about the implementation of the 4dsw from a range of stakeholders in four 4dsw districts in each state. At the 12 districts we visited, we conducted interviews with more than 465 students, parents, teachers, principals, and other stakeholders. The team also collected administrative information from schools in these 36 districts to understand how districts implemented the 4dsw.

Table S.1 shows what data were collected from the 18 4dsw and 18 5dsw districts in the three study focus states.

The survey and interview data in Table S.1 were supplemented with administrative data on student achievement and attendance for students

taking part in the 4dsw and 5dsw between 2009 and 2018. These data, which were from the Education Opportunity Project (EOP), Common Core of Data (CCD), and American Community Survey (ACS), allowed for analysis of student achievement and attendance before and after the introduction of the 4dsw compared with trends in 5dsw districts over time. This analysis combined these data with information available from additional states on the timing of 4dsw adoption, so Colorado, Missouri, and South Dakota were included as well as Idaho, New Mexico, and Oklahoma. There were 206 4dsw districts and 170 5dsw districts in the time series data. We improve on previous estimates of the effect of the 4dsw on achievement scores by using more than one state for the estimates and by using more recent data that go through the 2018–2019 school year.

Key Findings

Despite the increasing number of districts adopting the 4dsw, there is only limited research examining its effects, and the studies typically examine one state. There are several rigorous studies that have examined the impact of the 4dsw schedule on student achievement. Broadly, these studies have found negative or no effects (see, for example, Morton, 2021; and Thompson, 2021a). In their study that compared risk and health behaviors of students in 4dsw and 5dsw districts in Colorado, Israel et al. (2020) also found mixed results, with 4dsw students having a higher incidence of some positive outcomes and a higher incidence of some negative outcomes. One study found that 4dsw students participated in more minutes of physical education per week, but there were no differences in the prevalence of obesity between 4dsw and 5dsw students (Tomayko et al., 2020). Analyses of cost savings due to the 4dsw have generally documented small savings related to per-student costs (see, for example, Griffith, 2011; Morton, 2021; and Thompson, 2021b).

The research team examined student achievement, student health outcomes (sleep and physical activity), cost savings, and more. Table S.2 lists the outcomes studied in the first column. The findings are summarized in the second two columns of Table S.2, and briefly described in the following section.

TABLE S.2 Summary of Findings for Factors Playing a Role in Policy Decisions Regarding the Four-Day School Week

Factor	Qualitative Finding	Quantitative Finding
Districts save money/reallocate funds (small amount)	Positive	N/A
Recruit and retain teachers	Positive	N/A
Teacher attendance	Positive	N/A
Satisfaction with the 4dsw	Positive	Positive
Students have additional time to spend with family	Positive	Positive
Student attendance	Positive	No difference
Behavioral and emotional well-being	Positive	No difference
Parent stress	Positive	No difference
School climate	Positive	No difference
Sleep and fatigue	Positive/ negative ^a	Positive/ no difference ^b
Student achievement	Positive/ no difference/ negative ^a	Negative/ no difference ^c
Food insecurity	No difference	No difference
Family resources	No difference	No difference
Student enrollment	No difference	No difference
Physical activity	N/A	No difference

NOTES: "No difference" indicates when the qualitative analysis indicated there was no difference between 4dsw and 5dsw districts or for which the quantitative analysis found no statistically significant difference between the 4dsw and 5dsw, and N/A indicates we did not measure this factor. Green indicates that the qualitative data showed stakeholders perceived that the 4dsw had an advantage over the 5dsw, or that the quantitative analysis found that the 4dsw outcome was statistically significantly better than the 5dsw outcome. Yellow indicates when qualitative findings included mixed views from respondents, and the quantitative findings included positive, negative, and/or no differences between 4dsw and 5dsw outcomes.

^a Respondents reported mixed views.

^b Findings varied by student age group.

^c Findings varied by statistical model.

Implementation

Time in school. On average, the 4dsw districts had longer school days, but fewer of them and fewer instructional hours over the course of a school year. Students in the study's 4dsw sample had a day that was 49 minutes longer on average compared with the study's 5dsw sample: 7 hours and 55 minutes compared with 7 hours and 6 minutes per day. However, districts in the 4dsw sample had 25 fewer school days per year than the districts in the 5dsw sample: 146 days compared with 171 days. The 4dsw districts met for 1,156 hours per year, while the districts in the 5dsw sample met for 1,214 hours per year—a difference of 58 instructional hours per year.

Student schedules. Both 4dsw and 5dsw students reported having similar daily schedules during their school week. Both 4dsw and 5dsw students in grades K–6 spent the same time on homework each week, but 4dsw students in grades 7–12 spent approximately 30 minutes more on homework per week than 5dsw students.

Student free time. Students in grades K–6 and 7–12, respectively, reported having 4 hours and 3.5 hours more free time per week than 5dsw students. In each age group, 4dsw students spent approximately 30 to 60 minutes more than 5dsw students on nonschool sports and hobbies and spent 1 hour to 1.5 hours more on chores every week. Elementary 4dsw students most often used that free time to do chores and school sports, while the high school students used the free time to do chores as well as a wide variety of other activities. Older 4dsw students reported spending almost 1 hour more per week working at a job than 5dsw students. Eighty percent of high school students and 90 percent of elementary students reported they spent the fifth day at home.

School out-of-school time offerings. Most 4dsw districts offered sports practice or competitions on the fifth day, while a minority of 4dsw districts had clubs or student activities that met that day.

Teacher and staff activities on the fifth day. Most teachers reported that the day off was typically a mix of a workday and a weekend day. Most reported spending the day doing personal activities, such as attending doctors' appointments and doing chores, as well as school activities, like grading or participating in occasional professional development meetings.

Benefits, Drawbacks, and Outcomes

Perceived 4dsw benefits. Superintendents and school board members in the districts visited by the research team felt that cost savings were the major motivation for adoption of the 4dsw. This finding is consistent with most related research. Improving student attendance was the second most common motivator for the change; stakeholders in eight districts expressed this view. Many districts hoped that students who lived far from medical or other services would be less likely to miss a full or half day of school for attending doctor visits or running important errands. Other reasons for adoption, such as attracting more and highly qualified teachers, were also mentioned, but less frequently.

Districts: Cost Savings

Perceptions of savings. Most superintendents and school board members participating in the study indicated that they were saving some amount of money in categories such as decreased transportation and food expenditures, decreased expenditures on substitute teachers, and decreased salary and benefits expenditures for hourly employees. While these savings might be characterized as small-the research team has found that savings typically equal between 0 percent and 3 percent of the overall budget (Morton, 2021; Thompson, 2021a)-some administrators noted that even small savings were meaningful. At least two districts' administrators reported that because of the cost savings attributable to the 4dsw, they were able to keep instructional staff and avoid laying off teachers and increasing classes sizes. Similarly, some superintendents indicated that savings in some noninstructional cost categories allowed them to retain some services related to instruction. Many superintendents stressed that even if the 4dsw did not reduce overall expenditures, it allowed the district to reallocate funds to maintain some academic and student services despite growing costs.

Teachers

Teacher perceptions of the 4dsw as a job benefit. Most teachers viewed the 4dsw only as a "job perk," and other stakeholders thought it gave them a competitive advantage in teacher recruiting and retention. Several superintendents, school leaders, and school board members reported that their districts used the 4dsw as a "recruitment tool." However, the majority of teachers participating in the study had taught in the district when it had a 5dsw or lived in or moved into the community for reasons other than the 4dsw; for them, the 4dsw was a benefit but not a factor in their decision to take the job.

Students

Student absence rates. School leaders, teachers, parents, and students perceived student absences were lower in the 4dsw schedule than in a 5dsw schedule. However, our analysis of district-level attendance rates between the 2011 and 2018 school years in Colorado, Idaho, Missouri, New Mexico, and Oklahoma suggested there were no differences. Furthermore, the survey data reported by parents and students also showed no differences in absences for 4dsw and 5dsw students.

Perceptions of student academic achievement. School principals, teachers, parents, and students believed students learned just as much or slightly more in the 4dsw than in a 5dsw, and that the difference in minutes of instructional time had no real effect on student achievement. School staff and parents offered students' performance on state assessments as evidence that there were no academic disadvantages to the 4dsw. District leaders and principals reported that their test scores had remained the same or improved since adopting the 4dsw.

Student academic achievement in 4dsw districts over time. The research team found that student achievement did not grow as fast in the 4dsw districts after the adoption of the 4dsw policy compared with similar 5dsw districts. For example, three years after the policy change, the analysis estimated that 4dsw student achievement in English language arts (ELA) was between 0.040 and 0.096 standard deviations lower compared with that in similar 5dsw districts, and 4dsw student achievement in math is between 0.069 and 0.140 standard deviations lower. By eight years after adoption, the 4dsw achievement in ELA was between 0.145 and 0.229 standard deviations lower compared with similar 5dsw districts, and the 4dsw achievement gap in math was between 0.144 and 0.189 standard deviations lower.

Perceptions of student sleep and fatigue. Parents and students interviewed in all 12 of the 4dsw districts reported that one of the advantages of the 4dsw is the opportunity to sleep in on the fifth day when school is not

in session. However, others noted that because the 4dsw school day tends to be longer than a 5dsw school day, students were more tired at the end of the school day than they would be on a 5dsw schedule.

Survey results on sleep and fatigue. Elementary students in 4dsw districts got more school-week sleep than their peers in 5dsw districts, but there was no difference in the amount of sleep that middle and high school students got during the school week in 4dsw and 5dsw districts. Students in 4dsw districts used the fifth day to sleep more relative to their 5dsw peers; the 4dsw introduced more variability in the sleep patterns of students. The research team found no discernable difference in parents reporting that their elementary-age child was regularly tired by 4dsw or 5dsw status. Among secondary school students, 5dsw students reporting feeling regularly tired 60 percent more than their 4dsw counterparts.

Student food insecurity. Analysis of survey data on elementary parents and youths found no differences in the rates of food insecurity for 4dsw and 5dsw students. School and district leaders expressed concern that having meals at school one less day a week could exacerbate food insecurity.

Student physical activity. Analysis of the survey data on youths found no difference in physical activity between 4dsw and 5dsw students. Students, parents, teachers, and school and district leaders did not perceive that the 4dsw reduced students' physical activity, and survey data on elementary parents indicated that 34 percent of students in both the 4dsw and the 5dsw districts reported daily physical activity of at least an hour.

Student behavioral and emotional well-being. Analysis of the survey data on elementary parents and youths found no differences between 4dsw and 5dsw students on measures of behavioral and emotional well-being and behavior. Most parents, teachers, and students expressed the view that having a 4dsw improved students' behavioral and emotional well-being, giving students time to "reset" on the fifth day. However, many also recognized the possibility that having one more day at home might be undesirable for students in risky home environments, and some noted that the fifth day could give students "more time to make poor choices."

Families

Perceptions of family well-being, time, and relationships. Formal modeling of survey results on elementary parents indicated no significant difference

in the perceived stress of 4dsw and 5dsw parents. However, focus group parents across all 4dsw districts felt the schedule allowed more flexibility in their schedules and made it easier to spend time together as family. In some districts, stakeholders described how time with family is connected to the communities' rural roots, allowing students to learn skills not taught at school in such areas as outdoor sports, like mountain biking and hunting, and working with family on ranches.

Family resources. Overall, parents in surveys, interviews, and focus groups did not associate major cost savings or expenditures with the 4dsw. For example, less than 3 percent of parents in interviews and focus groups identified fifth-day childcare as a financial concern; they explained that parents or caregivers, extended family, or friends assisted as needed. Some parents noted that high school students could work and contribute to family income if needed, and the 4dsw leads to one less day of driving students to and from school, saving on fuel.

Schools

Student enrollment. Overall, there was little evidence from the interviews and focus groups to suggest the 4dsw motivated families to enroll or withdraw from these districts. Parents who were also teachers in the 4dsw districts were the only exception, noting that they preferred their children to have the same school schedule and, in turn, enrolled their children in the district.

School climate and engagement. In general, parents, teachers, students, and school leaders perceived that there were benefits of the shorter schedule for school climate and student and parent engagement. They noted that students had a three-day weekend to rest and recoup, and thus were more rested and more eager to learn and engage in the school community. However, analysis of the elementary parents and youth surveys showed that there were no differences in perceptions of the school learning environment or interpersonal relationships between 4dsw and 5dsw students.

Conclusion and Study Limitations

All studies have some limitations, and this one is no different. It was impractical and unethical to randomly assign districts to alternative schedules, and the research team used the strongest quasi-experimental designs available. In addition, the survey sample includes only 36 districts in three states, which makes it possible that this analysis is not representative of 4dsw districts more generally. To gauge this, the team did compare descriptive statistics of the sample 4dsw districts with those from the national population (Thompson et al., 2020). While the study sample is similar in many ways to the national population, the study districts' revenue per pupil is substantially lower, the rate of free or reduced lunch is much higher, and more students have Native American or Hispanic backgrounds. Other limitations are related to the possibility that the individuals who agreed to participate in the interviews had more positive views toward the 4dsw than typical community members.

As the study suggests, there are trade-offs in adopting the 4dsw model. Both qualitative and quantitative data found high levels of satisfaction with the 4dsw among students, teachers, principals, superintendents, and parents and caregivers. But the 4dsw districts had progressively lower academic achievement relative to 5dsw matched comparisons over time. Many study participants expressed the view that while the 4dsw worked in their rural community, it would not work in other places, such as big cities in which parental labor force participation, industry composition, childcare costs, and other factors would likely be very different.

The parents, teachers, district officials, and community members in the 4dsw districts the research team visited emphasized that they felt the 4dsw schedule prepared their students for life. Expressing a view similar to that at the heart of the Centers for Disease Control and Prevention's (CDC's) "Whole School, Whole Child, Whole Community" model, these study participants stated that while academic outcomes—such as achievement scores—were an important part of preparing students for life, a spectrum of other factors also played a role, including strong family relationships, cultural life, physical health, and behavioral and emotional well-being.

Acknowledgments

We are grateful to many people for their help during the course of this project. We would like to extend a special thanks to the thousands of students, families, teachers, school officials, and other community members who completed surveys and participated in our focus groups and interviews. We truly appreciate the time you took to share your experiences with the four-day school week.

We would like to acknowledge the funder of this project, the Robert Wood Johnson Foundation, and in particular Tina Kauh, who provided suggestions throughout the course of the project.

We are extremely thankful for the support of individuals who worked at state agencies in Idaho, New Mexico, and Oklahoma, who assisted us with data requests and data access. In Idaho, this was Cathleen McHugh. In New Mexico, we would like to thank Alexis Alvarez, Abenicio Baldonado, Terry Bryant, Timothy Hand, Marie Julienne, Richard Trujillo, Jeahno Rodriguez, and John Sena. In Oklahoma, we also appreciate the assistance of Brad Clark, Steffie Corcoran, Erik Friend, Maria Harris, Kalee Isenhour, Robyn Miller, Jerry Shay, Lakisha Simon, Craig Walker, and Marley Widman.

We are very thankful for the support of Erin Fahle, Thalia Ramirez, Sean Reardon, and other members of the Educational Opportunity Project. They worked to provide customized data sets during the COVID-19 pandemic and provided customized support to facilitate the linking of additional data. The analysis of outcomes across five states would not have been possible without their efforts.

Dozens of our colleagues at RAND helped us successfully complete the project from start to finish. We are obliged to Katy Sonnenleither for handling our contract issues, including data use agreements, and Sandy Berry and Daniel Chung for assisting us with Institutional Review Board issues. Thanks to Lance Tan for assisting us with travel arrangements. We are indebted to Stephanie Lonsinger and Andrea Wiernik, who helped us mail out large packets of materials to 36 school districts. Additionally, thanks are due to Ella Henry, who collected data on district schedules and policies.

We also would like to express our thanks to a number of individuals who executed programming for the project, including Geoff Grimm, Hanna Han, Lynn Hu, Cheryl Montemayor, Scott Naftel, and Dina Troyanker. We extend our gratitude to Teryn Mattox, who was part of the team in the first year, and Kathryn Giglio, who prepared the executive summary and research brief and advised us on communications. We also appreciate the peer reviews provided by Aaron Kopfer and Michelle Bongard, who reviewed programming, and Fatih Unlu and Heather Schwartz of RAND and Paul Thompson of Oregon State University, who greatly improve this report with their careful reviews.

We are especially grateful to Melanie Rote, who provided exceptional assistance on the project, including providing survey support, making travel arrangements, managing mailings to districts, and preparing this report.

Abbreviations

4dsw	four-day school week
5dsw	five-day school week
ACS	American Community Survey
CCD	Common Core of Data
CDC	Centers for Disease Control and Prevention
CI	confidence interval
CSCHLS	California School Climate, Health, and Learning Survey
ELA	English language arts
EOP	Educational Opportunity Project
IPW	inverse probability weights
NAEP	National Assessment of Educational Progress
NCES	National Center for Education Statistics
NCSL	National Conference of State Legislatures
OR	outcome regression
OST	out-of-school time
SD	standard deviation
SDQ	Strengths and Difficulties Questionnaire
SNAP	Supplemental Nutrition Assistance Program

CHAPTER ONE

Introduction

While the four-day school week (4dsw) is a novelty in the eastern United States, all states west of the Mississippi River now have 4dsw districts and the number of 4dsw schools has grown by more than six times since the turn of the century. In 1999 257 schools used a 4dsw, and by 2019 this number was 1,607 (Thompson et al., 2020). More than half of Colorado's school districts followed a 4dsw calendar in the 2019–2020 school year, and across the eight states where the 4dsw is most prevalent, more than 500 districts currently follow a 4dsw (Figure 1.1). One of the more dramatic increases in the use of the 4dsw in recent years has been in Missouri, where the number of its 226 districts using the 4dsw grew from 16 in the 2015–2016 school year to 61 in the 2019–2020 school year and 105 in the 2020–2021 school year (Riley, 2020).

This report examines 4dsw schedules implemented before COVID-19, when districts held classes four days of the week, typically holding no classes on either Friday or Monday. During the COVID-19 pandemic, many schools around the country adopted variants of the 4dsw as they implemented online and hybrid learning models. As a result, the experiences from districts around the country that offered the 4dsw before the pandemic are now of even greater general interest.

While the last decade witnessed increasing enthusiasm for the 4dsw, it also saw legislative action aimed at reining in the 4dsw. Some states, such as Florida, Iowa, and Texas, expanded the use of the 4dsw as districts in the aftermath of the Great Recession, because the 4dsw was viewed as a way to reduce costs (Heyward, 2018). Other states have begun restricting the use of the 4dsw or demanding greater accountability because of uncertainties regarding the effects of the shortened school week on student outcomes. For example, during the 2013–2014 school year, California passed Senate Bill 236,



FIGURE 1.1 Percentage and Number of Districts Using a Four-Day School Week in 2019–2020

which required districts to stop the 4dsw if they were not meeting adequate yearly progress. The following year, Montana ordered seven districts to cease using a 4dsw after failing to meet adequate yearly progress (Heyward, 2018). More recently, in February 2018, New Mexico used a funding bill to put a moratorium on the expansion of the 4dsw (Lee, 2018). After a study in Oklahoma that cast doubt on the savings from the 4dsw (Hofmeister, 2017), state representatives and senators voted to approve a bill requiring districts moving to a 4dsw to submit detailed plans to the state articulating the goals they hoped to achieve (Oklahoma State Legislature, 2017).

A common theme across all of these policy activities has been uncertainty over the potential benefits or drawbacks of the 4dsw (New Mexico Legislative Education Study Committee, 2018). Despite over half a century of experience with the 4dsw and an active policy landscape for it, there is limited information and research on its implementation and impact. As we discuss in more detail, documentation regarding the motivations for

SOURCE: Multiple state sources described in Appendix A. NOTE: Numbers on top of bars indicate the number of districts in the state that use a 4dsw. ^aData pulled from 2018–2019 school year for New Mexico and Oregon.

moving to a 4dsw, student outcomes associated with it, and the structure of 4dsw schedules and other logistics comes from a relatively small number of articles in the popular press, a handful of policy briefs, and less than a dozen statistical analyses of 4dsw data.

This study aimed to enrich existing information on the 4dsw by providing a comprehensive and objective assessment of its benefits and drawbacks. Previous studies have used administrative data sets on student outcomes and finance as well as surveys of districts (e.g., Morton, 2021; Thompson, 2021a; Thompson, 2021b). This study adds to the knowledge from these sources by also collecting data including elementary parents and youth surveys in 36 4dsw and five-day-school-week (5dsw) districts and a wide spectrum of stakeholder interviews in 12 4dsw districts. The primary goals of our study were to help parents, districts, legislatures, and other decisionmakers understand the following:

- How is the 4dsw implemented?
- What are the benefits and drawbacks of the 4dsw for different stakeholders?

Embedded in these two questions are a rich set of subsidiary questions. Subsidiary questions related to 4dsw implementation include the following:

- What motivates districts to adopt a 4dsw? The popular press has emphasized financial motivations for 4dsw adoption, but additional factors may play a central role in districts' decision to switch to a 4dsw.
- What is the structure of the 4dsw? This encompasses issues like which day of the week is taken off, what the length of the four days of school is, and the number of instructional days during the school year.
- What types of variation did we observe in 4dsw implementation? We explored how districts differed in terms of whether they offered student activities on the day off (the "fifth day"), provided food for students on the fifth day, required teachers to report on any fifth days, and a number of other features.

To address the second main question, we aimed to capture these aspects of stakeholders' experiences:

- students: academic achievement, attendance, social and emotional well-being, time use, connectedness to school, and overall satisfaction with the 4dsw
- families: childcare use on the fifth day, connectedness to school, stress, and overall satisfaction with the 4dsw
- teachers: pedagogy, attendance, job choice and satisfaction, and overall satisfaction with the 4dsw
- principals, superintendents, school board members, and community members: academic performance, finances, attendance, filled positions, teacher credentials and experience, and school climate.

Many school districts have a motto or mission statement that is similar to "preparing students for life," including academic achievement, physical health, behavioral and emotional well-being, strong family relationships, and cultural life (Figure 1.2), and this is very similar to the "Whole School, Whole Child, Whole Community" model that the Centers for Disease Control and Prevention (CDC) advocates (CDC, 2020). In recognition of these important facets of the "whole child," our study analyzed qualitative and quantitative data on outcomes that are related to these inputs in order to provide more information for stakeholders to use as they decide whether the 4dsw is the school schedule that provides their students with the best preparation for life. Later we discuss individual variables we used to capture the inputs into a whole-child model.



FIGURE 1.2 Inputs into Preparing Students for Life

This study employed both qualitative and quantitative analysis, and we analyze data collected explicitly for this study (original data) as well as existing data from publicly available sources (administrative data). We collected our original data in Idaho, New Mexico, and Oklahoma. We interviewed more than 465 students, parents, teachers, principals, and other stakeholders during in-person visits to 12 4dsw district in these states. More than 6,000 middle and high school students and more than 1,200 parents of elementary school students completed our online surveys, representing 18 4dsw and 18 5dsw districts distributed across the three states. Our analysis also examines administrative data from these three states as well as Colorado, Missouri, and South Dakota. Before describing our study methods and findings, we briefly review what is currently known about the 4dsw.

1.1. The Context and Structure of the Four-Day School Week

Districts adopting the 4dsw tend to be small, in western states, and in rural areas (National Conference of State Legislatures [NCSL], 2020; Thompson et al., 2020). Additionally, district shifts to a 4dsw appear to increase during financial downturns, and saving money is one of the main reasons that districts cite for making the switch (NCSL, 2020; Thompson et al., 2020). A primary motive for the 4dsw schedule is the potential to capture cost savings due to one less day of expenses such as hourly staff salaries, transportation, and utilities (Thompson et al., 2020). The recent surge in 4dsw adoptions came on the heels of the Great Recession, coinciding with a large real decline in state funding per pupil (Leachman and Figueroa, 2019). State funding typically accounts for about half of K–12 education funding (Leachman and Figueroa, 2019) and even greater amounts in higher-poverty districts, which are disproportionately in rural areas. Districts were unlikely to be able to raise local funding during the recession, and so this was a time when district leaders were facing epic budget challenges.

The 4dsw is very popular among parents (Turner, Finch, and Uribe-Zarain, 2019) and teachers (Turner, Finch, and Uribe-Zarain, 2018b), with views among other members of the community being split (Turner, Finch, and Uribe-Zarain, 2018a). In addition to financial savings, districts report

other merits of the 4dsw, including a benefit to help attract and retain quality teachers, increases in student and teacher attendance, less missed time for sports activities, greater time for professional development, and more time that students and teachers can spend with family (Missouri State University, 2020; Thompson et al., 2020).

The most popular 4dsw schedule holds classes Monday through Thursday, with a Tuesday-through-Friday schedule being the second most popular (Thompson et al., 2020). In order to meet state regulations on minimum instructional time, the 4dsw districts typically have longer days on four days compared with the number of hours each day that 5dsw districts meet. In addition to instructional time requirements, different states also have other requirements that 4dsw districts must meet, such as requesting a waiver (Washington and Utah) or meeting academic benchmarks (California) (Heyward, 2018).

1.2. Previous Research on the Four-Day School Week

Despite the widespread adoption of the 4dsw, research examining its effects on student, family, and teacher outcomes is limited and has yielded negative and positive results. Thompson et al. (2020) speculate that variation in the implementation of the 4dsw in different states—such as required number of instructional hours or activities offered at schools on the off day—may account for differences in these studies' findings. One line of rigorous empirical research has estimated the relationship between the 4dsw and student achievement using quasi-experimental methods, and the results have been mixed. The most recent study (Thompson, 2021b) uses student-level data from 2005 to 2017 in Oregon. Thompson estimates that the 4dsw is associated with statistically significant but relatively small declines in test scores: declines in math test scores of 0.037-0.055 standard deviations and declines in reading scores of 0.033-0.042 standard deviations. This paper also documents that a decline in achievement in 4dsw districts in Oregon is due to reductions in time in school in the 4dsw districts relative to the 5dsw districts in Oregon. Another recent study (Morton, 2021), which uses data from 2008-2009 to 2015-2016 in Oklahoma, finds no effect of the 4dsw

on math and English language arts (ELA) scores for grades 3–8. Finally, Anderson and Walker (2015) uses data on grade 4–5 students in Colorado and estimates a 4–7 percent boost in the percentage of students scoring proficient in math and ELA.

Using data from the 2017 administration of the Colorado version of the biennial Youth Risk Behavior Survey, Israel et al. (2020) compared risk and health behaviors of students in 4dsw and 5dsw districts. Their results were mixed, with students in the 4dsw districts having a higher incidence of some positive outcomes: participating in extracurricular activities; performing community service; not skipping school; not using marijuana, alcohol, or prescription drugs; spending less time on screens; and being more physically active. However, the 4dsw students also had a higher incidence of some negative outcomes, including being bullied at school, engaging in sexual activity, getting less than eight hours of sleep, and skipping breakfast. While these cross-sectional differences cannot be attributed to the 4dsw per se, they underscore the mixed information available to policymakers on the 4dsw policy. In the only other research to examine the relationship between the 4dsw and health outcomes, Tomayko et al. (2020) report that 4dsw schools provided almost 20 more minutes of physical education per week than 5dsw schools (120 versus 101 minutes per week, respectively). However, their study did not find any differences in obesity prevalence between 4dsw and 5dsw schools.

Only one study has examined the effects of the 4dsw on crime, and it found that juvenile crime in Colorado increased in 4dsw districts on the weekday when school did not meet (Fischer and Argyle, 2018). Relative to similar rural areas with 5dsw high schools, law enforcement agencies in areas with a 4dsw high school saw a 20 percent increase in overall crime and a 61 percent increase in property crime on Fridays, although these areas generally had relatively low crime rates. With a focus on the first nonrural district to adopt a 4dsw—District 27J near Denver—Nowak, Perrone, and Smith (2019) estimate that after switching to a 4dsw, the housing prices in this district's catchment area dropped 2–5 percent relative to neighboring communities. Research has not examined other outcomes for students, such as time use, or effects on the family or teachers.

Analyses of cost savings due to the 4dsw have generally documented small cost savings. Morton (2021) uses Oklahoma data to assess the effect of

the 4dsw on school finance. She recognizes that the 4dsw not only has the potential to reduce a district's costs, but it also is likely to reduce a district's revenues. This is because some revenues are tied to services that would be reduced as part of a reduction in the number of days of school—for example, reductions in federal payments for school lunches. Morton found that federal revenue, which constitutes 14 percent of total revenue per pupil in 4dsw districts in her Oklahoma sample, declined by 6 percent because of the 4dsw. The categories of revenue that made up the other 85 percent of total revenue per pupil were unaffected; state revenue, local revenue, and total per-pupil revenue did not change with 4dsw adoption.

Morton found no effect of the 4dsw on total per-pupil expenditures or per-pupil expenditures for administration, student support, or instruction. However, she reports a decrease in per-pupil spending of 7 percent in operations, 11 percent in transportation, and 12 percent in food services. A paper found that school districts that switched to the 4dsw reduced operating expenditures per pupil (does not include capital outlays) by 3.1 percent (Thompson, 2021a). Using data from a national survey of districts, Thompson et al. (2020) documented reductions in spending for 4dsw districts that adopted the shortened week primarily for cost-saving reasons, while districts that adopted the 4dsw for other reasons exhibited no reductions and some small increases in per-pupil spending after making the switch.

While the research on the effect of the 4dsw on student, family, and school outcomes is mixed, there is consistency in the research about the motivations for adopting the 4dsw and the types of districts that are more likely to use the 4dsw. Based on their national survey of 4dsw districts, Thompson et al. (2020) report that 65 percent of districts adopted the 4dsw primarily to reduce costs. These same authors grouped the second and third most prevalent purposes for adopting a 4dsw into two categories: to address attendance issues (29 percent) and rural issues (31 percent). Attendance issues included student absences, missing school because of medical appointments, and missing school because of athletics. In rural areas, medical appointments and athletic contests may necessitate missing the bulk of a school day because of long travel times. The category "rural issues" encompassed issues such as long commuting times; the need for time off for ranching, farming, or hunting activities; and retention of teachers and students.

Against the backdrop of other pervasive challenges facing rural districts, the period immediately following the economic recession of 2007– 2009 was one when current expenditures on education fell in real terms. Between school years 2000–2001 and 2016–2017, the only period that exhibited declines in expenditures was from 2008–2009 to 2012–2013, when real spending dropped by more than 5 percent (National Center for Education Statistics [NCES], 2020). Thompson et al. (2020) documented an uptick during this period in districts that switched to the 4dsw, reporting that they adopted it to reduce costs.

Rural districts tend to be smaller than urban or suburban districts, and districts that adopt the 4dsw are even smaller than the average rural district (Thompson et al., 2020) and have declining enrollment (Anglum and Park, 2021). This is important, because smaller schools tend to have higher-than-average per-pupil costs, in part because they cannot realize economies of scale for staff and services (Odden and Picus, 2019). Besides facing higher per-pupil costs, rural districts may also be at a disadvantage relative to suburban and urban districts in terms of raising revenue. After the recession of 2007–2009, the relative share of state funding for education dropped and local funding increased (Leachman and Figueroa, 2019). Rural districts are more likely to be in high-poverty areas, making it more challenging than for districts in other areas to raise funds through local means such as property taxes. The double squeeze of higher costs and falling revenues for rural districts during this period necessitated creative financial solutions and may have contributed to the approximate tripling in the number of districts using the 4dsw between 2007 and 2019.

The desire to save money supersedes all other motivations for implementing the 4dsw in national surveys. The predominance of this motivation, however, is not supported by the anticipated cost savings. If one assumed that reducing days in school by one day, or 20 percent, saved a proportional amount, then an upper limit on cost savings from switching to a 4dsw would be 20 percent. In fact, the bulk of district expenditures are largely invariant to the number of days that school is in session. This includes the largest category of spending, instructional salary and benefit costs, which accounted for 58 percent of district budgets in the 2018–2019 school year (NCES, 2020), because teachers are typically paid the same amount in 4dsw and 5dsw districts.

Spending on administration, student support services (e.g., library, technology, health, and other services), food service, operations and maintenance, and student transportation makes up the remaining portion of the district budgets nationally. Administration costs for schools are unlikely to decline significantly as a result of conversion to the 4dsw, as the primary costs in this category are personnel like principals and superintendents. Theoretically, the remaining categories of student support services, food service, operations and maintenance, and student transportation could be potential sources of savings. For example, if transportation is only needed four days instead of five and hourly workers like substitute teachers and cafeteria staff work only 80 percent as much, spending in these categories might be lower in 4dsw districts. However, several factors reduce the likelihood that these sources will generate substantial savings. First, some districts open their buildings on the fifth day for activities such as teacher professional development or athletic practices and competitions, requiring utility and other expenses related to having the buildings open. Another factor that compromises potential savings from reducing spending on one day is economies of scale and the large fixed costs of some categories of potential savings (Odden and Picus, 2019). Specifically, food service and transportation have large fixed costs (like kitchen equipment and space, and buses), so a 4dsw only reduces the variable costs by one day and leaves the large fixed costs unchanged.

Another factor that mitigates some potential financial advantage of the 4dsw is that when costs are reduced because of lower utilization of some categories of spending, the revenue also declines (Morton, 2021; Odden and Picus, 2019). This is true for food service and student transportation. State governments often reimburse districts for a portion of transportation costs, and the federal government reimburses a large portion of food service costs in 4dsw districts, reducing the savings that districts realize from reducing these services one day a week.

Combining these theoretical considerations with national finance data, Griffith (2011) estimated that the maximum savings that districts would realize from converting to a 4dsw would be about 5.4 percent. Griffith estimated that the actual savings realized by districts at that time was between 0.4 percent and 2.5 percent. More recently, using national data, Thompson (2021a) estimated that switching to a 4dsw reduced per-pupil operating
expenditures by 3.1 percent. He found the largest reductions in food service and transportation, with no change in instructional expenditures. Morton (2021) finds a similar result in Oklahoma: no significant effect on overall spending per pupil but declines in district expenditures on food services of 12 percent, transportation of 11 percent, and operations and maintenance of 7 percent. Morton also reports a 6 percent decline in federal revenue per pupil after districts switched to a 4dsw, reflecting lower reimbursement for food services. To sum up, empirical estimates of per-pupil spending savings range from 0 percent to 3 percent and have generally been characterized as small.

Proponents of the 4dsw also identify it as a mechanism that helps rural districts overcome employment barriers. Research indicates that recruiting and retaining high-quality teachers is particularly challenging in rural communities (Malkus, Hoyer, and Sparks, 2015; Monk, 2007; Showalter et al., 2019). Rural school districts offer lower teacher salaries (Goodpaster, Adedokun, and Weaver, 2012; Huysman, 2008; Schwartzbeck et al., 2003) than their more urban counterparts. They are also more geographically isolated and farther away from particular services and activities-such as medical care-which presents a barrier to recruitment (Lam, Boderick, and Toor, 2018; Plain, 2020; Zhang, 2008). In a study of the characteristics of districts in Missouri that adopted a 4dsw, Anglum and Park (2021) show that districts that adopted the 4dsw in fact have lower teacher salaries than neighboring districts. They also find that the presence of a nearby 4dsw district is the best predictor of whether a district adopts the 4dsw. Thompson (2021b) finds that teachers in 4dsw districts in Oregon have less experience than teachers in 5dsw districts, but he does not find a difference in teacher salaries between districts with the two types of schedules.

1.3. Road Map of This Report

The next chapter briefly summarizes the methods we used for this study, with a more detailed description of our methods in Appendix A. In Chapter Three, we describe what the 4dsw looks like in practice, documenting aspects such as the differences in 4dsw and 5dsw schedules and students' time use, and what happens in 4dsw districts on the fifth day. Chapter Four examines the motivations for switching to the 4dsw and the evidence on whether it delivers what proponents promise. In Chapter Five, we assess whether the 4dsw has a range of outcomes other than the ones that form the primary motivations for its adoption. Chapter Six concludes with a discussion of the 4dsw benefits, drawbacks, and tradeoffs.

CHAPTER TWO

Overview of Methods

This chapter summarizes the methods we use in this study. More detailed information on methods discussed in this chapter is provided in Appendix A. This study used mixed methods, meaning that we employ both qualitative and quantitative analyses. We also utilized multiple sources of data, including data we collected for this study as well as data from administrative sources, district websites, and data sets from federal data sources. All data-collection procedures were reviewed and approved by the RAND Institutional Review Board and each of the 12 school districts that participated in the survey. We first describe the outcome measures we examine, and then we describe the states, districts, and individuals in our samples. Next, we outline our analytic approach, and then we end this chapter with a discussion of study limitations.

2.1. Outcome Measures

In the previous chapter, we introduced a simplified version of the CDC's "Whole School, Whole Child, Whole Community" model. As shown in Figure 1.2, inputs into a "student prepared for life" include strong family relationships, cultural life, academic achievement, physical health, and behavioral and emotional well-being. We attempted to measure outcomes that would capture these inputs or that were widely viewed as contributing to them. An example of the latter is student attendance. Student attendance itself is not an input into helping students be prepared for life, but rather student attendance is valued because it is known to contribute to academic achievement (Gottfied, 2010). In addition to the measures playing a role in a whole-child model of student preparation, we also had other criteria for

selecting outcome measures. We prioritized those that have played a role in debates about the 4dsw, as documented in research, popular media, or legislative deliberation. They also needed to be concepts we could capture in a credible way through one of the sources of data described in the following sections that were feasible in this study—interviews, focus groups, elementary parents survey, youth survey, district websites, or available administrative data. Furthermore, we prioritized outcomes where we would have a large enough sample to enable the statistical detection of effects of the size that would be expected because of the 4dsw. As described in more detail in Appendix A, when collecting original data for this study, we also sought to adhere to good practices in data collection, such as minimizing respondent burden and using existing instruments from the literature.

2.2. States and Districts

Our three focal states are Idaho, Oklahoma, and New Mexico. We selected these states because they had a large number of 4dsw districts and available state administrative data. Our plan for including states and districts in the analysis considered statistical power needed to identify meaningful effect sizes, the availability of data on timing of implementation of the 4dsw in the states, and our resource constraints—time and money.

We use a mixed-methods approach for this study (Table 2.1). To address many of our research questions, we needed to collect original data, given that the required data were not available in administrative or publicly available data sets. Considering the small numbers of students in the rural districts that would likely be in our sample, our statistical power calculations indicated that we would need to collect survey data in at least 36 districts. We conducted surveys in six 4dsw districts and six 5dsw districts in three states. The time frame for the project and available resources indicated that we could visit about 12 of the 36 districts for the purpose of qualitative data collection. Therefore, we visited 4 districts in each of the three focal states.

We constructed the 36-district primary data-collection sample using a two-stage process. First, we recruited six 4dsw districts per state, targeting districts that converted to 4dsw between the 2010–2011 school year and the 2017–2018 school year. We sought a mix of 4dsw districts that converted

	Number of Districts					
	Idaho		New Mexico		Oklahoma	
Data Source	4dsw	5dsw	4dsw	5dsw	4dsw	5dsw
Interviews and focus groups	4		4		4	
Survey of students (grades 7–12)	6	6	6	6	6	4 ^a
Survey of parents of elementary-age students (K-grade 6)	6	6	6	6	6	6
Schedule and related data from districts	6	6	6	6	6	6

TABLE 2.1 Data We Collected by State and Days in School Week

^a Six 5dsw districts in Oklahoma were included in the survey sample. Two of these six districts did not complete the youth survey before the COVID-19 pandemic school shutdowns in the state.

recently enough that they could draw contrasts in surveys and interviews to their 5dsw experiences, but we only included districts that converted in the 2017–2018 school year or earlier so the districts had at least a full year of the 4dsw before our analysis commenced. For each recruited 4dsw ("treatment") district, we then selected a matched comparison 5dsw district. We identified matches for individual recruited 4dsw districts by estimating propensity scores, which is the probability of an individual district being a 4dsw district given its observed covariates.

The 18 treatment districts in the sample adopted 4dsw in different years. Thus, we estimated a propensity model for each potential implementation year, with matches drawn for each participating 4dsw district using data up to the year before that district's 4dsw implementation (i.e., the matches are drawn from the model for each district's individual base-line year).¹ Candidate 5dsw districts with the closest matching propensity score to that of each 4dsw district were then recruited as comparison districts. Data used for modeling propensity for 4dsw status included school district data from the Common Core of Data (CCD) and local economic

¹ Matching was considered at the district level only; students were not matched.

conditions from the American Community Survey (ACS). While no statistically significant imbalances between the 4dsw and 5dsw matched samples were present, we note that our statistical power to detect such imbalances was relatively low. Two notable differences of potential practical significance are 4dsw districts in the sample averaging about 200 fewer students and about \$3,200 less in median household income than their 5dsw matched counterparts.

Complementing our original data collection in the three focal states, we also used administrative data to examine the relationship between 4dsw status and several outcomes for six states: Colorado, Idaho, Missouri, New Mexico, Oklahoma, and South Dakota. For all of these states, we used data from the CCD, data from the ACS, and publicly available data on student attendance from state department of education websites. We analyzed test scores from the Educational Opportunity Project (EOP; formerly Stanford Education Data Archive). The EOP did not have complete data for the state of New Mexico, so for that state we used student-level data provided by the New Mexico Public Education Department in place of the EOP data. The EOP also has a large amount of missing data for Colorado, and we were not able to obtain test score data from the State of Colorado, so we do not include Colorado in the test score analysis. Additionally, we were not able to include South Dakota in the attendance analysis because it does not collect attendance data in a way that was similar to the other five states. We examined these six states using the national data sources because they had enough districts that switched to the 4dsw during the years for which the data are available for us to conduct statistical analyses, and up-to-date and accurate data were available for the dates when districts switched to the 4dsw. We also required that the state be able to report clear-cut 4dsw or 5dsw status for each district. For example, we excluded Oregon because it had many districts that appeared to have hybrid schedules (a combination of four-day and five-day weeks during the year). As shown in Table 2.2, the school years included in the administrative data range from 2009-2010 to 2017–2018. Table 2.2 also reports the number of 4dsw and 5dsw districts from each state included in the analysis; there were 206 4dsw districts and 170 5dsw districts in our time series data. We do not include charter schools in any of our analyses. We discuss the process of selecting participating districts in more detail in Appendix A.

	Colorado	Idaho	Missouri	New Mexico	Oklahoma	South Dakota
CCD	×	×	×	×	×	×
ACS	x	×	x	x	×	x
EOP: test scores		×	×		×	×
New Mexico Public Education Department: test scores				x		
State department of education websites: attendance	x	x	x	x	x	
School years in analysis	2010–2011 to 2017–2018	2009–2010 to 2017–2018	2010–2011 to 2017–2018	2010–2011 to 2017–2018	2010–2011 to 2017–2018	2009–2010 to 2017–2018
Number of 4dsw districts	31	29	26	15	85	20
Number of 5dsw districts	20	18	26	11	78	17

TABLE 2.2 Administrative Data Used in Time Series Analysis

2.3. Interviews and Focus Groups

One of the main contributions of this study to research about the 4dsw is richer and systematically collected qualitative information about the implementation of the 4dsw from a range of stakeholders. At the 12 districts we visited, we conducted one-on-one interviews and focus groups with adult stakeholders and only focus groups with students. As mentioned earlier, these districts included 4 4dsw districts in each of the three states. In inviting districts to participate in the qualitative data collection, we opted for some geographic diversity—specifically, we avoided visiting districts within 20 miles of each other and tried to represent different ecosystems and

Stakeholder type	Number of participants
Students (grades 6–12)	155
Teachers	125
Principals	24
Superintendents	12
Parents and caregivers	119
Community members	18
School board members	12
Total	465

TABLE 2.3 Number of Interviewees by Stakeholder Type

economic industries. For instance, in New Mexico we visited schools in districts where resource extraction was the main economic industry, and we also visited schools in districts where ranching was the primary industry. In New Mexico, we also visited schools in more northern mountainous regions and schools in southern low desert regions. As shown in Table 2.3, across the 12 districts we visited, we interviewed 465 individuals representing a wide spectrum of stakeholders. Stakeholders were roughly equally distributed across the three states (Idaho, New Mexico, and Oklahoma), and we interviewed every type of stakeholder in each district. Protocols for interviews and focus groups are supplied by Kilburn et al. (2021).

2.4. Schedule and Related Data from Districts

Using district websites and other internet sources, we collected information to help understand how districts implemented the 4dsw and how that compared with 5dsw districts, and then we filled in any missing data during the district site visits or by phone. We obtained information from both 4dsw and 5dsw districts on multiple measures, such as which weekday the district did not have school (the "fifth day"), the number of hours in a school day, the number of instructional days in a year, whether 4dsw districts offered activities for students on the weekday when school does not meet, whether the 4dsw districts provided food for students on the day off, and other aspects of school calendars and schedules. We developed a form for entering this information, and we collected the information during the first semester of the 2019–2020 school year. We collected these data from all 36 districts (18 4dsw and 18 5dsw) across the three states.

2.5. Surveys

We were interested in capturing the 4dsw experience of a range of stakeholders, including students and their caregivers. Given that collecting data from elementary-age students (kindergarten to grade 6) is challenging or even infeasible in some cases, we elected to collect data from the caregivers of elementary students (in the elementary parents survey) and directly from middle and high school students (in the youth survey). We did not collect data from the parents of middle and high school students, because we felt that it would be somewhat redundant given the information we obtained from parents of elementary students. We asked that primary caregivers of the elementary students complete the survey, and we recognize that not all of the primary caregivers will necessarily be parents. We describe survey administration procedures in Appendix A.

Elementary Parents Survey

We collected survey data from elementary parents online between January 6, 2020, and March 10, 2020, in all 36 districts in the three focal states: 6 4dsw districts and 6 5dsw districts in each state. We planned to accept one response each from 50 families in each of the 36 districts, or 1,800 total responses from individual families. On average, the total response rate for the elementary parents survey was 71 percent; the within-district response rates ranged from 10 percent to 110 percent because the survey allowed for 55 responses per district. Table 2.4 shows the total number of respondents to the elementary parents survey from 4dsw and 5dsw districts. The low response rates were partially influenced by the number of families with at least one elementary-age child. There were fewer than 50 families with an elementary-age child in at least two districts. Survey participants received a \$20 e-gift card to Amazon.

TABLE 2.4 Number of Respondents to Elementary Parents Survey by Days in School Week

District Type	Number of Respondents
4dsw	752
5dsw	580
Total	1,332

TABLE 2.5

Number of Respondents and Response Rate to Youth Survey by Days in School Week

District Type	Number of Respondents	Response Rate
4dsw	3,699	0.65
5dsw	2,759	0.76
Total	6,548	0.69

Youth Survey

We aimed to survey all middle and high school students in each of the 36 districts. Districts completed the online youth surveys on different schedules between January 6, 2020, and March 20, 2020, depending on factors such as the availability of computers to complete the surveys and the timing of parent notification of the survey. There were 9,465 students in grades 7 through 12 across the 36 districts. Parental refusal rates were very low (about 1 percent), resulting in 9,347 students eligible to take the survey (5,737 from 4dsw districts and 3,610 from 5dsw districts). Survey administration occurred during the school day; schools identified the most convenient class for administration (e.g., homeroom, advisory, science). Youth survey responses were available from 34 of 36 districts, with COVID-19 disrupting the survey schedule for 2 Oklahoma comparison districts. We describe survey administration in more detail in Appendix A.

Table 2.5 shows the number of respondents to the youth survey by 4dsw and 5dsw status; the overall survey response rate was 72 percent. When compared with the national population of 4dsw students, youth survey respondents were much more diverse, with much higher representation of Native American and Hispanic students (see Kilburn et al., 2021, Table A.5). Appendix C (Kilburn et al., 2021) includes a copy of the youth survey.

2.6. Time Series Data

In addition to the original data we collected as part of this project, we also analyzed time series data that came from multiple sources. We combined CCD data, ACS data, EOP data, student-level data from the State of New Mexico, and attendance data from state department of education websites. These data were used to identify matched 5dsw districts for the participating 4dsw districts, provide control variables in statistical models, and analyze outcomes of interest. The matching process is described in more detail later in this chapter and in Appendix A. Here we provide a brief overview of these data sets.

The EOP provided a set of data files that contains detailed information about American schools, communities, and student success from several sources. One of the attractive features of this data set was that the EOP team creates a standardized measure of student achievement across states and time so that achievement outcomes can be compared within and across states (Reardon et al., 2021). Note that the EOP did not include high school test scores, because states do not consistently assess high school students in the same subjects and in the same grades.

We analyzed the district-level EOP files, which include measures of academic achievement. The public EOP data files for each state suppress variables that are derived from small groups—for example, if there are 20 or fewer students in a grade in a district one year, the EOP would not report these values. This posed a significant challenge for this study. The 4dsw districts included in our analyses, on average, enroll 597 students across all grades. Half of the districts enroll fewer than 350 students, and a quarter of the districts enroll fewer than 200 students. Given the small size of most districts that implement the 4dsw, this meant that the publicly available EOP data, which are reported at the district and grade level, contained large amounts of suppressed data for these districts.

We were able to work with the EOP to create a special data set for this project that pooled the achievement scores for third through eighth graders in

districts, rather than reporting scores for each individual grade. This resulted in a large enough number of students that the data could be reported for this aggregated group. Our analyses do not include high school test scores.

The EOP did not report test score data in years or subjects for which it could not estimate scores from underlying data or for which underlying data do not meet quality standards. These restrictions resulted in too much missing data to analyze test scores from New Mexico and Colorado. We supplemented the EOP data with student-level administrative data provided by the New Mexico Public Education Department. We transformed the New Mexico test data to be on the same scale as the EOP's by leveraging the linking methods described in the EOP technical documentation (Reardon, Kalogrides, and Ho, 2019) and additional guidance from EOP staff. Publicly available test score data from Colorado also suppressed test scores from small sample sizes, precluding us from performing a similar linkage for that state. Therefore, our analyses of test scores did not include Colorado. The test score analysis covers the school years 2009–2010 through 2017–2018.

The CCD is an annual data set maintained by the U.S. Department of Education that includes information on all public schools and districts in the country. The CCD reported the number of students enrolled in districts and some of their demographic characteristics, the number of full-time-equivalent teachers, and financial information for districts. The U.S. Census Bureau's ACS provides local-level demographic and housing information on the geographic catchment area of school districts. These ACS data can be matched to other education data through unique NCES district IDs. Finally, we collected district-level, yearly attendance data from state department of education websites. South Dakota only reported a measure of chronic absenteeism on its website; therefore, our attendance analyses did not include South Dakota.

In sum, for the time series analysis, we used annual achievement data from the EOP that includes observations for each district; we supplement these data with student-level data in New Mexico that are aggregated to the district level. We used the CCD and ACS to create district-level control variables such as demographics, and we use publicly available data from state departments of education on attendance. Our sample includes six states for which we have a time series of 4dsw use by district starting no later than the 2010–2011 school year, that had a large number of districts switching from a 5dsw to a 4dsw between the 2010–2011 and 2017–2018 school years, and that do not have high numbers of districts using a hybrid of the 4dsw and 5dsw. The six states are Colorado, Idaho, Missouri, New Mexico, Oklahoma, and South Dakota.

2.7. Analytic Approach

In this section, we describe our analytic methods. We first describe how we coded and analyzed the interview and focus group data from the 12 visits to 4dsw districts. Then we present the methods used to analyze the survey and the time series data.

Qualitative Analysis

All data from the interviews and focus groups (hereafter, the qualitative data) were transcribed for coding and analysis. In instances where transcripts were not available (e.g., when a respondent did not consent to the recording), we used notes taken by researchers during the interview or focus group. Three researchers coded the qualitative data using Dedoose (2020), web-based qualitative analysis software. Our coding scheme reflected the project's core research questions and the topics covered in the interview protocols. For example, we coded for topics such as the districts' motivations for adopting the 4dsw, the activities students and staff engage in on the fifth day when they are not in school, and perceived effects of the 4dsw on key outcomes of interest (such as attendance, student learning, and family stress). We also allowed for emergent codes to reflect topics evident in the data that we did not plan for at the outset of coding (Strauss and Corbin, 1994). Appendix A contains additional information on handling new codes and ensuring consistency and reliability in coding.

Analysis involved thematically grouping the coded data. Coders conducted both inductive and deductive reading of the data. We deductively read across data focused on the project's core topics and hypotheses about the 4dsw identified in past research. For example, past literature and the popular press suggest several primary motivations for adopting the 4dsw. As such, we analyzed the data to determine what evidence and themes emerged to support or refute these reasons. We also read the data inductively, allowing for emergent themes to arise, particularly with regard to respondents' perceptions of the overall advantages and disadvantages of the 4dsw. Appendix A presents more details regarding the qualitative data analysis.

Analysis of Survey Data

We formally consider 12 youth survey and 15 elementary parents survey outcome variables, and we list these in Table 2.6. We discuss the results in Chapters Four and Five.

The analytic approach is the same for outcomes from both surveys. As survey respondents are clustered within school districts, we implement a modeling approach that accounts for this nested structure. For continuous outcome variables, such as sleep duration on school nights, we implement two-level hierarchical linear models, with student or parent responses nested within district (Raudenbush and Bryk, 2002), including an indicator for 4dsw status as well as the same district-level covariates used in the propensity score matching models and covariates capturing student characteristics we collected via the surveys.

District-level covariates include number of students and schools; proportion of student free or reduced lunch, special education, female, Hispanic, Native American, and English-language learners; community household income; and proportion of adults in the labor force, families in poverty, and families receiving Supplemental Nutrition Assistance Program (SNAP) benefits. The student-level covariates include number of adults in the household, family income, grade, age, gender, and Hispanic and Native American indicator variables. See Table A.3 for more information on covariates.

The regression coefficient for the indicator of 4dsw status produces an estimate of the average outcome difference between 4dsw and 5dsw districts, after controlling for the covariates (see Table A.2 for a list of covariates). We formally consider whether the outcome differs between 4dsw and 5dsw districts by testing the statistical significance of this coefficient.

For binary and count survey outcome variables, such as whether a student is experiencing food insecurity or the number of student absences, we use generalized hierarchical linear models (Raudenbush and Bryk, 2002)—that is, a hierarchical logistic regression for the binary outcomes and a hierarchical

Variable	Elementary Parents Survey	Youth Survey
Days absent	×	×
Fifth day doctors' appointments	×	x
School-week sleep hours	×	×
Fifth-day sleep hours	×	×
School-night sleep hours	×	x
Parent stress	×	
Family engagement	×	
Food insecurity	×	×
Feeling tired	×	x
K-grade 1 only	×	
Emotional problems (SDQ)	×	x
Conduct problems (SDQ)	×	x
Peer problems (SDQ)	×	
Hyperactivity (SDQ)	×	
Physical activity		x
Positive student learning environment (CSCHLS)	×	x
Positive interpersonal relationships (CSCHLS)		x

TABLE 2.6 Variables and Survey Source

NOTES: "SDQ" indicates that the Strengths and Difficulties Questionnaire was used as a resource for the outcome. "CSCHLS" indicates that the California School Climate, Health, and Learning Survey was used as a resource for the outcome.

Poisson regression for count outcomes. These models use the same independent variables as the continuous case, and the regression coefficient on the indicator of 4dsw status is again used to test for formal differences in the outcomes of 4dsw and 5dsw districts. For interpretability, we make the standard conversions of the 4dsw regression coefficient to an odds ratio scale for binary outcomes and to a rate ratio scale for count outcomes. We consider whether these ratios differ significantly from 1 when testing for formal differences in the survey outcomes of 4dsw and 5dsw districts. When we present graphical results, we show the point estimate and the 95 percent confidence interval. For odds ratio and rate ratio results, if the confidence interval includes 1, then there is no statistical difference between the 4dsw and 5dsw for that outcome. For continuous outcomes, if the confidence interval includes 0, there is no statistical difference between the two types of districts. For most outcomes, the district-level contribution to the variability in the outcome (also known as intraclass correlation) was very small; differences among individuals were overwhelmingly responsible for the variance of a given outcome.²

Analysis of Time Series Data

The administrative time series data are at the district level. Our analysis adds to the existing literature on the effects of the 4dsw by using data from multiple states rather than an individual state and using more recent data on the timing of districts switching to the 4dsw. We estimated the relationship between 4dsw status and three student outcomes: attendance, ELA achievement, and math achievement. Achievement test scores, gathered from EOP and state administrative data, are on a common scale. Attendance is expressed as a proportion of the days a student was present during the school year. Appendix A describes the methods used to create these variables.

To estimate the effect of the 4dsw on student outcomes, we employ two strategies: (1) a matched event study and (2) a matched difference-in-difference design (Abadie, 2005; Gopalan, Rosinger, and Ahn, 2020). To implement these strategies, we first find a 5dsw district that is a match for each 4dsw district in our sample.³ The general approach is to find the 5dsw district that

² In some cases, the estimated district-level variance was estimated to be virtually zero. In these cases, the district variance component was eliminated from the model, resulting in a standard linear or generalized linear model.

³ We restrict our pool of comparison districts to nonurban and nonsuburban districts because the vast majority of 4dsw-adopting districts are in rural areas. In our sample only 7 of the 213 4dsw districts that adopted the policy in our states in our time frame were in suburban or urban areas. Similar restrictions were imposed in prior studies of the 4dsw (e.g., Morton, 2021).

looks most similar to each 4dsw district in terms of historical trends in ELA and math achievement and attendance. Within each year during our time period,⁴ we first estimate a prediction model for the probability of adopting the 4dsw (i.e., propensity scores) for each 4dsw district based on historical trends in ELA and math achievement and attendance. We use this approach following the education production function literature, in which achievement and attendance are two outcomes that together summarize the family, school, district, and other educational inputs (Hanushek, 2020). Using the estimated prediction models, we assign each district the predicted probability of adopting the 4dsw. For each 4dsw district, we choose as its match the comparison district with the most similar probability of adopting the 4dsw.⁵ We allow the same 5dsw district to serve as the comparison for more than one 4dsw district so as to keep only the best matches.⁶ Table 2.7 presents the number of 4dsw and matched 5dsw districts in the final time series analysis, by state. Overall these analyses include 206 4dsw districts and 170 5dsw districts, for a total of 376 districts. Appendix A describes these methods in more detail.

After identifying the 5dsw match for each 4dsw district, we conduct the event study and difference-in-difference analyses using the resulting treatment and comparison groups. Both models use the same underlying strategy to estimate the effects of the 4dsw policy. Each model looks at trends in the outcomes in 4dsw districts, before and after the adoption of the policy, and compares them with trends in the outcomes of the matched comparison 5dsw districts. The assumption is that the trends over time of the matched 5dsw districts are an accurate representation of what would have occurred had the 4dsw districts *not* adopted the policy. Thus, any difference in trends is attributed as the effect of the 4dsw district. These models

⁴ For Idaho and South Dakota, we were able to obtain yearly lists of 4dsw districts for school years 2009–2010 through 2017–2018, and for the remainder of the states we obtained yearly lists of 4dsw districts for school years 2010–2011 through 2017–2018.

⁵ There are minor variations in the variables used for matching based on available data in each state. See Appendix A for details.

⁶ This differs from the propensity score matching conducted for our primary data sample, since matching with replacement would have diminished the number of districts participating in the survey and the associated statistical power.

State	Number of 4dsw Districts	Number of Comparison 5dsw Districts	Total
Colorado	31	20	51
Idaho	29	18	47
Missouri	26	26	52
New Mexico	15	11	26
Oklahoma	85	78	163
South Dakota	20	17	37
Total	206	170	376

TABLE 2.7 Number of Four- and Five-Day-School-Week Districts in Time Series Analyses, by State

also account for student and neighborhood characteristics from the CCD and ACS and differences between districts and between the years in our time frame.

The event study model explicitly estimates differences in outcomes between 4dsw and 5dsw districts each year before the adoption of the 4dsw and each year after adoption. If our matched 5dsw comparison districts are a valid comparison for the 4dsw districts, we would expect *no* differences in outcomes before the adoption of the policy. Any differences in outcomes after adoption are attributed to the adoption of the policy. The difference-in-difference model does not estimate effects for each pre- and posttreatment year separately but rather provides differences between average pre- and posttreatment trends. Our preferred model is the event analyses, but we also provide estimates from the difference-in-difference model so as to compare our results with prior research studies.

Recent scholarship has demonstrated that under certain circumstances, estimates from difference-in-difference models that take advantage of a policy that was adopted over time can produce biased results (e.g., Baker, Larcker, and Wang, 2021). We therefore employ two alternative models to understand whether bias is a concern in this study. Specifically, we use the outcome regression and inverse probability weighted models posited by

Callaway and Sant'Anna (in press) that ameliorate the underlying concerns. We present these results in tandem with the traditional estimates.

Note that in addition to examining attendance, ELA achievement, and math achievement, we also analyzed the effects of the 4dsw on the number of full-time-equivalent teaching positions and student-teacher ratios. We do not present the results in the main body of this report because the event study analyses indicate that there could be differences in those outcomes before the adoption of the policy between our 4dsw districts and their matched comparison 5dsw districts. We therefore treat those results as exploratory and present them only in Appendix B.

2.8. Limitations

This study has several limitations. One is that the quantitative methods all involve quasi-experimental designs rather than an experimental design. It would be impractical to randomly assign districts to the alternative schedules, so quasi-experimental designs are likely to be the best option for understanding the effects of the 4dsw. We have tried to mitigate this limitation by using quasi-experimental designs that are best matched to the structure of our data.

Our survey sample does feature some imbalance in the number of students served and median household income for 4dsw and 5dsw districts. While we control for these variables in our models, some potential for bias due to this imbalance remains. The direction of this bias may vary depending on the outcome. Given the large number of outcomes that we analyze and the speculative nature of these potential biases, we do not discuss the biases in detail. As with most quasi-experimental designs, an important missing variable could bias our results. For example, for both the survey and time series analysis, variables that affect both district choice to implement a 4dsw and outcomes could lead to estimates of the 4dsw's effect on the outcomes that are different from the true estimate.

A further weakness of the survey analysis is that our sample only includes 36 districts in three states, leading to the possibility that this analysis is not representative of 4dsw districts generally. We compared the descriptive statistics of the districts in our sample with descriptive statistics from a national population of 4dsw districts reported in Thompson et al. (2020). Our sample is similar to the national population of 4dsw districts on number of schools in the district, district enrollment, and proportion female. However, compared with the national population of 4dsw districts, our sample appears to be more disadvantaged: revenue per pupil is substantially lower, and the proportion of students eligible for free or reduced lunch is much higher in our sample. Our sample also has more Native American students and Hispanic students than the national population of 4dsw districts.

Another shortcoming of the survey is that fewer parents participated than intended. We aimed for 1,800 responses but received 1,332 responses, and relatively fewer from parents in 5dsw districts. This lower response rate reduces our ability to detect effects and may also result in a sample that is not representative of parents of elementary students in participating districts. An additional concern for the survey analysis is that the parents responded to an electronic survey, which may have resulted in the elementary parents survey not being representative of the parents in these school communities. While parents could complete the survey using smartphones and this did not require having access to the internet, it may be the case that parents with tablets, computers, or other devices that have internet access would be more likely to complete the survey. While cell phone use is reported to be ubiquitous, even in rural areas (Pew Research Center, 2019), some of the communities where we collected survey data are extremely remote and may not have reliable or comprehensive cell phone coverage.

An additional limitation relates to the representativeness of the focus group participants and interviewees in the 12 districts we visited. We interviewed a large number of individuals representing the different types of stakeholders that we specified in our interview plans: students, parents, teachers, school administrators, and community members. There may have been self-selection among the individuals who agreed to participate in the interviews, and in fact, several interview participants indicated that they wanted to participate because they felt strongly about the negative or positive aspects of the 4dsw. As a result of this type of self-selection, the qualitative responses may not represent the full range and diversity of perspectives in the 4dsw communities, but rather reflect the extreme opinions. Additionally, district administrators helped us with recruitment for interviews and focus groups, and so any biases administrators had about the 4dsw—likely in favor of it—may have influenced composition of the qualitative sample.

Another consideration about the qualitative and survey data is that responses might suffer from choice-supportive bias. Studies show that people assign more positive attributes to a choice after they have selected that choice (Brehm, 1956; Mather and Johnson, 2000). As a result, the responses of the 4dsw stakeholders might be skewed toward a positive view of the 4dsw.

Finally, we recognize that student achievement scores are weighted heavily in decisions about educational policies. We present findings on achievement scores for students in third through eighth grade, but a weakness of our study is that we do not have scores for high school students.

CHAPTER THREE

The Four-Day School Week in Practice

In this chapter, we describe what the 4dsw looks like in practice. We first provide an overview of the relevant state requirements on such issues as instructional hours and days of instruction. Next, we report on the schedules of the 4dsw and 5dsw schools in our sample. We conclude this section by reporting our findings on how students in 4dsw and 5dsw districts spend their time Monday through Friday.

3.1. Relevant State Requirements

Key Findings

- Requiring minimum hours of instruction per year rather than days of instruction per year or school year start and end dates frees districts to use a 4dsw.
- Districts with a 4dsw had a school day about 50 minutes longer than the districts with a 5dsw, but 4dsw students went to school 25 fewer days per year on average.
- On net, 4dsw districts in our sample held school 58 fewer hours on average over the year compared with 5dsw districts in our sample.

States regulate a variety of instructional time parameters and have differing definitions of instructional time, making cross-state comparisons challenging (Rowland Woods, 2015). States typically mandate a minimum

TABLE 3.1 State Requirement Regarding Minimum Days per School Year for Eight States with Highest Incidence of Four-Day School Weeks

State	Requirement of Minimum Days per School Year
35 of the states without 4dsw	180–185
Colorado	160
Idaho	Set by school district
Missouri	None
Montana	Set by school district
New Mexico	None
Oklahoma	Days or hours requirement could be met
Oregon	None
South Dakota	Set by school district

SOURCE: Education Commission of the States (2020).

number of instructional days per year, a minimum number of instructional hours per year, or both. As of January 2020, the most common number of required instructional days was 180 (Education Commission of the States, 2020). The number of hours of instruction states required typically ranged from 900 to 1,100 (Education Commission of the States, 2020). Replacing requirements regarding instructional days per year with requirements regarding hours of instruction per year frees districts to engage in more flexible scheduling arrangements, such as the 4dsw (Rowland Woods, 2015). Thirty-five of the states and District of Columbia required 180 or more days; Table 3.1 shows the state requirements regarding instructional day for the eight states with 4dsw districts in Figure 1.1. Only Colorado had a requirement regarding minimum days, and at 160 days per year, it was well below the modal number of 180. Thompson et al. (2020) report that among 4dsw schools, the average number of instructional days is 148, and among 5dsw schools, the average number is 179.

Other state instructional time policies that might affect the viability of having a 4dsw include regulations related to start and end dates for school

TABLE 3.2 Features of Schedules for Districts in Our Survey Sample (2019–2020 School Year) and National Sample Reported in Thompson et al. (2020) (2018–2019 School Year)

		Means			
	4dsw Districts, Our Sample	5dsw Districts, Our Sample	4dsw Districts, National Sample	5dsw Districts, National Sample	
School start time	7:53 a.m.	8:03 a.m.	7:56 a.m.	8:07 a.m.	
Hours of school per day	7 hours, 55 minutes	7 hours, 6 minutes	7 hours, 46 minutes	6 hours, 54 minutes	
Number of school days per year	146	171	148	179	
Hours per year	1,156	1,214	1,150	1,235	

SOURCE: Data authors collected from district websites and interviews.

NOTE: Our survey sample includes 18 4dsw districts and 18 5dsw districts, equally distributed across Idaho, Oklahoma, and New Mexico.

years and those related to daily school start and end times. Only 14 states have requirements for start and end dates, and our review suggests that they are unlikely to constrain districts' choices to use a 4dsw (Education Commission of the States, 2020).

Out of the 18 4dsw districts in our survey sample, only 3 had Monday off (17 percent of districts), while the others had Friday off. This is the same percentage of 4dsw districts that reported having Monday off in the national population used by Thompson et al. (2020). Some of the 4dsw districts we visited reported that when there was a holiday that fell on a Monday, they might still go to school four days on that week by using a Tuesday–Friday schedule.

We collected detailed information on school start times, hours of school per day, and number of instructional days from the 36 4dsw and 5dsw districts in our sample. Table 3.2 reports these values along with those reported in Thompson et al. (2020) for national 4dsw and 5dsw samples. The mean values of these variables in our 4dsw sample are very similar to those presented in Thompson et al. (2020). While the 5dsw districts in our

sample have fewer school days per year than Thomson et al. (2020)'s sample (171 compared with 179), this is nearly offset by the longer school days used by our 5dsw districts compared with those in Thomson et al. (2020).

Compared with our 5dsw districts, our 4dsw districts started the school day 10 minutes earlier on average (7:53 a.m. versus 8:03 a.m.). Students in our 4dsw sample had a day that was 49 minutes longer on average compared with those in our 5dsw sample—7 hours and 55 minutes versus 7 hours and 6 minutes. Districts in our 4dsw sample had 25 fewer school days per year than our 5dsw districts—146 days compared with 171 days. Using the same approach as Thompson et al. (2020) for calculating instructional hours per year, we estimated that our 4dsw districts met for 1,156 hours per year, while our 5dsw districts met for 1,214 hours per year, a difference of 58 hours per year.

Comparing calendars of our 4dsw and 5dsw districts suggests that the contrast between their schedules may not be as stark as Table 3.2 would suggest. In at least one of our three focal states, a third of public school students were subject to "early release days" regularly scheduled in three of the largest districts in the state (New Mexico Legislative Finance Committee, 2018). The inclusion of this time off was sometimes reflected in the calendars reported to the state, but the reporting was inconsistent. This time was used for parent-teacher conferences, teacher professional development, faculty meetings, teacher planning, and other purposes. For example, as of 2018, every Wednesday Rio Rancho Public Schools released elementary students three hours early and high school students one hour early, and this totaled 35 partial days (New Mexico Legislative Finance Committee, 2018). Hence, in New Mexico, the alternative to the 4dsw in the largest districts is closer to a four-and-a-half-day week rather than a five-day week, which is the way the state classifies these districts. This type of measurement error in the true calendars of districts would drive estimated differences between 4dsw and 5dsw outcomes toward zero. Additionally, many 5dsw districts go four days a week on the weeks that have holidays, and 5dsw districts may also go four days on weeks with a teacher professional development day or a parent-teacher conference day. Out of 37 weeks in school between September 1 and June 1, the 2019–2020 school year had 7 weeks with four or fewer days because of federal holidays. If we also assume that there are two days a year for parent-teacher conferences and two days off a year for professional development, that brings the total

number of weeks with four or fewer days to 9, or almost a quarter of the weeks in this example. Districts that use a 4dsw calendar typically schedule teacher professional development and parent-teacher conferences on the fifth day. More fine-grained characterization of time in school and time in learning, such as that undertaken by Thompson (2021b), is a fruitful direction for further research.

3.2. Four-Day and Five-Day Students' Time Use Monday to Friday

Key Findings

- The daily schedule during the school week for 4dsw and 5dsw students was very similar, with the longer school days resulting in less free time after school for 4dsw students but not less time on other types of activities.
- Both elementary and high school students in 4dsw schools had more free time outside school over Monday–Friday compared with 5dsw students.
- Elementary 4dsw students most often used that free time to do chores and school sports, and high school students used that free time to do chores, work, and a wide variety of other activities.

In our surveys, we asked parents to report on the typical school-day schedule of elementary students, and we asked grade 7–12 students to report on their own typical school-day schedule. As displayed in Figure 3.1, we found that the 4dsw and 5dsw students in our sample reported having very similar schedules on school days. All reported differences between 4dsw and 5dsw students in these sections were statistically significant at p < .05. Statistically significant differences of less than 10 minutes in daily time use categories and 20 minutes in weekly time use categories were substantively small and are not interpreted or reported as meaningfully different in this section. Exact estimates of all descriptive statistics and comparisons reported in this section can be found in Appendix A.

FIGURE 3.1 School-Day Schedules for Students on Four-Day-School-Week and Five-Day-School-Week Schedules



SOURCE: Elementary parents survey and youth survey. NOTE: Statistically significant differences in daily time categories between 5dsw and 4dsw students in grades K–6 and grades 7–12 are noted by *p < 0.05 and **p < 0.001.

The 45-minute-longer school day for 4dsw students was almost entirely offset by having about 30 to 40 minutes less of free time or out-of-school time (OST) after school for all students in grades K–12. Two other major categories of time use—travel and before-school OST—were comparable for students on 4dsw and 5dsw schedules. OST is time during which students might pursue extracurricular activities, complete homework, work, or help out around the house. Despite having earlier start times and later end times, the 4dsw did not result in meaningful differences in bedtimes or wake-up times for elementary or secondary students.

Although 5dsw students reported having slightly more OST after school each school day, they had less total OST over the course of a week because 4dsw students have a full day of OST on the fifth day. Not only did 4dsw students not spend time attending school on the fifth day, but they also did not have to spend time traveling to and from school on that day. Figure 3.2





SOURCE: Elementary parents survey and youth survey. NOTE: Statistically significant differences in total weekly OST between 5dsw and 4dsw students in grades K–6 and grades 7–12 are noted by *p < 0.05 and **p < 0.001.

shows that 4dsw students in grades K–6 and 7–12, respectively, reported having about 4 hours and 3.5 hours more weekly OST than 5dsw students. The fifth day makes up approximately 30 percent of the total OST reported by 4dsw students in grades K–6 and 7–12. Our findings about OST are consistent with those of Israel et al. (2020), who report that 4dsw students are more likely to participate in extracurricular activities.

Our respondents reported that both elementary and secondary students spent their OST on a variety of activities. As demonstrated in Figure 3.3, there were both similarities and differences in how much time students on 4dsw and 5dsw schedules spent on average on each measured type of activity per week. In each age group, 4dsw and 5dsw students spent similar amounts of time on school sports, on school activities, and working for their families. The 4dsw students spent approximately 30 to 60 minutes more than 5dsw students on nonschool sports and hobbies, and they spent 1 hour and 10 minutes to 1 hour and 40 minutes more on chores every week. Students using the additional time they have on a 4dsw to help out their family by doing chores

FIGURE 3.3 Weekly Time Spent on Activities for Students on Four-Day-School-Week and Five-Day-School-Week Schedules



Panel A: grades K-6

SOURCE: Elementary parents survey and youth survey.

NOTE: Statistically significant differences in total weekly time spent on activities between 5dsw and 4dsw students in each in grades K–6 and grades 7–12 are noted by *p < 0.05 and **p < 0.001. Time spent on "Other" activities refers to time spent on activities other than the ones we measured. This "other" activity time could include eating dinner, getting ready for bed, or watching television, for example.

5dsw school days
4dsw school days
4dsw 5th day

may be particularly important in rural areas where chores can include farm work or other tasks that are associated with the family's income. Relatedly, older 4dsw students also reported spending about 40 minutes more per week working at a job than 5dsw students, enabling them to increase their own income or contribute to their family's income.

Time spent on homework was similar across 4dsw and 5dsw students in grades K–6, but 4dsw students in grades 7–12 spent approximately 40 minutes more on homework per week than 5dsw students. In each age group, 4dsw and 5dsw students reported spending similar amounts of time on activities other than the ones we measured. These could include eating dinner, getting ready for bed, or watching television.

Additionally, respondents reported that elementary and secondary students on 4dsw and 5dsw schedules spent similar amounts of time outside school on non-school-related screen time (e.g., playing video games, watching television) over the course of the week. Screen time was measured separately from students' other activities (Figure 3.4), so respondents were likely to account for this time as a "hobby" or "other" activity in Figure 3.3. In contrast

FIGURE 3.4 Weekly Screen Time for Students on Four-Day-School-Week and Five-Day-School-Week Schedules



SOURCE: Elementary parents survey and youth survey. NOTE: There were no statistically significant differences in this analysis.

to our findings, Israel et al. (2020) find that 4dsw students in Colorado are less likely to have more than three hours of nonschool screen time daily.

Importantly, these findings regarding students' weekly time use suggest that 4dsw students were not simply spending their extra OST doing unproductive activities; rather, they used some of the extra time to engage in the types of activities that we measured in this study, many of which are typically considered to be productive for youths and related to positive developmental outcomes (Durlak, Weissberg, and Pachan, 2010; Lauer et al., 2006; Lerner et al., 2005).

3.3. What Happens on the Fifth Day in Four-Day Districts?

Key Findings

- Most districts offered sports practices or competitions on the fifth day, some districts had clubs or student activities that met on the fifth day, and academic enrichment activities were rarely offered.
- While most teachers reported doing school-related work on the fifth day, school staff generally reported only occasionally being required to report to school on the fifth day.
- Eighty percent of high school students and 90 percent of elementary students reported that home was the primary place they spent time on the fifth day.

What Four-Day-School-Week Districts Offer to Students on the Fifth Day

In the 12 4dsw districts we visited, we asked what types of activities the district offered on the fifth day. The offered activities varied, and only one community offered regular coordinated activities open to all students throughout the school year. The fifth-day activities were typically related to athletics and extracurricular clubs. We learned that most districts have sports practices on the fifth day, and districts with Friday as the fifth day

attempt to schedule competitions on the day students do not have school. The time of day sports practices occurred and the length of practice varied by district. Some electives and clubs also met on the fifth day, but the activities often depended on the adult leaders' schedules. No districts offered transportation to fifth-day activities.

What Teachers and School Staff Do on the Fifth Day

During focus groups and interviews in the 12 4dsw districts we visited, we queried teachers about how they spent time on the fifth day. Broadly, the day was described as "flexible," meaning that the activities teachers engaged in and how long they engaged in those activities varied and was not prescribed by the district. It was typically a mix of a workday and a weekend day. Across states, teachers reported using the fifth day to schedule medical and other appointments for themselves and their family members. Many teachers spent some time on personal chores, such as grocery shopping, cleaning, banking, and home maintenance.

All teachers reported spending some time on the fifth day or over the weekend on schoolwork (e.g., writing lesson plans, grading). Many teachers reported completing work on the fifth day so that "Saturday can be a real weekend day." In this way, teachers perceived that the fifth day allowed them to spend more time with their family. Teachers who lived close to their school building reported going to school on the fifth day to do work. Teachers who described themselves as living farther away (e.g., 30 minutes one way) tended to do schoolwork at home.

Teachers in Idaho were more likely than teachers in Oklahoma or New Mexico to report spending most fifth days at their school. The frequency and duration of time spent at school were related to their contracts. Each of the Idaho districts specified the number of fifth days and hours teachers were required to spend on campus. Staff in one district reported spending about two Fridays a month on campus; one Friday was allocated to professional development and other meetings while the other was allocated to delivering services to students (e.g., tutoring, enrichment). On the fifth days teachers were required to be on campus, the schedule was described as somewhat flexible and lasting about half a day. In contrast, professional development days in Oklahoma and New Mexico were described as an "occasional" fifth day taking place a few times a year. Only one district reported that teachers "do not have to report for any reason" on the fifth day; all staff trainings and meetings took place after school.

In 8 of the 12 4dsw districts, we spoke with teachers who led school activities for students; these teachers reported spending some time at school on the fifth day throughout the year because of these activities. For example, teachers who led clubs like FFA, Future Business Leaders of America, and Future Cities met with students on the fifth day, primarily before events or competitions. According to these teachers, in a 5dsw these additional preparatory meetings would occur on a Saturday. Teachers who also coached sports teams reported spending "every" fifth day at school during the sport season for practice or coach meetings.

Unique to the districts we visited in Oklahoma was teachers' working in an additional job on their fifth day. At least one teacher in each district reported doing so to supplement their teacher salary. Jobs included lawncare service, family businesses, and retail. Moreover, respondents without a second job often reported that their colleagues used the fifth day to work outside the district. While we could not assess the proportion of staff with second jobs, it was a prevalent activity on the fifth day in Oklahoma districts. Nationally, 18 percent of teachers hold a second job during the school year (NCES, 2021).

Overall, teachers in nearly all districts reported spending more time on family activities or taking time for themselves on the fifth day or over the weekend as a result of the 4dsw. Teachers universally spent time on schoolwork over the weekend but felt they were better able to balance professional and personal demands with the fifth day off.

What Students Do on the Fifth Day

In the elementary parents survey and youth survey, we asked about where students spent their fifth day and whether there was an adult present at that location. Detailed estimates of all descriptive statistics and comparisons reported in this section can be found in Appendix B. Survey results indicated students of all ages are primarily home with their parents or other adults on the fifth day. As displayed in Figure 3.5, home was the primary location for over 90 percent of students in grades K–6, and less than



FIGURE 3.5 Fifth-Day Locations by State and Adult Supervision



Panel B: grades 7-12

SOURCE: Elementary parents survey and youth survey.

NOTE: Statistically significant state-based differences in the total percentage of students spending time at a location on the fifth day in grades K–6 and grades 7–12 are noted by *p < 0.05 and **p < 0.001. Table A.3 reports the numbers on which this figure is based.

1 percent of these students were at home without adult supervision. Parents reported that 12 percent of students in grades K–6 also spent time at someone else's home, such as that of a friend or family member, with adult supervision. Findings for the younger age group were similar in each state, with one exception. In Idaho, parents of elementary-age students reported that 5 percent of students spend some time at school on the fifth day compared with less than 3 percent of students in Oklahoma and New Mexico. Across all states, less than 4 percent of families reported that their child spent time on the fifth day in childcare, at a government-run location (e.g., city library, community center, public athletic facility), or at another location not already counted.

According to survey data, students in grades 7–12 were only slightly more likely to spend time at locations other than their home or someone else's home. Among these older students, 81 percent reported spending time at home and 25 percent reported spending time at someone else's home on the fifth day. The older students were more likely than the younger students to report being at school, a government-based location, or another location, but no more than 9 percent of students were at one of these locations in any of the three surveyed states. It was also uncommon for the older students to be unsupervised on the fifth day: fewer than 16 percent of older students reported it in each state.

Students and parents whom we spoke to in the 12 site-visit districts echoed these findings from the survey. The majority of interviewees across all districts reported that students were primarily at home or at the home of a family member or friend on the fifth day. Many interviewed parents reported that they were able to organize their families' schedules to ensure that someone was home with their children (especially younger children) on the fifth day. In some families, one parent did not work outside the home; for other families, flexible work schedules (e.g., part-time work or nontraditional work hours, such as four 12-hour shifts in health care fields) allowed parents to be home with their children on the fifth day. Many participants in the focus groups and interviews believed that their communities had more adults available to spend time with the students on the fifth day than communities that did not have a 4dsw. One reason was that one parent was not in the labor force or was self-employed, or that some local employers had nontraditional work schedules, such as four days of work followed by three days off. Another reason they gave was that their community included a lot of extended families with adults who could care for children on the fifth day. In fact, consistent with the survey findings reported earlier, some families with whom we spoke reported relying on extended family to help with caregiving. The interviewees reported that students spent time on various activities while at home on the fifth day, such as catching up on sleep, engaging in leisure activities (e.g., watching television, playing outside), working on school assignments, and completing chores. Middle and high
school students reported that they also sometimes spent this time at home (or someone else's home) hanging out with their friends.

Consistent with findings from the elementary parents survey and youth survey, interview and focus group participants (students, parents, and school staff) reported that students occasionally spent time outside the home on the fifth day. For some students, this time was spent at school. School activities varied from regularly scheduled enrichment activities in districts' fifth-day programming to sports practices and meetings for clubs and extracurricular activities. Sometimes these extracurricular activities took place regularly on the fifth day, such as in one district where parents reported their children had band practice on the fifth day. In other instances, the activities occurred infrequently or on an as-need basis. For example, an interviewed member in one district described having supervised a group of students on the previous Friday when they came to campus to decorate the building for spirit week. Parents and teachers also noted that the fifth day provided additional time for nonschool extracurricular activities, including nonschool sports like skiing or mountain biking (as reported in the survey).

As mentioned earlier, youth survey data indicate that middle and high school students in the 4dsw districts spent more hours per week at a job than students in the 5dsw districts. High school students and parents of high schoolers with whom we spoke corroborated this finding and reported that adolescents often used the fifth day to work. Across the survey, interview, and focus group data, students' locations and the supervision at those locations were similar across the three states despite differences in the states' offerings for students on the fifth day.

Despite having longer school days, 4dsw students spent less total time at school over the course of a week than 5dsw students, which left them with more OST than 5dsw students. Overall, these findings indicate that 4dsw students used some of their extra OST on the fifth day to engage in a range of activities rather than there being one most common activity. The 4dsw students spent that extra time on chores, hobbies, nonschool sports, homework, and jobs. These activities and all other student activities largely occurred at the students' homes or other peoples' homes, as it was uncommon for students to spend any substantial time at school, government-based locations, daycare, or any other locations. Rates of adult supervision for students of all ages and at all locations were high.

CHAPTER FOUR

Analyzing the Claims of Proponents of the Four-Day School Week

In this chapter, we report findings related to the primary motivations proposed by proponents of the 4dsw. We first present the motivations reported in the districts in our sample and the broader literature. Then we describe our findings on the extent to which the evidence we have supports the arguments in favor of the 4dsw. Additional details on the statistical methods used to analyze the survey and time series data discussed in this chapter may be found in Chapter Two and Appendix A, and additional information on results, including confidence intervals for all survey results, may be found in Appendix B.

4.1. Motivations for Adopting the Four-Day School Week

Key Findings

- Stakeholders in all site-visit districts mentioned cost savings as one of the reasons the district adopted the 4dsw.
- Improving student attendance was also one of the primary reasons cited in about two-thirds of districts.
- Other reasons included improving instruction and learning, boosting teacher recruiting and retention, and allowing children to spend more time with their families.

As mentioned earlier, the 12 4dsw districts we visited all adopted the 4dsw between the 2010-2011 and 2017-2018 school years. The stakeholders in the districts we visited described a range of reasons why their communities chose to adopt a 4dsw, and in almost all communities, multiple factors were mentioned. Consistent with the research literature, the prospect of cost savings emerged as the most common motivation for adopting a 4dsw in our study; stakeholders described cost savings as a major motivation in all 12 districts. Some district stakeholders communicated that, because of budgetary shortfalls, the districts were faced with either laying off staff, and thus increasing class sizes, or moving to a 4dsw. As one 4dsw principal explained, "We literally felt like we were forced into a corner and we made a decision.... We were faced with either going to a four-day week or increasing class sizes by cutting five to six teachers." There were some notable state differences in the described cause of the budgetary shortfalls. Some of the New Mexico districts cited the "boom-bust" cycles of local oil industries; their districts chose to adopt a 4dsw in a "bust" phase when state funds were low. In Idaho and Oklahoma, district stakeholders noted that the 2008 recession and historic lows in public education funds were hard on the districts' budgets. For example, district administrators in three Oklahoma districts cited ongoing years of state education funding cuts as the cause of their precarious financial situation.

Improving student attendance was the second most common motivator for moving to a 4dsw; stakeholders in 8 of the 12 districts expressed this view. The stakeholders we spoke to also echoed the sentiments regarding the "rural issues" described by Thompson et al. (2020). In many communities, stakeholders explained that in part because of their rural location, families often drive long distances for appointments, causing students to miss half to a full day of school for doctors' visits or other errands. These communities hoped that adopting the 4dsw would increase attendance rates as families could use the fifth day to schedule necessary appointments. Other districts noted that students missed school for sports, particularly on Fridays; stakeholders saw the 4dsw (with Friday off) as one way to make these absences less frequent.

Although less common, other motivations were also cited. For example, stakeholders in three districts said their communities adopted the 4dsw in part to improve educational opportunities and outcomes at the districts. According to the administrators in these districts, the perceived mecha-

nisms for improvement were longer school days during the 4dsw, opportunities for unique enrichment activities on the fifth day, and the idea that students would be more focused as a result of the shorter week and thus learn more. In two districts, stakeholders reported that increasing teacher recruitment and retention was a motivation for adopting the 4dsw; these districts were facing teacher shortages and hoped to attract new talent with the shorter school week. Other motivating factors included a desire to emulate the perceived success of the 4dsw in other districts, stakeholders' perception that the 4dsw would allow more time for children to spend with their families, and their perception that it would provide more time for teacher professional development.

4.2. Does It Save Districts Money?

Key Findings

- Theoretical considerations and existing empirical estimates suggest that savings associated with switching to a 4dsw would be less than 5 percent.
- In our interviews, some district administrators reported larger savings than the empirical evidence would suggest is possible.
- Some district officials stressed that even small savings were meaningful as they allowed districts to retain staff or preserve or invest in other instructional supports.

We did not estimate the cost savings for our sample of 4dsw districts and 5dsw districts in the three states (total of 36 districts), since this would not provide enough data to estimate such small effects with precision. We interviewed superintendents and school board members (i.e., individuals with some authority over the district finances) in the 12 districts we visited on the topic of the cost savings due to the 4dsw. Most interviewees indicated that they were saving some amount of money, though the reported savings varied, as did the extent to which officials had access to or had recently reviewed data on savings. Notably—and consistent with the literature—multiple administrators indicated that it is not possible to save 20 percent of a district's budget by switching to a 4dsw. However, in some cases, their reported savings exceeded the 0–3 percent estimates in the most recent research literature. About a third of the administrators we spoke to named hard figures—raw numbers or a percentage of their budget—when describing cost savings. While not precise, they suggested that it was possible to save between 4 percent and 12 percent. They reported that the savings came from decreased transportation and food expenditures, decreased expenditures on substitute teacher costs (due to perceived improvement in teacher attendance), and decreased salary and benefits expenditures for hourly employees (such as paraprofessionals, bus drivers, and food service workers). Some administrators perceived an increase in students' attendance, which they attributed to the 4dsw, and believed that the increase in attendance led to an increase in per-pupil funding from the state.

Administrators noted that even small savings were meaningful. At least two district administrators reported that as a result of the cost savings attributable to the 4dsw, they were able to keep instructional staff and avoid laying off teachers and increasing classes sizes. Similarly, some superintendents indicated that they used savings in some areas-like operations/maintenance and transportation-to maintain services related to instruction that might more directly affect student achievement. One superintendent reported that their net savings from switching to the 4dsw was zero, but the district was able to use the savings in some noninstructional areas to pay for a reading coach and other services, maintaining the level of academic support for students. The superintendents stressed that the 4dsw did not reduce overall expenditures, but it allowed the district to maintain the level of some academic and student services in the face of growing costs and expanding requirements. Note that while this type of redirection of funds might be detected empirically as a decline in spending in the smaller categories like transportation, reallocating the same amount to the larger instructional expenditures might not be empirically detected as a meaningful increase in the larger category of instructional spending or as a decrease in overall spending.

Some administrators indicated that the extent to which a district can save money by switching to a 4dsw depends on the choices made when designing the new 4dsw schedule and staffing structure. Specifically, three superintendents noted that there can be substantial savings by decreasing the number of working hours—and in some cases cutting benefits—of hourly staff. However, some explained that district stakeholders may not agree with these changes, knowing the decreased hours and benefits may present a hardship for those employees affected by the changes. Indeed, at least one district chose to give all hourly staff the option to maintain their full-time status and benefits when they adopted the 4dsw, thus relinquishing the potential of some cost savings in favor of staff needs and equity. Other superintendents noted that it was possible to save money on utilities by shutting school buildings down on the fifth day, though doing so would require limiting building access and not allowing teachers or students to use their schools for the fifth-day activities described earlier. In this way, cost savings is not a foregone conclusion but may depend on how the policy is implemented.

In sum, saving money is the most cited reason that districts converted to a 4dsw. However, theoretical considerations suggest that the associated cost savings would be small, and previous empirical estimates find overall cost savings in the 0–3 percent range. The qualitative data we collected corroborated cost savings as a primary driver of the conversion to the 4dsw as well as the realization that the cost savings might be small after the switch. Nevertheless, superintendents' comments suggest that these small or even net-zero cost savings can be meaningful if reducing costs in some areas, like noninstructional expenditures, facilitates greater or maintained spending on instructional activities that might be related to student achievement.

4.3. Does It Reduce Student Absences?

Key Findings

- Interview and focus group participants perceived that student absences were lower in the 4dsw schedule than the 5dsw schedule.
- While 4dsw students missed fewer days than 5dsw students in absolute terms, the proportion of missed school days over the course of the academic year was similar between the two groups.
- We found no statistically discernable difference between the absenteeism rates of 4dsw and 5dsw students.

Our interviews and Thompson et al. (2020)'s national survey found that student attendance was the second most common motivation for adopting the 4dsw. Student attendance is widely recognized as an important factor in student achievement—students who attend more regularly have been shown to have higher achievement levels than students with chronic absenteeism (Garcia and Weiss, 2018; Gottfried, 2009; Romero and Lee, 2007). Thus, student attendance and effective approaches to improve it are of significant interest to district and school leaders. We report findings on attendance from our interviews and focus groups in 4dsw districts. We also analyzed time series and survey data on student absences to assess whether there were differences in attendance between 4dsw and 5dsw districts.

Qualitative Findings

There was consensus among interview and focus group participants that students in 4dsw districts missed less school than they would if they had 5dsw schedules. School leaders, teachers, parents, and students in all districts also noted that attendance under a 4dsw schedule is more critical because there are fewer days in the school week. One superintendent described a uniform understanding among all stakeholders that "the four days are sacred" and thereby attendance was a priority. To that end, parents and students alike reported "pushing through" or "sticking out" the school week when suffering minor illnesses, because there was a fifth day to "fight off" sickness. Similarly, the fifth day offered families time to "recover" from the general fatigue associated with the longer days of the 4dsw.

There was also a prevailing thought that the amount of instructional time students missed when missing a day in a 4dsw was far more compared with the 5dsw, and it was difficult for students to make up the lost learning time. High school students in particular believed the longer 4dsw day meant they missed "way more work" when they were absent compared with a 5dsw. Students who had recently transferred from a 5dsw supported this perception; one shared, "Because you just have so much all crammed in at one time [in a 4dsw], I guess . . . it's more difficult to miss [a school day] here." According to high school students, taking a day off from school to relax, catch up on work, or avoid an assignment was not worth it in a 4dsw.

Stakeholders also reported that students might miss less school to participate in family or community activities with a 4dsw schedule. For example, some districts had a strong hunting tradition or seasonal family business needs, such as spring roundup on cattle ranches, that resulted in students missing school. Another example of a type of community activity that would result in students missing school was traditional tribal activities. Stakeholders in one district indicated that when multiday tribal ceremonies and other tribal activities occurred on the fifth day, students missed less school to participate in these events. Even with the 4dsw schedule, students continued to miss instructional time for school-sponsored sports.

Another issue related to understanding the differences in absences across the 4dsw and 5dsw districts is that there may be a difference between official unexcused absences and the amount of time the "seat is in the chair," as one school official put it. When a student misses class for an athletic event or other school activity, the student is not counted absent even though the student is missing instructional time. Hence, if 4dsw schedules are arranged to minimize absences for sports or school activities and increase the amount of time students are in class, this might not be picked up by absence analysis, which does not count school activities as an absence.

Further complicating the analysis of learning time differences is that when a large number of students are out for an excused event, teachers may adapt their lesson plans for the attending students in a way that reduces the value of attending school for those students. As an example, one district reported that a large fraction of the high school student body would not be in the classroom on the afternoons when there were away football games, which involved players, cheerleaders, and band members. The teachers would not engage in much instruction on those afternoons since a large fraction of students were not in class. This may be a bigger problem in 5dsw districts than 4dsw districts, leading to another way that the instructional time advantages of the 4dsw might be underestimated.

Time Series Findings

Our preferred quantitative estimates of attendance effects are those based on district-level attendance rates over time in five states: Colorado, Idaho, Missouri, New Mexico, and Oklahoma. Specifically, we look at how district-level attendance rates compare between 186 school districts that adopted the 4dsw between 2011 and 2018 and 153 similar school districts that never adopted it during this time frame.

Another advantage of the time series analysis is that we can analyze attendance rates rather than days of school missed, which was the attendance measure captured in the surveys. Each state defines attendance slightly differently, but all states in our analyses count students as being present if they missed less than a predetermined amount of a school day. The attendance rate is then calculated by dividing the number of days present by the total number of school days in the school year. The attendance rate provides a better measure of the total proportion of instructional time a student was present during the school year than days of school missed, but it is still an imperfect measure of instructional time missed since students who miss instructional time because of such activities as school sports are not counted absent.

Because of current research that shows that traditional time series analyses can provide biased estimates, we also present results from two other models that correct for these biases. We present results from three models: the traditional time series model and two models recommended in Callaway and Sant'Anna (in press), which we call "outcome regression" and "inverse probability weights" based on the description of these models in their paper. Our methods for this analysis are described in Chapter Two and Appendix A, and the results are presented in greater detail in Appendix B.

Overall, we estimate that the 4dsw districts have between a 0.4 and 1.1 percentage-point better attendance rate compared with 5dsw districts, depending on the model, though these estimates are not significantly different. To put this number in context, after adopting the 4dsw, the 186 districts in our analytic sample had an average attendance rate of 93.4 percent. In contrast, the 153 comparison 5dsw districts had an average attendance of 92.9 percent. These raw differences in attendance imply an effect that is similar to our 0.4 percentage-point estimate. Thus, our estimates represent a small additional but statistically insignificant increase in attendance. More details on the statistical methods are presented in Appendix A, and detailed results are in Appendix B.

As described in Chapter Two, we present time series findings from a traditional model and the outcome regression and inverse probability weights models described in Callaway and Sant'Anna (in press). These methods are

FIGURE 4.1 Estimates of Attendance Rates of Four-Day-School-Week Students Compared with Five-Day-School-Week Students, by Time Period Relative to Four-Day-School-Week Adoption



SOURCE: Administrative data from Colorado, Idaho, Missouri, New Mexico, and Oklahoma. NOTES: Each circle represents an estimated difference in attendance between the 4dsw and 5dsw districts in a particular year relative to the year before districts adopted the 4dsw. Three statistical models were used to estimate effects, with each statistical model given a different color. Circles are filled if the estimate is statistically significant from zero and are hollow if not. The first five circles of each model represent the difference in attendance between the 4dsw and 5dsw districts in the five years before a district adopted the 4dsw. The time zero estimate is set to zero and is not an estimated zero. OR = outcome regression; IPW = inverse probability weights.

described in Chapter Two and Appendix A, and the detailed results are presented in Appendix B.

Figure 4.1 shows the results from our event study models, which allow for the possibility that the attendance effects change over time. In the figure, each circle represents the difference in attendance rate between 4dsw and 5dsw districts each year before and after adopting the policy. Each color represents a different statistical model. Circles are filled if an estimate is statistically different from 0 and hollow if it is not. The first five estimates (circles) show the difference in attendance rates between a 4dsw and a 5dsw in the five years before the 4dsw districts adopted the policy. The estimates show that there are no differences (all circles are hollow) in attendance before the policy took place, which indicates that the 5dsw districts in our sample are a good comparison to the 4dsw districts. In the years after the 4dsw policy is adopted, we see small growth in attendance rates in 4dsw districts. No estimate, however, is consistently significant across all models. We report detailed results of this analysis in Appendix B. Overall, we observe a pattern that over time, students with a 4dsw exhibit better attendance, though no difference is consistently significantly different. We therefore cannot make strong conclusions about the effect of the 4dsw on attendance other than that it is unlikely that the policy hurt student attendance. Our findings are consistent with those of Thompson (2021b), who finds no difference in fraction of days absent or chronic absenteeism between 4dsw and 5dsw students.

Elementary Parents Survey and Youth Survey Findings

Results from the elementary parents survey and youth survey analysis also do not provide evidence that the 5dsw students are missing more school than the 4dsw students. One limitation to the analyses based on the elementary parents survey is that self-reported absenteeism may contain recall errors. Attendance is likely to change week to week as students face idiosyncratic life events and demands on their time such as seasonal illnesses, athletic events, and medical appointments. Asking parents to estimate the number of days their children miss school throughout a school year because of events that often do not occur with regular frequency is difficult and prone to error. We therefore consider the survey analysis as a complement to the preferred time series analysis. The elementary parents survey asked parents to provide the number of days their child missed school for any reason, from the start of the school year, and the youth survey asked the students the same question. After controlling for available student and district covariates, enrollment in a 4dsw district provided an attendance advantage, with K-6 students experiencing 74 percent of the absences of 5dsw students through the point in the school year at which the survey was administered in the 2019–2020 school year (Figure 4.2). For the K-6 4dsw students in our sample, this corresponds to one less day missed on average. The youth survey results revealed a similar pattern, with grade 7-12 4dsw students experiencing 82 percent of the absences of their 5dsw counterparts (Figure 4.2). This corresponds to 0.86 fewer days missed for the 4dsw students. It is important to note that the 4dsw students have 80 percent of the

FIGURE 4.2 Ratio of Four-Day-School-Week Days Absent to Five-Day-School-Week Days Absent



SOURCE: Authors' calculations from elementary parents survey and youth survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the rate ratio of days absent (ratios less than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result.

opportunity of a school absence that the 5dsw students have. Thus, while the 4dsw students miss fewer school days, they are missing about the same proportion of scheduled school time. This is empirically shown by the fact that 80 percent is contained in the confidence interval for the estimates of 4dsw absence, as a percentage of 5dsw absence, noted earlier.

The qualitative data indicated that stakeholders felt that the ability to schedule medical appointments on the fifth day was a major reason for the attendance advantages conferred by the 4dsw. We explored this possibility in the student and elementary parents surveys. We asked parents and students which day of the week they typically use for student doctor appointments, including dental and orthodontic care. Response options included each individual weekday or no daily preference. We then created an indicator variable to capture whether the 4dsw district day off was chosen as the usual appointment day. For 5dsw districts, the day off of their matched 4dsw district in the sample was used. The survey results indicated that 4dsw students were much more likely to have medical appointments on the fifth day. After controlling



FIGURE 4.3 Odds of Using the Fifth Day for Medical Appointments

SOURCE: Authors' calculations from elementary parents survey and youth survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the odds ratio of the use of the fifth day for medical appointments (ratios greater than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result.

for available district and parent covariates, the odds of parents using the fifth day as the primary day for medical appointments for their elementary school children were 20 times higher for 4dsw parents than for 5dsw parents. Similarly, the odds of responding middle and high school students using the fifth day for medical appointments was nearly 12 times higher for 4dsw students than for 5dsw students (Figure 4.3). While 5dsw parents do not actually have the option of a fifth day where their students are already out of school, their utilization rate of the day off in their respective matched 4dsw district for medical appointments serves as a baseline for what the 4dsw parents might experience in the absence of having a fifth-day option.

Although stakeholders perceived that absences due to medical appointments were low in 4dsw districts, families in each of the three states described unavoidable circumstances and scheduling constraints that resulted in medical visits on days other than the fifth day off. For example, parents and students universally agreed that sick visits occurred when necessary, which might not be the fifth day. This resulted in high demand for appointments and limited availability for some types of appointments (e.g., specialists). The requisite timeline for care (e.g., orthodontics, medical procedures) also placed constraints on scheduling; availability of medical appointments necessitated school absences. Some stakeholders in 4dsw districts where Friday was the day off reported that many health care providers, such as primary care physicians, dentists, and allergists, were not open on Friday or were limiting their Friday hours, reducing the value to their district of having a 4dsw.

4.4. Does It Help Attract and Retain Teachers?

Key Findings

- District and school leaders, school board members, and teachers agreed the 4dsw was a competitive advantage for teacher retention and, to a lesser degree, recruiting.
- Interview and focus group participants' perceptions of the influence of the 4dsw on teacher attendance was mixed.

We report findings on stakeholders' perspectives of the role of the 4dsw in attracting and retaining staff, as well as staff attendance. We also examined the effect of the 4dsw on the number of full-time-equivalent teachers and the teacher–student ratio to assess whether adopting a 4dsw boosted teacher recruiting and retention. This analysis was inconclusive, because we were not confident that the requirements of the statistical models were met. In Appendix B, we present the results of this analysis and a description of how the assumptions of these models were violated. Thus, the following discussion relies exclusively on interview and focus group data. Note that using one year of data from Oregon, Tomayko et al. (2020) find that student–teacher ratios were lower in 4dsw districts.

Teacher Recruitment and Retention

Focus groups and interviews in the 12 visited districts with school leaders, teachers, and school board members explored the extent to which the 4dsw influenced recruitment and retention of teachers. Conversations with teachers explored their decisions about employment in greater depth.

Expressing sentiments similar to those of proponents of the 4dsw, school leaders and school board members stated that they believed the schedule aided teacher recruitment. Several superintendents, school leaders, and school board members reported that their districts used the 4dsw as a "recruitment tool." Though application data were not available, stakeholders believed more teachers applied for vacant positions since adopting the 4dsw. One superintendent explained,

There was a time here—two or three years—where we didn't have a certified high school math teacher, and that was because not one single applicant [applied]. That's how dire the recruiting efforts [are] for some of those critical positions. And I will say that [the 4dsw] has, with absolute certainty, improved our ability to attract candidates, and it has also improved the quality of applicants that we're getting.

In one district, a course previously taught online through a third party was now taught in person by a certified teacher. Administrators in this district and others described a single certified applicant for a previously unfilled position as a notable benefit of the 4dsw. With larger applicant pools, administrators felt that they had the ability to hire higher-quality teachers. School leaders, school board members, and teachers suggested that the 4dsw offset longer drive times or a lower salary that deterred teachers from applying to their district before the 4dsw.

While teachers agreed the 4dsw was a "perk," for the majority of teachers with whom we spoke it was not a factor in deciding to work for the district. In most districts, teachers taught in the district when it was a 5dsw and lived in or moved into the community for reasons other than the 4dsw. Yet there were three districts where the 4dsw influenced teachers' employment decisions. In two districts, many of the teachers we spoke with had retired from a teaching career in a 5dsw district in a neighboring state and taken a job in the 4dsw districts in our sample. Teachers at one school moved into the area and learned the district operated a 4dsw, while the others commuted from the neighboring state. Teachers in a third district commuted long distances because of the district's positive reputation and the 4dsw.

There was variation in the extent to which individual teachers valued the 4dsw in their employment choices, and district leaders in Idaho and Oklahoma reported that the recruitment benefits diminished as more districts in their area adopted the 4dsw. For example, two of the three leaders in one Idaho district hypothesized the 4dsw made "hardly any difference" in recruiting now that many nearby districts had adopted it. Teachers in this district reported a similar trend. In this way, the power of the 4dsw as a recruitment tool may depend on local context.

When school staff and board members were asked whether the schedule influenced retention, as opposed to recruitment, participants replied by saying, "yes," "definitely," "absolutely," and "hands down makes a difference." Some teachers reported that having a 4dsw factored into their decision to stay at the district or in the profession. The power of the 4dsw as a retention tool appeared strongest for two sets of teachers. Teachers who were eligible to retire or nearing retirement reported that they would retire if the district reverted to a 5dsw. A second set of teachers also noted that they would "reevaluate" their district of employment were the 4dsw policy to change, and they would consider moving to a 5dsw district that offered better pay and benefits. These teachers described themselves as traveling long distances to teach at the 4dsw or living outside the 4dsw catchment area. While some teachers thought the 4dsw improved teacher retention overall, they noted that it did not affect their own decision to remain at the district or in the profession. Thus, the extent to which the 4dsw affects retention may depend on local context.

Teacher Absences

Teacher absenteeism was another factor that stakeholders felt the 4dsw influenced. The majority of stakeholders in interviews and focus groups believed teacher attendance was higher in 4dsw districts. From their perspective, the advantage that 4dsw districts experience in teacher absences was primarily related to medical appointments. Teachers in all 12 of the 4dsw districts in the site visit sample reported scheduling medical and other appointments for themselves and their family members on the fifth day when school is not in session. Particularly for teachers with "a lot of health issues" or chronic health issues, it was "extremely helpful" to have the fifth day to schedule appointments. Scheduling appointments on the fifth day meant teachers did not miss class for their medical care. It was also a "relief" for teachers who are responsible for the care of family members with chronic health conditions, elderly parents, and children with frequent medical appointments such as "constant orthodontist" visits. As one teacher put it, "I don't ever miss for that [medical appointments], I mean all those things that you can plan out." A few teachers and school leaders shared an expectation in the district that teachers would not miss school for appointments or other life events that could be planned around the 4dsw schedule. As one teacher put it,

The administrators get to tell us beginning of the year, this is when you go do these things and there's no excuse. You need to be in the classroom if possible every single day. I mean, they lay it out for us [expectations for attendance], and it works well.

Interview and focus group participants also perceived that the 4dsw schedule allowed teachers time to plan, grade, rest, and attend to family matters. There was almost no need to take "mental health" days to "recoup" from the "fatigue" of the profession. Stakeholders also argued the 4dsw schedule meant teachers were less "burned out" and, in turn, less likely to miss school for this reason. Furthermore, some interview and focus group participants believed the 4dsw schedule meant teachers were sick less often, resulting in fewer absences.

There was also a small minority of focus group and interview participants who described the 4dsw as having "no major difference" on teacher attendance. They described teacher absences as generally being unplanned (e.g., flu, family tragedy) or resulting from chronic absenteeism, and they did not feel that the 4dsw altered these absences.

4.5. Satisfaction with the Four-Day School Week

Key Findings

- Our survey results indicate high levels of satisfaction with the 4dsw among parents and students.
- Parents and students in 4dsw districts overwhelmingly reported that they would select a 4dsw over a 5dsw.
- Other stakeholders were similarly enthusiastic about the 4dsw in the interviews and focus groups.

FIGURE 4.4 Responses to the Question, "Generally, How Satisfied Are You with the Four-Day School Week?"



SOURCE: Elementary parents survey, N = 765.

We asked elementary parents in the 18 4dsw districts where we conducted the surveys three questions related to their satisfaction with the 4dsw. As we show in Figures 4.4 and 4.5, parents overwhelmingly reported high levels of satisfaction with the 4dsw. When asked, "Generally, how satisfied are you with the four-day school week?" 73 percent of parents responded "very satisfied," and about 1 in 10 were indifferent or dissatisfied (Figure 4.4). When asked whether they would choose a 4dsw or 5dsw, 84 percent of parents selected either "probably four days a week" or "definitely four days a week" (Figure 4.5). The overwhelming majority of parents also reported that the 4dsw met the needs of their family; these results are shown in Figure B.1.

High school students in the 16 4dsw districts who completed the youth survey were even more enthusiastic about the 4dsw. When asked whether they like having a 4dsw, 85 percent responded, "I like it a lot" (Figure 4.6). When asked whether they would choose to go to school five days a week or

FIGURE 4.5 Responses to the Question, "If You Were to Have the Choice Between a Four-Day School Week and a Five-Day School Week, Which Would You Choose?"



SOURCE: Elementary parents survey, N = 766.

four days a week, 95 percent of students picked either "probably four days a week" or "definitely four days a week" (Figure 4.7).

The students and parents who participated in our site visit interviews and focus groups (four districts in each of the three focal states) were similarly positive about the 4dsw schedule. We ended nearly every interview or focus group by asking our respondents whether they would continue with the 4dsw schedule for their district or go back to a 5dsw schedule if the choice were entirely up to them. In many groups there was unanimous support for the 4dsw, with interviewees often endorsing it without hesitation and with great enthusiasm. As one parent said, "Having [a] three-day weekend ... who wouldn't want that?" The stakeholders discussed a range of reasons why they preferred the 4dsw. Some of the noted advantages were discussed earlier, including the perceived benefit to student attendance and the flexibility to schedule medical appointments on the fifth day. In the following chapters, we will describe the other outcomes on which some interviewees



FIGURE 4.6 Responses to the Question, "Do You Like Having a Four-Day School Week?"

felt the 4dsw had a positive effect but that were not listed as primary motivations for switching to it.

During interviews and focus groups, teachers and administrators were equally positive about the 4dsw schedule. Teachers in all districts reported valuing its flexibility. As described earlier, teachers used their time on the fifth day for a range of both personal and professional matters. When asked about the main advantages of the 4dsw, one teacher put it this way: "The flexibility as a professional that you can work that fifth day or not work that fifth day, and you use it as you need to. And the kids are still getting what they need." Administrators also referenced benefits such as the perceived cost savings and perceived positive effects on teacher recruitment.

Outright dissatisfaction with the 4dsw was rare among the interviewees, just as it was among the survey participants. However, the lack of dissatisfaction may indicate that those who do not like the 4dsw schedule were less

SOURCE: Youth survey, N = 3,964.





likely to attend our focus groups, or less likely to remain in the 4dsw district. While the stakeholders we spoke to were largely satisfied, parents, teachers, and administrators in our focus groups speculated about the potential disadvantages of the 4dsw for other students, parents, and families. In particular, stakeholders worried about families who might struggle to find childcare for younger children on the fifth day, because they cannot arrange to have one parent or caregiver at home or have extended family and friends care for young children on that day. Many noted that small rural communities typically have limited childcare options, often relying on only one or two formal settings. Yet only parents in two districts identified childcare challenges as a personal hardship or spoke explicitly about the challenges of a close friend. In most cases, parents identified abstract concerns for other families.

The fact that most of the parents we spoke to did not raise concerns about childcare may indicate that these challenges were limited to a small percentage of families. This pattern may also suggest potential selection bias in the focus group and interviews samples. That is, families who struggled with childcare on the fifth day may also be the families who did not have the time to attend our focus groups. However, we also note that the survey data suggest that the large majority of children were home on the fifth day, indicating that most families are not utilizing childcare. In addition, multiple administrators noted that while they worried that childcare might pose a problem, they reported few complaints from families.

Stakeholders in all 12 districts also expressed concerns in focus groups and interviews about the potential disadvantages of the 4dsw for families living in poverty and for students who do not feel safe at home. As we will discuss in more detail in Chapter Five, interviewees explained that the 4dsw might exacerbate food insecurity for children who rely on school meals (see Section 5.2). In addition, the extra day away from school may be disadvantageous for children whose home lives are not stable (see Section 5.3).

In focus groups, the occasional student expressed dissatisfaction with the 4dsw because he or she felt bored on the fifth day. A student in one community noted that because of the large geographic size and rurality of their town, she felt isolated from friends on the fifth day and missed seeing her peers at school. As we will describe in more detail in Chapter Five, some stakeholders expressed concerns that the longer school day caused student fatigue, particularly for the early elementary students (see Section 5.2).

This chapter has provided qualitative and quantitative findings on some of the main motivations for adopting the 4dsw: saving money, reducing student absences, and recruiting and retaining teachers. In general, it appears that the 4dsw does not reduce district spending much, but it may enable districts to preserve or increase funds for instructional expenses by saving money in areas such as transportation and food service. While there is evidence that students miss fewer days in 4dsw districts, when viewed as a proportion of instructional days, students in 4dsw and 5dsw districts miss similar proportions of instructional days. Qualitative data endorses the 4dsw as a way to improve teacher recruiting and retention. Despite relatively limited evidence that the 4dsw is able to deliver what proponents promise, stakeholder satisfaction with it is generally very high. In the next chapter, we present our findings on outcomes of concern to opponents of the 4dsw along with other outcomes that the 4dsw might influence.

CHAPTER FIVE

How Does the Four-Day School Week Affect Other Outcomes?

The last chapter reported our findings on the outcomes that are often used to advocate for the adoption of the 4dsw. However, policy debates also recognize that there may be drawbacks to the 4dsw (Mulvahill, 2019; National Conference of State Legislatures, 2020). Some of the main arguments against the 4dsw are that for children in lower-income or emotionally challenging home environments, one less day at school might result in greater food insecurity or more emotional and behavioral challenges. Furthermore, it might reduce children's physical activity, contributing to poor health. Opponents of the 4dsw also express concerns that childcare expenses on the fifth day might present a financial hardship for some families. While they may not factor into debates about the desirability of the 4dsw, there are also other outcomes for a variety of stakeholders that might differ under a four-day schedule, and these include students' sleep (given longer school days for 4dsw districts and more variable schedules across the week) and parents' stress, among others.

In this chapter, we analyze outcomes that were mentioned in the previous literature or discussed in the popular press, or those that are theoretically hypothesized to be influenced by the 4dsw. The outcomes we discuss here are academic achievement, measures of student well-being (sleep and fatigue, food security, physical activity, and behavioral and emotional well-being), measures of family well-being, and school enrollment and climate. We first present our findings on the effects of the 4dsw on academic achievement, which is arguably one of the most salient outcomes in education policy debates, and then we present evidence on other outcomes that could be affected by the policy. Additional details on the statistical methods used in this chapter may be found in Chapter Two and Appendix A, and detailed results, including confidence intervals for all survey results, may be found in Appendix B.

5.1. Academic Achievement

Key Findings

- Most stakeholders believe the 4dsw has no effect on academic achievement.
- Time trends in outcomes show that absolute achievement levels of ELA and math in 4dsw school districts did not decrease after the adoption of the policy. Rather they may not have grown as fast as similar districts that did not adopt the policy.
- Small disadvantages in 4dsw achievement scores could compound over time to reach a meaningful size by eight years after adoption.
- Three different statistical models produced negative estimates of the trends in student achievement in ELA and math in 4dsw districts, but the models varied in their statistical significance.

While improving academic achievement is rarely a stated reason for adopting the 4dsw, some of the motivations that proponents use to advocate for the 4dsw would lead to better academic achievement. For instance, reducing student absences and attracting higher-quality teachers are valuable, because it is believed that they would, in turn, improve academic achievement. A few stakeholders in our interviews and focus groups thought there were no academic downsides to the 4dsw.

In interviews and focus groups, we asked participants how the 4dsw influenced student learning. Nearly all participants perceived students learned just as much or more in the 4dsw than in a 5dsw. Stakeholders perceived that how instructional time was used was more important than the number of minutes in a school week. From their perspective, having one less instructional day created a sense of urgency or academic pressure compared with a 5dsw because 4dsw districts had to cover the same content as 5dsw districts in fewer days. Although fitting curriculum designed for a 5dsw into a 4dsw was a challenge, teachers perceived they were more intentional with the design of lessons in a 4dsw as compared with a 5dsw. Teachers felt they were more selective among instructional activities offered in the curriculum, and they reported fewer "fluff" and "fun" activities (e.g., noncurricular holiday crafts or movie days) in the 4dsw. A few stakeholders in almost every district expressed concern that the academic pressure meant added stress for teachers and students in a 4dsw as compared with a 5dsw.

Teachers and students consistently argued that the longer class periods in the 4dsw compared with their 5dsw schedule were an instructional advantage. In their opinion, the longer classes added instructional or working minutes to each class. By way of example, 4dsw stakeholders presented calculations like the following: 15 minutes of a 45-minute class on a 5dsw schedule would be allocated to noninstruction (e.g., attendance, clean up), leaving 30 minutes of instruction; by contrast, 40 minutes of a 55-minute class on a 4dsw schedule would be devoted to instruction, leading to more learning time. However, we note that this contrast only would lead to a slight time advantage for the 4dsw class in instruction (160 minutes per week versus 150 for the 5dsw in this example).¹

While the longer class periods were perceived as advantageous for middle and high school students, some stakeholders expressed concern about the impacts of longer school days on learning, particularly for the youngest students (grades K–2). In five districts, at least one district leader or teacher perceived that students were "too tired" early in the morning and late in the afternoon. Some teachers reported that they attempted to arrange core instruction midmorning to early afternoon—students' peak learning time. Moreover, some district and school staff believed the 4dsw interrupted the school routine, resulting in lost instructional time to address behavior challenges or reset expectations when students return from the weekend. Further, there were concerns about the extent to which parents of low-performing or high-risk students engaged in learning activities (e.g., writing letters, reading, practicing numbers and sounds) over the longer weekend.

¹ If 10 minutes of each class were consumed by noninstruction, the 4dsw class would have 180 minutes of instruction per week, and the 5dsw class would have 175 minutes.

FIGURE 5.1

Mean English Language Arts and Math Achievement Scores for Third Through Eighth Graders Before and After Four-Day-School-Week Adoption (Four-Day-School-Week Districts)



SOURCE: Authors' calculations from EOP data from Idaho, Missouri, New Mexico, Oklahoma, and South Dakota.

Overall, school staff and parents with whom we spoke offered students' performance on state and national assessments as evidence that there were not academic disadvantages to the 4dsw. District leaders and principals reported that their test scores had remained the same or improved since adopting the 4dsw. Some reported that the district's rank in the state improved, while others described an increasing trend on state assessments. As one superintendent put it, "There's not been a drop in our test scores. As a matter of fact, we have continued to stay at the same pace and even risen above state and national averages." District staff and parents suggested they actively monitor students' performance and, based on the information available, there was no evidence to suggest the 4dsw presented academic disadvantages in their district.

This is consistent with our time series data from five states in our EOP data set, which included 175 4dsw districts and 150 5dsw districts. Figure 5.1 shows the trend in average ELA and math test scores for grades 3–8 in the 4dsw districts before and after districts adopted the 4dsw (the year before the 4dsw adoption in the figure is 0). In this graph, student achievement is

expressed in standard deviations, where 0 is the national average of performance for all students in that grade. There is a clear upward trend over the period in both ELA and math test scores of 4dsw districts in these five states. In sum, given their experiences and data that would be available to stakeholders in 4dsw districts, stakeholders would have little evidence to suggest that the 4dsw harmed academic achievement.

Our time series analysis provides a more rigorous assessment of whether the 4dsw influences student achievement than that provided by the trends in data readily available to districts. Rather than simply examining whether 4dsw students' achievement scores grew after their districts adopted the 4dsw, we examine how the growth in 4dsw students' achievement scores compared with those in similar 5dsw districts. We look at trends in the performance of districts, before and after they adopt the 4dsw, and compare them with trends in the performance of districts that look historically similar in performance but never adopted the policy. While Figure 5.1 shows that 4dsw scores went up after 4dsw adoption, the policy-relevant question is whether they went up more or less than they would have if they had used a 5dsw. Using time series data from our five-state sample, we estimate the effect of the 4dsw on student's ELA and math achievement. We improve on previous estimates of the effect of the 4dsw on achievement scores by using more than one state for the estimates and by using more recent data that go through the 2018–2019 school year. As discussed in Section 4.3, we present time series findings from the traditional model and the "outcome regression" and "inverse probability weights" models described in Callaway and Sant'Anna (in press). For each of these three models, we present findings from (1) a matched event study and (2) matched difference-in-difference estimates. These methods are described in Chapter Two and Appendix A, and the detailed results are presented in Appendix B.

Our time series analyses estimate the 4dsw students' average ELA achievement scores to be between 0.028 and 0.087 standard deviations lower than comparable 5dsw districts and 4dsw average math achievement scores to be between 0.044 and 0.099 standard deviations lower than 5dsw counterparts (results not shown). These results are attributable to 4dsw adoption but vary in whether they are statistical significance depending on the model. These estimates are of about the same magnitude as or larger than those found in Thompson's (2021b) study of the 4dsw in Oregon. He estimates that the policy decreased student achievement in ELA by 0.042 standard deviations and decreased student achievement in math by 0.059 standard deviations, and both of these estimates were statistically significant.

However, this average could be hiding important differences over time. For example, it is possible that student achievement in 4dsw districts decreases shortly after adoption as teachers adjust to teaching the curriculum in a compressed week with longer school days. In such a case we may see only temporary decreases in student achievement. Conversely, if the policy causes declines in student achievement, the effect may grow over time as students experience an accumulation of effects over their many years in a district.

Figure 5.2 shows estimates of the effect of the 4dsw policy for each year after adopting it from each of our three statistical models. Each circle represents the difference in performance between the 4dsw and 5dsw districts in a given year relative to the year before districts adopted the 4dsw. Each color represents the results from one of the three statistical models. Circles are filled if the estimate is statistically different from zero and hollow if not. The first five circles represent the difference in ELA or math achievement between the 4dsw and 5dsw districts in the five years before a district adopted the 4dsw. For both ELA and math, each circle is close to zero and the estimate is not significant. This result indicates that both the 4dsw and 5dsw districts in our sample were experiencing similar trends in student achievement before the adoption of the policy and that the 5dsw districts are a good comparison group for the 4dsw districts.

In the years after adoption, however, we see a clear, negative trend in test scores that become significant in some models three years after a district adopts the 4dsw schedule. Depending on the statistical model, after three years, ELA achievement in 4dsw districts was between 0.040 and 0.096 standard deviations lower and math achievement was between 0.069 and 0.140 standard deviations lower compared with the 5dsw districts. Eight years after adoption, ELA achievement in 4dsw districts was between 0.145 and 0.229 standard deviations lower compared with the 5dsw districts. However, statistical significances varied by model. A similar analysis of analogous 4dsw districts in Thompson's (2021b) study in Oregon found decreases of about 0.1 standard deviations in ELA and math achievement four years after adopting the policy. These estimates are comparable to our estimates. Our results suggest that this downward trend persists after four years, poten-

FIGURE 5.2

Differences in English Language Arts (Top Panel) and Math (Bottom Panel) Scores Between Students in Four-Day-School-Week and Five-Day-School-Week Districts, by Year Relative to Four-Day-School-Week Adoption



SOURCE: Authors' estimates from EOP time series data on 175 4dsw and 150 5dsw districts in Idaho, Missouri, New Mexico, Oklahoma, and South Dakota.

NOTES: Each circle represents an estimated difference in test scores between the 4dsw and 5dsw districts in a particular year relative to the year before districts adopted the 4dsw. Three statistical models were used to estimate effects, with each statistical model given a different color. Circles are filled if the estimate is statistically significant from zero and are hollow if not. The first five circles of each model represent the difference in ELA or math achievement between the 4dsw and 5dsw districts in the five years before a district adopted the 4dsw. For both ELA and math, each circle is close to zero and the estimate is not significant. The time zero estimates are set to zero and not estimated zeros.

tially leading to larger losses in student achievement up to the last year for which we have data, which is eight years after adopting the policy.

When we compare the growth in scores in the five states' 4dsw districts with the growth in scores in those states' 5dsw districts, we find that the growth in scores in 5dsw districts was greater. In other words, while adopting the 4dsw may not have led to lower achievement scores for the 4dsw districts in absolute terms, the districts were unlikely to have experienced as much average growth in scores as it is estimated they would have had they not adopted the 4dsw.

5.2. Student Well-Being

In addition to academic achievement, there are other student outcomes that stakeholders mentioned as possibly being affected by the 4dsw. Here we present findings on four of those that we could examine with the two surveys and qualitative data: sleep and fatigue, food security, physical activity, and behavioral and emotional well-being.

Sleep and Fatigue

Key Findings

- Stakeholders reported students getting more sleep as one of the benefits of the 4dsw but expressed concern that the longer school days may be tiring for the youngest students.
- Elementary students in 4dsw districts got more school-week sleep than their peers in 5dsw districts, but 4dsw students were no more likely to have their parents report that they were regularly tired.
- There was no difference in the amount of sleep during the school week that middle and high school students got in 4dsw and 5dsw schools, but the 4dsw students in secondary grades were much less likely to report feeling tired regularly.
- The 4dsw students used the fifth day to sleep more relative to their 5dsw peers; the 4dsw introduced more variability in the sleep patterns of students.

It is well documented that inadequate sleep among children and adolescents is linked to poor academic performance as well as other negative outcomes such as attention and concentration problems, behavioral problems, reduced physical and mental health, and higher rates of motor vehicle crashes among teen drivers (Governors Highway Safety Association, 2015; Hafner, Stepanek, and Troxel, 2017; Shapiro, 2015). The expected effects of the 4dsw on student sleep are ambiguous. As documented in Chapter Three, schools with a 4dsw have earlier start times compared with schools with a 5dsw. Earlier start times might induce students to get less sleep per night (Hafner, Stepanek, and Troxel, 2017; Paksarian et al., 2015). However, students with 4dsw schedules may be able to get more sleep over the course of a week given that they have three days per week when they can sleep in.

Interviewees in the 4dsw districts reported during focus groups and interviews that they believed the 4dsw schedule affords students more time to sleep. Indeed, respondents in all 12 of the 4dsw districts we visited reported that one of the advantages of the 4dsw is the opportunity to sleep in and catch up on rest on the fifth day, when school is not session. For example, when we asked high school students during focus groups how they spent the fifth day, we often heard a chorus of "sleep late!" or "sleep in!" from the adolescent participants. Some students reported that the night before the fifth day is typically treated like a weekend night in that they stay up later than they would on a day before school; they sleep later to compensate for the late night, and fatigue from the week in general. In some cases, both students and parents noted that the extra time to sleep was particularly important for student athletes who traveled for away games. Our focus group participants noted that students often travel long distances for games. When athletes returned home late on a Thursday night, the 4dsw week allowed them to rest on Friday (if their 4dsw schedule has Friday off).

In addition to noting that the fifth day in particular offered more time for sleep, community members in four districts expressed that the 4dsw helped students feel more rested throughout the entire week. They argued that the three-day weekend allowed time for students to rest and recuperate from the week and helped students start the coming week more prepared to learn. As one teacher put it, "I think . . . [the 4dsw is] good because kids kind of come back ready to go again on Monday. I never feel like they're completely burned out . . . because they've had a full three days to . . . sleep." However, community members in 6 of the 12 districts we visited (representing all three states) thought that the 4dsw can cause fatigue. Specifically, the 4dsw school day tended to be longer than a 5dsw school day; some community members felt students end each school day—and the school week as a whole—more tired than they would on a 5dsw schedule. One parent described her kids as "wiped out" by the end of the 4dsw day. Some parents and teachers expressed particular concern for the youngest elementary school students—kindergarteners and first graders. These students may still be used to taking midday naps, making it difficult for them to stay awake and focused through the long 4dsw school day. Related to the foregoing discussion, the fatigue that some students feel after four longer days at school is one of the reasons why some community members felt the time to rest during the three-day weekend was so critical.

Weekday Sleep. We surveyed both parents and students about student sleep habits during the school week. Respondents in 4dsw and 5dsw districts were asked about the usual time the student goes to bed before and wakes up on school days, yielding an estimate of sleep duration on a school night. Respondents in 4dsw districts were also asked to give the usual time the student goes to bed the night before and wakes up on the morning of the fifth day, providing an estimate of sleep duration for the fifth day. Based on this information, we consider three different sleep outcome measures. The first measure is the total school-week sleep hours, calculated as the cumulative sleep between Sunday night and Friday morning. For 5dsw students, the nightly duration was multiplied by five to provide a school-week sleep total. For 4dsw students, the fifth-day total was added to four times the school-night sleep duration to provide total school-week sleep hours.

The focus group responses strongly suggest that the fifth-day sleep opportunity for 4dsw students may be treated more like an extra weekend night. Thus we also examine survey results on sleep at a more granular level and compare 4dsw and 5dsw sleep experiences on two other measures: daily sleep on the four common school nights, and fifth-night sleep. The elementary parents survey results indicate that younger students (kindergarten through sixth grade) in 4dsw districts average a statistically significant additional 1.486 hours (89 minutes) of school-week sleep, counting the night before the fifth day as a school night. Figure 5.3 displays these results. The blue points in the figure indicate the estimated difference between 4dsw and

FIGURE 5.3 Difference in Weekly Minutes of Student Sleep from Elementary Parents Survey and Youth Survey



SOURCE: Authors' calculations from elementary parents survey and youth survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the average difference in sleep measures (positive values favor the 4dsw). Confidence intervals that do not contain the value of 0 (gray line) indicate a statistically significant result.

5dsw students, and the black bars are the 95 percent confidence intervals for the estimated differences. We use a similar figure format to display survey results throughout this chapter. Depending on the outcome, the difference between 4dsw and 5dsw districts may be expressed as an average, an odds ratio, or a rate ratio. Statistical significance is indicated in these graphs when the confidence intervals for average differences exclude 0, as is the case in Figure 5.3, or when the confidence intervals for ratio estimates exclude 1.

Further examining the elementary parents survey results (Figure 5.3), for school nights when both 4dsw and 5dsw students attend school the next day, estimates indicated no significant difference in nightly sleep. Looking at sleep during the night before the fifth day that 4dsw students do not go to school, we find that 4dsw students in grades K–6 average a statistically significant 1.33 hours of additional sleep (80 minutes).

For older students, we found no meaningful differences in the total school-week sleep between 4dsw and 5dsw students in middle and high

school. This is different from the findings of Israel et al. (2020), whose study focused on Colorado. They found that 4dsw students are less likely to get eight or more hours of sleep on an average day.

The 4dsw students display greater variability in their sleep schedule over the week, sleeping later on the fifth day than on school days. From a sleep-quality perspective, "catch-up" sleep on the fifth day does not compensate for reduced sleep during the week, and research suggests that variability in sleep-wake schedules may be associated with negative developmental, physical, and mental health outcomes in adolescents (Becker et al., 2017; Telzer et al., 2015).

Feeling Tired. We asked parents how often their elementary school child felt tired, worn out, or sleepy during the day. Middle and high school students were asked the same question. Possible responses were on a five-category ordinal scale: never, rarely, occasionally, often, or every day. We analyzed whether students were regularly tired—that is, whether their responses were in the "often" or "every day" category. It was highly uncommon for parents to indicate that their elementary school–age child was regularly tired; only 6 percent chose one of these two response categories. Conversely, 39 percent of responding adolescent students indicated regularly feeling tired.

Formal modeling of the elementary parents survey results revealed no discernable difference between how often the 4dsw and 5dsw students felt tired. Important differences were present for secondary school students, with the odds of 4dsw students reporting feeling regularly tired being lower than those of their 5dsw counterparts. For adolescent students in our responding sample, the lower odds correspond to 4dsw students being 12 percentage points less likely to report being regularly tired (33.6 percent of 4dsw students versus 45.2 percent of 5dsw students).

Our focus group and interview findings indicated that respondents were most concerned about the impacts of the long 4dsw day on kindergarten and first-grade students. Hence, we reconsidered the formal elementary parents survey results reporting feeling tired often or daily for 4dsw kindergarten and first-grade students only. Although parents of 4dsw kindergarten and first-grade students reported their children were often or daily tired with greater frequency than their 5dsw counterparts (7.5 percent versus 5.3 percent, respectively), when adjusting for all available covariate information, these reported differences were not statistically significant. It
is possible that the sample, restricted to just kindergarten and first-grade responses, yields insufficient statistical power to detect a meaningful difference, should one exist.

Food Security

Key Findings

- Participants in focus groups and interviews expressed concern that having meals at school one less day a week would exacerbate food insecurity.
- Our analysis of data from both the elementary parents survey and the youth survey did not find differences in experiencing food insecurity among 4dsw and 5dsw students.

Research suggests school meal programs are an important source of nutrition for children, particularly for children from families who live in poverty and experience food insecurity (Nord and Romig, 2006). Rates of poverty and food insecurity are especially high in rural areas (Kyzyma, 2018), where 4dsw districts are concentrated. One of the potential drawbacks of the 4dsw is that students who depend on the free or reduced-priced breakfast or lunch at school may experience more food insecurity on the fifth day, when school is not session and no meals are provided. To examine this possibility, we asked about food insecurity during stakeholder interviews and focus groups and on the elementary parents and youth surveys.

At least one stakeholder in each of the districts where we conducted site visits (four districts in three focal states) noted that he or she was concerned that the 4dsw could exacerbate food insecurity for low-income families. Specifically, stakeholders worried that there were children going hungry on the fifth day. As one community member said, "I'm sure there's some kids that their best meal is here at school . . . [and the fifth day off] takes them out . . . of a good meal." All of the districts offered free or reduced-price meal programs for income-eligible students; some districts described receiving grants to offer free meals to all students, regardless of income.

Notably, we did not speak to any students or parents who identified themselves as experiencing food insecurity. Based on the descriptive survey findings (described later), this lack of reporting should not suggest that the issue does not exist in the 4dsw communities. It is possible that families experiencing insecurity chose not to attend the focus groups or did not feel comfortable sharing this information. In an effort to support families who may rely on meals from schools, 5 of the 12 districts we visited sent children home with backpacks of prepared food on the last day of the school week. The districts only provided the backpacks to students who were identified as needing food support, and some districts provided these only for elementary students. The other 7 districts reported no systematic approach to addressing potential food needs on the fifth day. Interviewees in some of these districts reported that there were food pantries and church services that offered food to families on the fifth day.

Our analysis of a measure of food security derived from the elementary parents survey and youth survey did not find that 4dsw students were more likely to experience food insecurity than their 5dsw peers. Respondents to both surveys were asked whether, in the prior 12 months, they or their family had run out of food and did not have money to purchase more or they had worried this condition could arise. From these responses, we derived a food insecurity indicator reflecting whether either of these conditions arose. For both questions, possible responses were "often true," "sometimes true," or "never true"; respondents were coded as experiencing food insecurity if their response to either question was "sometimes true" or "often true," while those responding with "never true" to both questions were coded as not experiencing food insecurity.

Our estimates of the food insecurity model, accounting for all available covariates, shows no meaningful effect of district type on the food insecurity measure in either the elementary parents survey or youth survey data. In the elementary parents survey, the estimated odds ratio of being food insecure for 4dsw versus 5dsw parents is 0.91; for the youth survey, the estimated odds ratio is 1.13 (Figure 5.4). Detailed results of this analysis are reported in Appendix B. These results are consistent with those of Israel et al. (2020), who found no difference in the incidence of 4dsw and 5dsw students going hungry in the past 30 days.



FIGURE 5.4 Odds Ratio of Food Insecurity

SOURCE: Authors' calculations from elementary parents survey and youth survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the odds ratio of experiencing food insecurity (ratios less than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result.

Physical Activity

Key Findings

- Interview and focus group participants did not perceive that the 4dsw was reducing students' physical activity.
- Analysis of the survey data finds no difference in physical activity between 4dsw and 5dsw students in middle and high school.

Along with a healthy diet and healthy sleep, adequate physical activity is considered one of the cornerstones of healthy mental, physical, and socioemotional development in children and adolescents. In particular, lack of physical activity in youths is linked to increased risk for obesity, as well as chronic health conditions, including cardiovascular disease, diabetes, and poor mental health (Hills, King, and Armstrong, 2007). Given skyrocketing rates of pediatric obesity, and that children and adolescents



FIGURE 5.5

SOURCE: Authors' calculations from youth survey responses and CCD and ACS data. NOTES: Point estimate (blue box) and 95 percent confidence interval (black line) for the odds ratio of being physically active at least one hour daily (ratios greater than 1 favor the 4dsw). A confidence interval that does not contain the value of 1 (gray line) indicates a statistically significant result.

spend more time in schools than any other setting (other than their homes), numerous reports demonstrate the vital importance of schools for promoting physical activity in youths (Pate et al., 2006).

Despite the important role that school has in ensuring that students are physically active, we did not find evidence in the survey analysis that switching to a 4dsw and students being at school one day less affected amounts of physical activity. Given CDC guidelines that recommend school-age youths experience at least an hour of moderate to vigorous activity daily (CDC, Division of Nutrition, Physical Activity, and Obesity, 2019), we considered as a primary outcome whether students meet this guideline and asked in the youth survey how many days a week students were physically active for at least an hour. After accounting for all relevant covariates and district clustering, estimated physical activity totals show no important differences in the proportion of 4dsw and 5dsw students meeting recommended physical activity guidelines (Figure 5.5). The estimated odds ratio of being physically active at least an hour a day is 1.13; note in Figure 5.5 that the odds ratio confidence interval crosses 1, indicating that there is no statistically significant difference in the odds of meeting the physical activity guideline. Detailed results of this analysis are reported in Appendix B.

This survey finding is consistent with the time use results in Chapter Three, which indicate that 4dsw students spend a lot of time on the fifth day engaged in school or nonschool sports. In our interviews and focus groups, participants did not describe physical activity as a major benefit or drawback of the 4dsw, and we do not present detailed qualitative findings for this outcome. We are aware of two other studies that compare physical activity of students in 4dsw and 5dsw schools. Using data on first through third graders in Oregon, Tomayko et al. (2020) found that 4dsw schools offered an average of 120 minutes of physical education per week, while 5dsw schools offered an average of 101 minutes per week, and this difference was statistically significant. However, they did not find differences in obesity prevalence across the two types of schools. Israel et al. (2020) found that 4dsw high school students in Colorado were more likely than 5dsw students to be active at least 60 minutes per day for five or more days in the past seven days.

Behavioral and Emotional Well-Being

Key Findings

- Teachers, principals, parents, and other adults we interviewed expressed the view that having a 4dsw improved students' behavioral and emotional well-being.
- Many stakeholders also recognized the possibility that having one more day at home might be undesirable for students in risky home environments.
- Our analysis of elementary parents survey and youth survey data found no differences between 4dsw and 5dsw students on measures of behavioral and emotional well-being.

There was near consensus among interviewees in the 4dsw districts we visited that the shorter schedule was a positive factor in students' emotional

and behavioral health. Multiple stakeholders in all of the districts we visited expressed this view. Most parents, teachers, and students we spoke to felt that the fifth day provided the much-needed time for students to "recharge," "recoup," or "decompress" after the school week. Middle and high school students noted that after the long days filled with schoolwork, sports, part-time jobs (for older students), and extracurricular activities, they have little time to themselves during the school week. They described the fifth day as a time to reset. Others noted that the fifth day made schoolwork less stressful, as it provided dedicated time to work on projects if they had fallen behind. Adults in the community largely shared this sentiment, noting that the downtime was good for the students. As a parent in one focus group said, "I 100% feel like our lives are less stressful. It is one less crazy day, throughout the week. . . . I feel like my kids are just happier."

A subset of parents and teachers reported that for students with acute mental health concerns, the 4dsw was particularly helpful. School staff noted some students have regular counseling appointments that they are able to schedule on the day off, thus allowing them to receive the care they need without missing school. Other parents felt the 4dsw helped to accommodate their children's mental health needs: "One of my children has an intense case of anxiety, and I actually think in a lot of ways [the 4dsw] has helped her to know that she can get through it, and she can have a few hours on Friday to reclaim herself."

On the other hand, at least one stakeholder in half (six) of the districts we visited acknowledged that the fifth day presented an opportunity for unsupervised students to engage in risky behavior. As one community member said, "It's a great opportunity for kids to make poor choices." However, in most cases, community members reported that these fears were not borne out in observed poor behavior or other indicators that students were making poor choices in their time away from school. The interviewees said that, like all communities, they have students who get into trouble; but they did not perceive that the rates of risky or poor behavior were higher than what would be expected in a district with a 5dsw schedule.

Stakeholders also discussed the possibility that, because of a lack of supervision, or unstable home lives, some students may not be safe while

at home (or otherwise not at school) on the fifth day. As one school staff member said,

We have a lot of at-risk kiddos, a lot of kids who this [school] is their safe place. And I think the biggest disadvantage [of the 4dsw] is they have one less day to be in their stable safe place. They have one less day where they know they're going to get fed. They have one less day where they know that there's people who they can talk to.

In most cases, the community members' concerns were nonspecific and somewhat speculative. That is, they did not speak about individual students or circumstances, but rather spoke broadly about their worry given the socioeconomic demographics in their communities.

Our analysis of parent-reported behavioral and emotional problems for elementary students and self-reported emotional and conduct problems for high school students did not support the hypothesis that the 4dsw resulted in fewer of these problems. The elementary parents survey included items from four of the SDQ scales for their children: emotional problems, conduct problems, peer problems, and hyperactivity. The youth survey also included two of these: emotional problems and conduct problems. The outcome variable for this analysis was the percentage of respondents scoring in the medium- to high-difficulty range for each of the surveyed SDQ scales. Appendix A provides more information about these scales.

While other relevant district and parent or student covariates are taken into consideration in the model, 4dsw status fails to appear as a significant predictor in explaining whether students were in medium- to high-difficulty range on the SDQ scales. Figure 5.6 shows the results for elementary students, and Figure 5.7 shows the results for middle and high school students. Detailed results are in Appendix B.

5.3. Family Well-Being

Opponents of the 4dsw argue that the shorter week may compromise a number of dimensions of family well-being (e.g., Mulvahill, 2019), and we are not aware of any other research that examines the effect of the 4dsw on parents or family well-being more generally. Policymakers worry that

FIGURE 5.6

Odds Ratio of Elementary Students Scoring in the Mediumto High-Difficulty Range, by Strengths and Difficulties Questionnaire Scale



SOURCE: Authors' calculations from elementary parents survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the odds ratios of elementary students scoring in the SDQ scale medium- to high-difficulty range (ratios less than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result.

FIGURE 5.7

Odds Ratio of Middle and High School Students Scoring in the Medium- to High-Difficulty Range, by Strengths and Difficulties Questionnaire Scale



SOURCE: Authors' calculations from youth survey responses and CCD and ACS data. NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the odds ratios of middle and high school students scoring in the SDQ scale medium- to highdifficulty (ratios less than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result. having to find childcare for young children on the fifth day may be both costly and stressful for parents. Alternatively, others have pointed out that having to manage transportation to school, school lunches, and other logistics of school attendance one less day might reduce family stress. Furthermore, switching to a 4dsw might have both negative and positive effects on families' pocketbooks. For instance, families that drive their children to school might save money on transportation costs, but they may spend more on childcare if their young children go to school one day less per week. We analyze both qualitative data and elementary parents survey and youth survey data to assess some of the potential impacts of the 4dsw on family well-being.

Parent Stress

Key Finding

• Analysis of elementary parents survey data shows no differences in perceived stress of 4dsw and 5dsw parents.

Parents in our 4dsw and 5dsw samples were asked a set of four survey items about perceived stress over the last month. After accounting for available covariates, our results indicated no significant difference in the perceived stress of 4dsw and 5dsw parents. The survey items were sourced from the Perceived Stress Scale (Cohen, Kamarck, and Mermelstein, 1983). The response categories consisted of "never," "almost never," "sometimes," "fairly often," and "very often." Two of the items had positive phrasing and the other two had negative phrasing. As is common for this scale, response categories were treated in a Likert-score framework and coded from 0 to 4, with the category indicating the least stress mapped to 0. These Likert scores were then summed across the four items to produce a parent stress scale score with possible values ranging from 0 to 16. After accounting for available covariates, our results indicated no significant difference in the perceived stress levels of 4dsw and 5dsw parents. However, we caution that the estimated difference after controlling for available covariates indicates a reduction of nearly two-thirds of a point on the parent perceived stress scale



FIGURE 5.8 Difference in Parents' Perceived Stress

 $\ensuremath{\mathsf{SOURCE}}$: Authors' calculations from elementary parents survey responses and CCD and ACS data.

NOTES: Point estimate (blue box) and 95 percent confidence interval (black line) for the average difference in parents' perceived stress (negative values favor the 4dsw). A confidence interval that does not contain the value of 0 (gray line) indicates a statistically significant result.

for 4dsw parents and the confidence interval is nearly all in the negative range (Figure 5.8). It is possible that a meaningful difference exists but our sample did not offer sufficient power to detect it.

Family Time and Relationships

Key Finding

• Stakeholders in all 12 districts we visited named additional time with family as one of the primary benefits of the 4dsw.

The benefits that the 4dsw conferred to the amount of time family members could spend with each other emerged as a clear theme from the interviews and focus groups in the districts we visited. Stakeholders in all of the districts we visited consistently cited additional time with family as a major advantage of the 4dsw as compared with a 5dsw. As one parent put it, "Valuable time with family and friends is what we do with our extra day." Parents across all districts explained that the 4dsw allowed more flexibility in their schedules and made it easier to carve out time together as family. Some noted that because they used the fifth day for chores, appointments, grocery shopping, and other errands, they had more time on the weekends to relax and spend time together without the worry of other priorities. One parent noted that the extra day off helped families achieve "family, work and life balance." Parents noted the fifth day gave them time for fun activities (such as going to an ice-skating rink or going out to eat), time to help their children with homework, or time to relax together. Others explained that the extra day allowed more time with extended family in the area, especially grandparents. And for those with out-of-state family, the extra day away from school allowed more flexibility to travel.

In some districts, stakeholders described how time with family is connected to the communities' agricultural roots. Parents, teachers, and students noted that the fifth day off from school gave children time to work at family ranches, farms, sawmills, and other agricultural endeavors. This time together allowed parents, grandparents, and other family members to educate children in their family business. Some stakeholders highlighted the value of students seeing their family members work on farms and ranches; doing so helped the students learn life skills that they cannot in school. Some noted that this time together on the fifth day allowed families to pass on important cultural values to their children. Two parents in one focus group described their feelings in this way:

Parent 1: Sometimes on Fridays those students need to be able to help their parents bale hay.... There's a lot of life skills that can be learned outside of the classroom setting that is just as important if not more important.

Parent 2: I think it's good to see your parents work and learn something....I think it's good for [children] to see there's more to life than...[school]. And honestly, most people around here have some sort of farming background, and there's a lot of outdoor [work] that happens between [tending to] cows and horses. And it's good to learn that, too. Some stakeholders were clear that the opportunity to spend quality time together on the fifth day was a privilege afforded to families with financial stability and a strong social or family network. Parents and teachers noted that many families were able to organize their schedules such that one or both parents were off from work on the fifth day, or they had extended family members with the flexibility to spend time with children when they were not in school. Some noted that families without this flexibility may not have been able to reap the same benefits from the 4dsw schedule.

Family Resources

Key Findings

- Stakeholders mentioned transportation cost savings and earnings from teen jobs as potential financial benefits of the 4dsw and child-care costs on the fifth day as a potential drawback.
- Survey data statistics do not find evidence of differences in resources between 4dsw and 5dsw families for some of the most-cited potential resource differences.

As mentioned earlier, the 4dsw might have negative or positive effects on families' pocketbooks, and the effect might vary depending on family characteristics. For example, families living far from school might experience larger transportation cost savings or families with younger children might incur greater childcare costs. While our report does not undertake a comprehensive analysis of the differences between budgets for families in 4dsw and 5dsw districts, we provide evidence on some of the major categories of family resources that stakeholders thought might be influenced by the policy.

Some interview and focus group participants identified additional childcare costs as a potential burden of the 4dsw for some families, and this potential drawback has figured heavily in policy debates (e.g., Mulvahill, 2019). As described in Chapter Three, parents in our interviews and focus groups largely did not identify childcare on the fifth day as a personal stressor or concern. Indeed, the large majority of students in the sample spent the majority of their time at home on the fifth day. Less than 3 percent of families with elementary school children reported their child spending time at childcare. Families largely relied on a parent or caregiver, extended family, or friends for childcare. As described previously, stakeholders in all communities worried that there were families who faced childcare stressors. But in nearly all cases, these were speculations about other families. In only two districts did parents in our focus groups identify childcare as a personal concern.

Another way that the 4dsw might reduce family expenditures is through reduced transportation costs. Parents or students who drive to school would have 80 percent of the transportation costs under a 4dsw schedule compared with a 5dsw schedule. Across all our interviews and focus groups, this was one of the most commonly cited potential financial benefits of the 4dsw. In the elementary parents survey, nearly three in five 4dsw parents reported that they drove their elementary-age child to school. However, about two-thirds of these parents reported that they lived within 10 minutes of school. Even more middle and high school students-about two-thirds-reported that they either got a ride from family members or drove themselves to school, and 63 percent indicated that they lived within a 10-minute drive to school. Hence, while large portions of 4dsw families drove their children to school, the majority had short drives. There are a small number of families who drive longer distances, and the cost savings from one less day of driving to school could be relatively larger across the whole school year for them.

Some stakeholders also mentioned that families might spend more on leisure activities or school enrichment activities. However, many felt that they may have incurred these expenses anyway, and reports were mixed on this point. We do not have data on these types of expenses in the surveys, so we were not able to examine the potential for these costs to increase using our data.

An additional way that the 4dsw might influence family resources is by enabling students to spend more time working at jobs, which would affect family budgets in a positive way. During interviews and focus groups with district staff, parents, and students, participants mentioned students' ability to work at a job on the fifth day and earn additional money for family or personal use as an advantage of the 4dsw. We found little difference in the percentage of students who had a paid job in the survey data: 28 percent of students in 5dsw districts reported having a paid job compared with 29 percent of students in 4dsw districts. However, the number of weekly hours students in 4dsw districts worked was significantly higher than that for the students in 5dsw districts. The 4dsw students with a job averaged 8.8 hours per week, while the 5dsw students with a job averaged 7.3 hours per week. Whether this 1.5-hour difference is meaningful is subject to debate. For instance, the minimum wage in Oklahoma is \$7.25, and if a student worked a minimum-wage job, this would only amount to a wage difference gain of \$10.88 per week.

In sum, the qualitative data indicate that most stakeholders did not feel that differences in family resources were an important benefit or drawback of the 4dsw. When we examined survey data to assess whether there were quantitative differences for some of the ways that stakeholders thought resources may affect the 4dsw, we did not find much evidence of this being an important factor.

5.4. School Enrollment and Climate

A final set of outcomes we examine are at the school level. There was speculation that switching to a 4dsw might induce some students to enter the district and others to leave the district, depending on family preferences and circumstances. This is not only an interesting policy question in its own right, but it also informs whether there is sorting of families between 4dsw and 5dsw districts, whereby families that would accrue more benefits from the 4dsw would select 4dsw districts and other families would select 5dsw districts. However, it is important to keep in mind that the rural districts offering a 4dsw are often geographically distant from other districts, which reduces the likelihood that there is substantial sorting of families on their preference for the 4dsw or 5dsw.

Student Enrollment

Key Finding

• Interviewees perceived that few, if any, families enrolled or withdrew students in the district because of the 4dsw schedule.

Overall, there was little evidence from the qualitative data to suggest the 4dsw motivated enrollment or withdrawal decisions among families in the districts. We asked school staff about the extent to which the 4dsw influenced student enrollment during interviews and focus groups. Perceptions of the 4dsw motivating enrollment were mixed, ranging from "not at all" to "definitely." The most common sentiment was surprise that the 4dsw did not result in a larger influx of students. One principal commented, "No one's ever said, 'Hi, I want to move in because you're a four-day.' I've never heard it, . . . which surprises me." In a few cases, school leaders or teachers identified an individual family or student who might have transferred into the school in part because of the 4dsw. A teacher in one district believed the recent influx of students was related to families' desire to move to the community, not the 4dsw.

Conversations with parents and students explored reasons for enrollment in greater depth, as these stakeholders would be the authority on enrolling or withdrawing students. Many of the parents and students we spoke with lived within the district catchment area before adoption of the 4dsw or before students were school age, meaning the 4dsw did not motivate enrollment. For the remaining participants, very few identified the schedule as the main reason for enrolling in the district. Participants most often moved into the area or transferred because of other school factors, such as proximity to family, employment, and lifestyle in the local community. School factors included the reputation of leadership and rigor of the academic programs (e.g., student achievement).

However, there was a family type for whom the 4dsw status was a factor in student enrollment decisions. In one district, a number of teachers who lived outside the district catchment area opted to work in the district because of the 4dsw. These teachers preferred for their children to have the same school schedule and thus chose to enroll their children in the 4dsw district in which they worked.

School Climate

Key Findings

- Stakeholders in interviews and surveys generally perceived that the 4dsw improved school climate and relationships, primarily because students and school staff were happier under the 4dsw and this led to an overall improvement in school climate.
- Analysis of survey data on school climate, school relationships, and family engagement in school showed no difference between 4dsw and 5dsw districts.

"School climate" refers to the "quality and character of school life" (National School Climate Center, undated) and includes a range of factors, such as the nature of student-student, student-staff, and staff-staff relationships; how connected students feel to school; the quality of teaching and the extent to which staff promote a positive learning environment; and the norms, values, and goals espoused by leadership and staff (Thapa et al., 2013). Research suggests that a positive school climate can help promote student academic achievement and positive social-emotional development (Jones and Bouffard, 2012). Another factor that contributes to school climate is family engagement. The extent to which families feel they are engaged partners in their children's learning and active members of the school community is associated with a positive school environment (Gold-kind and Farmer, 2013).

The 4dsw schedule alters the rhythm of the traditional school week and may change the school environment. With one less day at school, students might feel less connected to their school community, teachers, and peers; or it is possible that the longer school days may lead to deeper interpersonal connections that promote a positive climate. We explored whether the 4dsw had an effect on school climate using both qualitative and quantitative analysis.

When asked about the advantages of the 4dsw, multiple stakeholders in all the districts we visited described perceived benefits of the shorter schedule for school climate, particularly with regard to student and staff morale. Interviewees said that students seemed happier to be at school than they would be on a 5dsw schedule. Because the students only had to be at school for four days and had three days to rest and recoup, stakeholders perceived that they were less burned out and more eager to learn and engage in the school community. In addition, community members reported that the 4dsw had a positive effect on student discipline, which in turn had a positive effect on school climate. While they did not cite specific numbers, teachers and administrators in 3 of the 12 districts we visited reported that discipline referrals were down since their district had adopted the 4dsw. They attributed the change to students being happier and more focused while at school.

As in the description of student morale, teachers and administrators reported that school staff morale and overall well-being improved after switching to a 4dsw schedule. Teachers noted that because they were able to use the fifth day to plan, catch up on work, or take care of personal matters, they were more prepared for the workweek, more attentive to their students, and generally in better spirits.

In contrast, stakeholders in two districts also described disadvantages of the 4dsw for school climate. Contrary to the sentiment that the longer school day allowed for more connection, some felt that the long days had a negative effect on climate. As in the comments on sleep and fatigue, some noted that students are tired by the end of the long day and, as a result, may be less focused and engaged. Teachers also mentioned that students were "grumpy" in the morning, because of the early start times and lack of sleep. Relatedly, some students reported that because of the 4dsw week, their classes felt too rushed and the material went too quickly, making school less enjoyable for them.

To address school climate, we surveyed parents and students about whether the school promotes a positive learning environment for students, and we asked students about the quality of interpersonal relationships and their sense of connectedness to school. For none of the three measures we examined in this domain did we find a difference between 4dsw and 5dsw districts. The survey questions were sourced from the California School Climate, Health, and Learning Surveys (undated). All survey questions for these constructs featured a five-category response scale of "strongly disagree," "disagree," "neither agree nor disagree," "agree," and "strongly agree." The response categories were treated as a Likert scale and coded from 1 (strongly disagree) to 5 (strongly agree), and then a unidimensional scale





SOURCE: Authors' calculations from elementary parents survey and youth survey responses and CCD and ACS data.

NOTES: Point estimates (blue boxes) and 95 percent confidence intervals (black lines) for the odds ratios of measures of school climate (ratios greater than 1 favor the 4dsw). Confidence intervals that do not contain the value of 1 (gray line) indicate a statistically significant result.

was constructed by averaging the five item responses. All three scales were skewed toward agreement, with means ranging from 3.71 to 4.25. Appendix A describes these scales in more detail.

We considered the influence of the 4dsw on the probability that a parent would agree or strongly agree with the statement that school provides a positive environment for student learning, where "positive environment" is defined as an average higher than 3.5 (i.e., an average higher than the midpoint between "neither agree or disagree" and "agree" on the response scale).² After accounting for available covariates, our results indicated no appreciable difference in 4dsw and 5dsw parents' perceptions of a positive environment in their child's school (odds ratio of 1.06; Figure 5.9).

We also assessed the influence of the 4dsw on the probability that a student would at least agree the school provides a positive environment for stu-

² One might consider alternate definitions of "at least agree," such as placing the cut point on the scale at 4, the exact position of agree. As a sensitivity check, we examined multiple cut points between 3 and 4 on the scale and the substantive conclusions reported in this section did not change.

dent learning, where "positive environment" is defined as an average higher than 3.5 (i.e., an average more than halfway between "neither agree or disagree" and "agree" on the response scale).³ However, after accounting for available covariates, our results indicated no statistical difference in 4dsw and 5dsw students' perceptions of a positive social and emotional learning environment in their school (odds ratio of 1.07; Figure 5.9).

Finally, we examined the influence of the 4dsw on the probability that a student would at least agree that he or she has positive interpersonal relationships at school and feel a sense of school connectedness where "at least agree" is defined as an average higher than 3.5 (i.e., an average more than halfway between "neither agree or disagree" and "agree" on the response scale).⁴ Our estimates indicated no appreciable difference in 4dsw and 5dsw

FIGURE 5.10 Differences in Family Engagement



SOURCE: Authors' calculations from elementary parents survey responses and CCD and ACS data.

NOTES: Point estimate (blue box) and 95 percent confidence interval (black line) for the average difference in family engagement (positive values favor the 4dsw). A confidence interval that does not contain the value of 0 (gray line) indicates a statistically significant result.

³ As a sensitivity check, we examined multiple cut points between 3 and 4 on the scale and the substantive conclusions reported in this section did not change.

⁴ As a sensitivity check, we examined multiple cut points between 3 and 4 on the scale and the substantive conclusions reported in this section did not change.

students' views of school interpersonal relationships and sense of school connectedness (odds ratio of 1.17; Figure 5.9).

To assess whether there were differences in family engagement at 4dsw and 5dsw schools, we surveyed parents about their engagement with their K-sixth-grade child's school. A series of six questions, originally used in the Panorama Family-School Relationships Survey (Panorama Education, undated), gathered frequency of interaction on a series of school engagement topics, such as meeting with the teacher, visiting the school, engaging with other parents and parent groups at the school, and assisting in the classroom and with fund-raising. Responses were aggregated in an overall scale score ranging from 1 to 5, consistent with how these items are typically used, with higher scores indicating a higher level of engagement. Raw response scale averages were virtually identical between 4dsw and 5dsw respondents (2.95 for 4dsw parents versus 2.97 for 5dsw parents). After accounting for available covariates, formal modeling results also indicated no appreciable difference in engagement between 4dsw and 5dsw parents (estimated average difference = -0.08; Figure 5.10). Appendix B reports detailed estimates for all school climate and relationships analysis.

CHAPTER SIX

Four-Day School Week Benefits, Drawbacks, and Trade-Offs

Debates about the 4dsw have long recognized that it has potential advantages and disadvantages. Our goal in this report was to add to the information available to stakeholders as they weigh the benefits and drawbacks of using this scheduling option. Specifically, we contributed to the existing research base by examining the largest and most comprehensive set of implementation and outcome measures to date. As described in Chapter One, we used both qualitative and quantitative analysis, and we analyzed data we collected explicitly for this study and also existing data from administrative sources. We also add to the current knowledge about the 4dsw by including multiple states in our analysis rather than focusing on a single state. A final strength of this report is that we are able to include the most up-to-date administrative data available from the EOP and state websites.

In Table 6.1, we summarize our findings on the aspects of the 4dsw explored in this study. As depicted by green boxes, many factors emerged in the focus groups and interviews as perceived advantages of the 4dsw. Our interviews with district officials indicated that they had been able to save some money on operational costs like transportation and food service and reallocate those to support instruction. Consistent with the existing literature, most respondents indicated that the savings due to the 4dsw were relatively small. There was support in the qualitative data for the argument that the 4dsw helps rural districts recruit and retain teachers. Interview and focus group participants also perceived that teacher attendance in 4dsw districts was higher than in 5dsw districts. For three of the factors that the qualitative data found were perceived benefits of the 4dsw, we did not have

TABLE 6.1 Summary of Findings for Factors Playing a Role in Policy Decisions Regarding the Four-Day School Week

Factor	Qualitative Finding	Quantitative Finding
Districts save money or reallocate funds (small amount)	Positive	N/A
Recruit and retain teachers	Positive	N/A
Teacher attendance	Positive	N/A
Satisfaction with the 4dsw	Positive	Positive
Students have additional time to spend with family	Positive	Positive
Student attendance	Positive	No difference
Behavioral and emotional well-being	Positive	No difference
Parent stress	Positive	No difference
School climate	Positive	No difference
Sleep and fatigue	Positive/ negative ^a	Positive/ no difference ^b
Student achievement	Positive/ no difference/ negative ^a	Negative/ no difference ^c
Food insecurity	No difference	No difference
Family resources	No difference	No difference
Student enrollment	No difference	No difference
Physical activity	N/A	No difference

NOTES: Green indicates that the qualitative data showed stakeholders perceived that the 4dsw had an advantage over the 5dsw, or that the quantitative analysis found that the 4dsw outcome was statistically significantly better than the 5dsw outcome. Yellow indicates that qualitative findings included mixed views from respondents, and the quantitative findings included positive, negative, or no differences between 4dsw and 5dsw outcomes. "No difference" indicates that the qualitative analysis indicated there was no difference between 4dsw and 5dsw districts or the quantitative analysis found no statistically significant difference between the 4dsw and 5dsw districts. N/A indicates we did not measure this factor.

^a Respondents reported mixed views.

^b Findings varied by student age group.

^c Findings varied by statistical model.

quantitative data to analyze: saving money or reallocating funds, recruiting and retaining teachers, and teacher attendance.

However, for most of the factors where the qualitative data indicate that the 4dsw was perceived to have an edge over the 5dsw, we also had quantitative data. In only two of those cases did the quantitative findings support the qualitative findings. Both qualitative and quantitative data found high levels of satisfaction with the 4dsw among all stakeholders. Additionally, both the qualitative and quantitative data indicated that the 4dsw allowed families and students to spend more time together. The other four outcomes with positive qualitative findings that also had quantitative data did not show a statistically significant difference between the 4dsw and 5dsw in the quantitative analysis. As described previously, the relatively positive results from the qualitative data may be an indication that the participants who chose to attend the focus groups and interviews tended to be those who were in favor of the 4dsw.

Participants in the interviews and focus groups had mixed perceptions about two outcomes: sleep and fatigue, and student achievement. Both the qualitative and quantitative data supported the idea that the 4dsw allows students to get more sleep over the week and feel less tired on a regular basis, although we did not find this to be consistent across elementary and high school students. Additionally, inconsistent sleep schedules across the weekdays could be an unrecognized drawback to the 4dsw.

Most participants in focus groups and interviews expressed the view that the 4dsw did not affect academic achievement, but a small number of respondents thought it might improve or reduce academic achievement. As a result, we have labeled the achievement outcome for the qualitative finding as "mixed." The quantitative analysis indicates that in the short term, there is little difference in achievement between the 4dsw and 5dsw districts, but that small achievement disadvantages for 4dsw students may accumulate over time, so that by eight years after adoption, ELA and math scores are statistically significantly lower for 4dsw students. Using a combination of quantitative approaches, we find that 4dsw students' ELA and math scores were between 0.1 and 0.2 standard deviations lower than their matched 5dsw comparison districts eight years after 4dsw adoption. Alternative approaches yield similar estimates of the size of the differences in achievement between 4dsw and 5dsw districts, but the approaches vary in their estimates of the statistical significance of the differences. In the context of the education literature, these would be considered substantively important differences. Our quantitative analysis has advantages over the estimated effects presented in the extant literature because we include five states rather than one state, and we are able to use more recent data, which are available through the 2018–2019 school year. Furthermore, we use more recent approaches to testing the assumptions of the statistical methods. Comparing trends in the test scores of 4dsw districts with those of the 5dsw districts revealed that the achievement growth in 4dsw districts, although positive, was not as strong as in their 5dsw counterparts.

For three outcomes—food security, family resources, and student enrollment—neither the qualitative nor the quantitative findings indicated differences between 4dsw and 5dsw districts. Finally, we did not collect qualitative data on physical activity, but the quantitative analysis found no differences by 4dsw status.

Table 6.1 shows that our quantitative analyses did not find effects of the 4dsw on nearly half of the outcomes—the lower portion of the table shows entries labeled "No difference," indicating that we did not find any statistically significant differences between the 4dsw and 5dsw districts for these outcomes. For a majority of these outcomes, however, the respondents in focus groups and interviews expressed the view that the 4dsw improved them.

A strength of our study is that we included data from multiple states. Nevertheless, it is important to note that we included only three states in our qualitative and survey analysis and six states in our administrative data analysis. Furthermore, our survey respondents included a higher representation of Native American and Hispanic families and students than the national population of 4dsw districts. Our findings are largely consistent with previous studies that examined individual states (e.g., Morton, 2021; Thompson, 2021b), and we did not observe profound differences in policies or outcomes across states, despite the fact that the states have different histories with the 4dsw, such as how long they have had the 4dsw and varying levels of current enthusiasm from state government. The consistency in findings are likely to have relevance for 4dsw policy in locations not included in our study. However, we would expect there to be limits to the relevance when the contexts deviate considerably from the implementation

in the states in our study, as would be true for urban districts, districts that implement a year-round 4dsw, or districts that have a substantially different demographic composition.

Many participants in the focus groups and interviews expressed the view that while the 4dsw worked in their community, it would not work in many other places. One of the main reasons they offered was that their community had a large number of adults available to spend time with the students on the fifth day. This was either because one parent was not in the labor force or was self-employed, or because some local employers had nontraditional work schedules, such as four days of work followed by three days off. They also expressed the opinion that their communities included a large number of extended families with adults who could spend time with children on the fifth day. We did not have data to empirically verify these patterns.

A second reason that focus group and interview participants gave for why the 4dsw worked in their community but perhaps not others was that most urban areas, they speculated, would not have as high a rate of families with a parent or relative who could care for children on the fifth day, and families in other communities might face high childcare costs if their children were not in school five days a week. This suggests that communities with a 4dsw may be those in which labor force participation and industry composition facilitate having a three-day weekend for families, while many communities would not consider a 4dsw if these factors were barriers. For example, if the school district is one of the larger employers in a district catchment area, the 4dsw might be more feasible since the school district employees would be available to care for their own children or others' children on the same day. Similarly, ranching communities might have more adults available to care for children on the fifth day than communities where more adults work in an office setting.

A third reason that participants in focus groups and interviews reported was that a high rate of student participation in sports would raise the benefits to a district of adopting the 4dsw. This is because the benefits of a 4dsw for student attendance would be greater if a higher percentage of students were athletes who might miss classes because of traveling to and participating in competitions. For instance, communities that had the majority of high school students in sports mentioned that they gained more from a schedule that reduced the number of students missing "time in the seat" in classrooms than districts with low rates of sports participation. The characteristics of communities that adopt the 4dsw would be a productive line of inquiry for additional research.

We also discussed three additional topics that figured prominently in the debate about the 4dsw but on which we did not collect information, and research on these topics would inform decisions about the 4dsw. As discussed in Chapter Four, the conventional student absenteeism measures may not accurately reflect the time that students are actually in classrooms engaging in instruction because these measures may not reflect "excused absences" such as school sports competitions. An area that our quantitative data could not address is the issue of teacher quantity and quality. For example, future research that collected data that informed this issue could enhance the information available about whether the 4dsw improves measures of teacher quality, such as teacher certification, experience, and education, and measures of quantity, such as unfilled positions, turnover, and numbers of applicants for positions. Another issue that merits additional inquiry is the impact of the 4dsw on the highest-risk students. Stakeholders in nearly every district we visited raised this as a concern for students in families that are not able to offer safe or nurturing environments, and we were not able to examine this issue.

We close with a few recommendations for stakeholders making decisions about whether to adopt or continue the 4dsw:

- Debates about 4dsw adoption should acknowledge that there is only weak support for the three main reasons that districts typically adopt the 4dsw—saving money, reducing student absences, and attracting and retaining teachers. Enough information now exists that policy-makers can be confident in characterizing the costs savings due to the 4dsw as "small," while recognizing that even small shifts in spending from operational categories to instructional categories may be meaningful. We did not find quantitative evidence that the 4dsw on teacher recruiting and retention is currently based on educator perceptions.
- Policymakers should also acknowledge the overwhelming popularity of the 4dsw as they engage in community discussions about 4dsw adoption or switching back from a 4dsw to a 5dsw. All types of stake-

holders in all 12 districts we visited expressed high levels of satisfaction with the 4dsw in our qualitative data, and the analysis of the quantitative data corroborated this enthusiasm. However, as noted in the discussion of limitations in Chapter Two, it is likely that the sample of community members in our study is inclined to have a positive view toward the 4dsw.

- School and district officials should recognize that examining a school's or district's student achievement over time is not an adequate metric for assessing the effects of the 4dsw on achievement. We show that even though student achievement at 4dsw districts was generally trending upward over time, this growth was not as large as what the 4dsw districts would have attained with a 5dsw schedule.
- Decisionmakers should be aware that while achievement is an important consideration in weighing the advantages and disadvantages of the 4dsw, other factors are also important when considering the 4dsw policy—most community members implicitly adhere to a variant of the "Whole School, Whole Child, Whole Community" model (CDC, 2020). Given the insignificant or mixed findings for some of the outcomes in our study and other studies, more evidence is needed on the impacts of the 4dsw on physical activity, student behavior and emotional outcomes, family well-being, and teachers before firm recommendations can be made regarding these factors.

While our research can help promote the understanding of how much the 4dsw affects each of the inputs in the "whole child" type of model, each community decides how to weight the different inputs. As a result, even with a clearer understanding of the effects of the 4dsw on inputs to preparing students for life, communities may make different choices about the 4dsw depending on how they value the affected inputs.

APPENDIX A

Detailed Methods

In this appendix, we present more detailed information about the methods used for data collection and analysis.

Additional Information About Sources of Four-Day-School-Week Lists

TABLE A.1 Sources of Four-Day-School-Week Lists

State	Source of Four-Day School Week List				
Colorado	Colorado Department of Education, 2021				
Idaho	Idaho State Department of Education, undated				
Missouri	Turner, 2021				
Montana	Montana Office of Public Instruction, 2020				
New Mexico	Personal correspondence with New Mexico Board of Education				
Oklahoma	Oklahoma State Department of Education, 2019				
Oregon	Personal correspondence with Oregon Board of Education				
South Dakota	South Dakota Department of Education, 2020				

Additional Information About District Recruitment for Primary Data Collection

We identified the 18 4dsw districts in Idaho, Oklahoma, and New Mexico eligible to participate in the primary data collection (elementary parents survey, youth survey, and interviews and focus groups) for this study by reviewing publicly available information, including lists of 4dsw districts provided by state department of education and district websites. Since most of our data spanned the period from the 2010–2011 school year through the 2017-2018 school year, we sought to include districts that switched to the 4dsw during that time span. Thus, we invited districts to participate in the primary data collection based mainly on the school year in which they commenced the 4dsw. We then considered geographic diversity and proximity to other 4dsw districts. When districts expressed interest in participating in the study, we validated that all schools in the district had implemented 4dsw since the commencement year. Where possible, we tried to recruit districts that were distributed across the state and represented different industries and economic climates (for instance, in New Mexico, the north is mountainous and tourism oriented, the east includes a large amount of ranching, the south is dominated by oil and extraction industries, and the west contains more tribal communities). In Idaho, we expanded the commencement year to the 2009-2010 school year because of recruitment challenges. After we recruited six 4dsw districts in each state, we used propensity matching techniques described later to identity and recruit a 5dsw district that provided the best match possible for each participating 4dsw district.

As discussed in the main body of the report, we asked each of the 18 4dsw and 18 5dsw districts to participate in a variety of primary data-collection activities. All 36 districts agreed for us to survey families of students in grades K–6 and students enrolled in grades 7–12. They also agreed to provide us with administrative data such as schedules. Twelve of the 4dsw districts (4 in each state) agreed to a two-day site visit from RAND researchers. In recognition of the time and demand placed on district staff for these efforts, each participating district has been offered a \$1,000 honorarium. This also honors the time districts spent establishing a memorandum of understanding with RAND and, in some cases, obtaining school board approvals for the study. While we are not able to guarantee that the identity of districts remains anonymous given the large number of community members who participated in the research, we do not identify the participating districts in any publicly available materials.

Additional Information About Interviews and Focus Groups

We conducted the site visits over two days at each of the 12 districts during October–December 2019. In advance of the site visit, we worked with district personnel to schedule interviews and focus groups that included students from different grades, teachers of different grades and subjects, principals and superintendents, parents and caregivers of children in different grades, and community members and school board members.

Before commencing site visits, we developed semistructured protocols designed to elicit information relevant to our research questions. The protocols varied depending on the respondent. In general, the interview and focus group protocols asked participants to describe the reasons that the district became a 4dsw, the pros and cons of the 4dsw, and how the 4dsw affected different facets of various stakeholders' lives. In advance of each focus group and interview, we read the informed consent verbiage approved by the RAND Institutional Review Board and answered any questions they had about the study. Each individual needed to provide verbal confirmation that he or she understood the consent and agreed to participate in the discussion. Appendix C (Kilburn et al., 2021) contains a complete set of protocols.

To ensure consistency and reliability in the process of coding interview and focus group responses, we conducted a coding calibration exercise at the outset. The coding team of three people first discussed the codebook in depth to establish consensus on the codes. Next the team independently coded the same transcript, then met to compare code applications. The team discussed discrepancies after the initial independent coding until they were resolved. Throughout the coding process, the coders regularly communicated about issues related to code definitions and coding decisions. When new codes arose, we discussed them as a team to establish agreement. We then recoded previously coded transcripts such that all data were coded with the same master set of codes. Additionally, the coding team double-coded approximately 5 percent of interviews throughout the coding process to ensure continued alignment.

During this process, we regularly summarized findings in analytic memos, taking note of the general frequency with which different themes appeared across interviews. We accounted for how themes varied by respondent type, district, state, and other key characteristics (e.g., district size and urbanicity). The coding team met regularly to discuss emergent findings and hypotheses, as well as to identify and address potential bias in our analyses and reading of the data. Findings and limitations were presented to the broader research team, who served as an internal quality assurance for the coding team throughout the analytic process.

Additional Information About Time Use Analysis

Here we provide some additional information about data used for the time use analysis and analysis of those data.

Data Cleaning

Survey responses about time spent on various activities and free time on the fifth day (4dsw students only) and after school in a week were used for time use analyses. Respondents who reported spending the maximum amount of time, 30 or more hours per week, or zero time spent on each activity were assumed to be nonrespondents for the time use data and were excluded from the sample for these analyses. Respondents who reported over 8 hours of activities per night, not including free time or had nonsensical responses to open-response items regarding their activities, were also assumed to be nonrespondents for the time use data and were excluded from the sample for the time use data and were excluded from the sample for the time use data and were also assumed to be nonrespondents for the time use data and were also assumed to be nonrespondents for the time use data and were excluded from the sample for these analyses.

School-Day Schedules

Students' school-day schedules, as displayed in Figure 3.1, were calculated using district information about school-day start and end times as well as student and family survey responses about students' sleep schedules and travel times to and from school. Students' OST was calculated by subtracting the time spent in school, sleeping, or traveling to and from school from 24 hours. The equation used to calculate all students' school-day OST for student i in district d was the following:

$$OST_{id,schday} = 24 \text{ hours} - school_{id,schday} - sleep_{id,schday} - travel_{id,schday}$$

All remaining time in the 24-hour day was designated as OST. The schedule of 4dsw students' fifth day was calculated using their reported sleep schedule for the fifth day. All remaining time on the fifth day was designated as OST. The equation used to calculate 4dsw students' fifth-day OST for student *i* in district *d* was the following:

$$OST_{id,5th \, day} = 24 \text{ hours} - sleep_{id,5th \, day}.$$

Weekly Out-of-School Time

The school-day and fifth-day OST calculations inform the 4dsw and 5dsw weekly OST totals shown in Figure 3.2. These totals were calculated using the following equations for student i in district d:

5dsw weekly
$$OST_{id} = 5 * OST_{id,schday}$$
.
4dsw weekly $OST_{id} = 4 * OST_{id,schday} + OST_{id,5th,day}$.

Weekly Time Spent on Activities

Students' weekly time spent on various activities, as displayed in Figure 3.3, was calculated using their survey responses regarding the usual amount of time they spent on the following activities on the fifth day (4dsw students only) and after school in a week: school sports, nonschool sports, school activities, hobbies, homework, work for family, chores, a job (grades 7–12 only), and free time. Both surveys had some respondents report spending more time on activities, including free time, after school, or on the fifth day, than would be possible based on their calculated total OST (n=904 for the grade 7–12 youth survey and n=306 for the grade K–6 elementary parents survey). These respondents did not tend to overreport any one activity more than any other. Excluding these responses from the sample would be problematic because it could systematically exclude students who were the most

involved and engaged in activities as well as those prone to overreporting their time use. Rather, we made the assumption that these respondents were still reporting their time use proportionally and calculated the percentage of their reported total time use that was allocated to each activity (Kelly et al., 2015). We then multiplied these percentages by each student's total possible amount of OST after school to calculate the weekly time these students spent on each activity. In these cases, the equation used to calculate each respondent's weekly time spent on activity a for student i in district d was the following:

$$time_{aid} = (reported time_{aid} / total reported time_{id}) * total OST_{id}$$
.

For the remaining respondents who reported spending less time on these activities than their total OST, we increased their time spent on "free time" to account for their remaining OST. We rename the "free time" category as "other" time, as we know this time will now account for all of students' time after school before going to sleep. This time can include time that students would consider free time, but it would also include eating dinner, getting ready for bed, and any other activity not included in the activity categories listed on the survey. For these respondents, the equation used to calculate each respondent's weekly time spent on "other" time was the following:

Figure 3.3 displays the adjusted activity times and "other" time for all respondents who overreported their activity time relative to their total OST, and it displays the unadjusted activity times and adjusted "other" time for all respondents who underreported their activity time relative to their total OST.

Table A.2 provides descriptive statistics on time use, and Table A.3 presents descriptive statistics on the locations where students spend the fifth day.

	4dsw		5dsw		Difference (5dsw – 4dsw)	
	Mean	SD	Mean	SD	Mean	95% CI
School-day schedule						
Wake up (hours of sleep after 12 a.m.)	6.47	0.48	6.53	0.47	0.06*	[0.01, 0.12]
Bedtime (hours of sleep before 12 a.m.)	3.30	0.69	3.32	0.63	0.02	[-0.06, 0.09]
OST after school	4.61	0.73	5.18	0.70	0.57**	[0.48, 0.65]
OST before school	1.14	0.42	1.29	0.43	0.15**	[0.10, 0.20]
Travel to school	0.26	0.25	0.26	0.24	0.00	[0.02, 0.03]
Travel to home	0.29	0.27	0.32	0.27	0.02	[-0.01, 0.05]
Weekly OST activities						
Total OST	36.57	3.58	32.39	4.00	-4.19**	[-4.62, -3.75]
School sports	0.97	1.83	0.79	1.76	-0.18	[-0.40, 0.04]
Nonschool sports	3.41	3.20	2.39	2.49	-1.02**	[–1.37, –0.66]
School activities	0.44	1.34	0.34	1.37	-0.10	[-0.27, 0.07]
Hobby	2.22	2.44	1.77	2.04	-0.45*	[-0.73, -0.17]
Homework	2.75	1.94	2.62	2.26	-0.12	[-0.38, 0.14]
Family work	1.50	2.48	1.34	2.27	-0.16	[-0.45, 0.14]
Chores	3.69	2.30	2.52	1.97	-1.17**	[–1.44, –0.91]
Screen time	17.46	16.05	18.26	14.51	0.79	[–1.14, 2.72]
Other	21.96	7.29	20.87	7.26	-1.09*	[–1.99, –0.19]

TABLE A.2(a) Descriptive Statistics on Time Use (in Hours), Grades K–6

SOURCE: Elementary parents survey.

NOTES: *p < .05; **p < .001.

SD = standard deviation; CI = confidence interval.

	4dsw		5dsw		Difference 4dsw – 5dsw	
	Mean	SD	Mean	SD	Mean	95% CI
School-day schedule						
Wake up (hours of sleep after 12 a.m.)	6.27	0.67	6.37	0.72	0.10**	[0.06, 0.13]
Bedtime (hours of sleep before 12 a.m.)	1.58	1.29	1.55	1.35	-0.03	[–0.10, 0.05]
OST after school	6.36	1.32	6.99	1.41	0.63**	[0.55, 0.71]
OST before school	1.36	0.66	1.45	0.68	0.08**	[0.04, 0.12]
Travel to school	0.22	0.21	0.26	0.25	0.03**	[0.02, 0.04]
Travel to home	0.27	0.25	0.30	0.27	0.03**	[0.01, 0.04]
Weekly OST activities						
Total OST	45.75	6.19	42.20	7.15	-3.55**	[-3.94, -3.15]
School sports	2.98	3.89	2.96	4.32	-0.02	[-0.26, 0.22]
Nonschool sports	2.48	2.76	1.86	2.47	-0.61**	[-0.77, -0.46]
School activities	1.05	2.18	0.83	1.76	-0.21**	[-0.33, -0.10]
Hobbies	2.38	2.72	1.56	2.33	-0.82**	[-0.97, -0.67]
Homework	2.67	2.40	2.06	2.46	-0.62**	[-0.76, -0.48]
Family work	2.29	3.57	1.95	3.32	-0.34**	[-0.54, -0.14]
Job	2.09	4.86	1.40	3.78	-0.69**	[-0.94, -0.44]
Chores	4.93	4.39	3.28	3.55	-1.64**	[–1.88, –1.41]
Other	25.44	11.31	26.30	12.46	0.85*	[0.16, 1.56]

TABLE A.2(b) Descriptive Statistics on Time Use (in Hours), Grades 7–12

SOURCE: Youth survey.

NOTES: *p < .05; **p < .001.
TABLE A.3(a) Descriptive Statistics on Fifth-Day Locations Percentage of Grade K–6 Students Who Report Spending Any Time at a Location by State and Supervision

		State-based comparisons									
	All (n	All States (<i>n</i> = 696)		ID (n=216)		NM (n = 217	7)		(/	OK n = 263)	
	n	% total	n	% total	n	% total	Mean diff (%) from ID (NM – ID)	n	% total	Mean diff (%) from ID (OK – ID)	Mean diff (%) from NM (OK – NM)
My home	636	91.38	198	91.67	202	93.09	1.42	236	89.73	-1.93	-3.35
Supervised	628	90.23	194	89.81	201	92.63	2.81	233	88.59	-1.22	-4.03
Unsupervised	8	1.15	4	1.85	1	0.46	-1.39	3	1.14	-0.71	0.68
Other home	87	12.50	28	12.96	23	10.60	-2.36	36	13.69	0.73	3.09
Supervised	86	12.36	27	12.50	23	10.60	-1.90	36	13.69	1.19	3.09
Unsupervised	1	0.14	1	0.46	0	0.00	-0.46	0	0.00	-0.46	0.00
School	20	2.87	11	5.09	3	1.38	-3.71*	6	2.28	-2.81*	0.90
Supervised	20	2.87	11	5.09	3	1.38	-3.71*	6	2.28	-2.81*	0.90
Unsupervised	0	0.00	0	0.00	0	0.00	0.00	0	0.00	0.00	0.00

TABLE A.3(a) – Continued

		State-based comparisons										
	All States (<i>n</i> = 696)		ID n=216)			NM (<i>n</i> = 217	7)		OK (n = 263)			
	n	% total	n	% total	n	% total	Mean diff (%) from ID (NM – ID)	n	% total	Mean diff (%) from ID (OK – ID)	Mean diff (%) from NM (OK – NM)	
Government location	16	2.30	5	2.31	4	1.84	-0.47	7	2.66	0.35	0.82	
Supervised	16	2.30	5	2.31	4	1.84	-0.47	7	2.66	0.35	0.82	
Unsupervised	0	0.00	0	0.00	0	0.00	0.00	0	0.00	0.00	0.00	
Daycare (supervised only)	17	2.44	7	3.24	5	2.30	-0.94	5	1.90	-1.34	-0.40	
Other location	14	2.01	3	1.39	6	2.76	1.38	5	1.90	0.51	-0.86	
Supervised	14	2.01	3	1.39	6	2.76	1.38	5	1.90	0.51	-0.86	
Unsupervised	0	0.00	0	0.00	0	0.00	0.00	0	0.00	0.00	0.00	

SOURCE: Elementary parents survey.

NOTE: *p < .05.

TABLE A.3(b)

Descriptive Statistics on Fifth-Day Locations: Percentage of Grade 7–12 Students Who Report Spending Any Time at a Location by State and Supervision

		State-based comparisons									
	All : (n =	All States (n = 2,752)		ID = 819)		NM (<i>n</i> = 569	9)		(n	OK = 1,364)	
	n	% total	n	% total	n	% total	Mean diff (%) from ID (NM – ID)	n	% total	Mean diff (%) from ID (OK – ID)	Mean diff (%) from NM (OK – NM)
My home	2,221	80.70	678	82.78	470	82.60	-0.18	1,073	78.67	-4.12*	-3.94*
Supervised	1,976	71.80	624	76.19	430	75.57	-0.62	922	67.60	-8.60**	-7.98**
Unsupervised	253	9.19	56	6.84	41	7.21	0.37	156	11.44	4.60**	4.23
Other home	686	24.93	177	21.61	132	23.20	1.59	377	27.64	6.03*	4.44
Supervised	613	22.27	155	18.93	118	20.74	1.81	340	24.93	6.00*	4.19
Unsupervised	74	2.69	22	2.69	14	2.46	-0.23	38	2.79	0.10	0.33
School	210	7.63	72	8.79	33	5.80	-2.99	105	7.70	-1.09	1.90
Supervised	203	7.38	71	8.67	33	5.80	-2.87	99	7.26	-1.41	1.46
Unsupervised	7	0.25	1	0.12	0	0.00	-0.12	6	0.44	0.32	0.44

		State-based comparisons									
	All 3 (n =	All States (n = 2,752)		ID (n = 819)		NM (<i>n</i> = 569))	OK (<i>n</i> = 1,364)			
	n	% total	n	% total	n	% total	Mean diff (%) from ID (NM – ID)	n	% total	Mean diff (%) from ID (OK – ID)	Mean diff (%) from NM (OK – NM)
Government location	168	6.10	46	5.62	43	7.56	1.94	79	5.79	0.18	-1.77
Supervised	201	7.30	54	6.59	51	8.96	2.37	96	7.04	0.44	-1.92
Unsupervised	34	1.24	8	0.98	8	1.41	0.43	18	1.32	0.34	-0.09
Other location	198	7.19	51	6.23	38	6.68	0.45	109	7.99	1.76	1.31
Supervised	180	6.54	45	5.49	32	5.62	0.13	103	7.55	2.06	1.93
Unsupervised	18	0.65	6	0.73	6	1.05	0.32	6	0.44	-0.29	-0.61

SOURCE: Youth survey.

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NOTES: *p < .05; **p < .001.

TABLE A.3(c)

Descriptive Statistics on Fifth-Day Locations: Differences in the Percentage of Students Who Reported Spending Any Time at These Locations on the Fifth Day by Age Group

	Grades K–6 (1)		Grade (2	es 7–12 2)	Difference (1) – (2)		
	Mean	SD	Mean	SD	Mean	95% CI	
Location							
My home	91.38	28.09	80.70	39.47	-10.67	[–13.79, –7.56]	
Other home	12.50	33.10	24.93	43.27	12.43	[8.98, 15.87]	
School	2.87	16.72	7.63	26.55	4.76	[2.69, 6.83]	
Government place	2.30	15.00	7.30	26.02	5.00	[2.99, 7.02]	
Daycare	2.44	15.45	n/a	n/a	n/a	n/a	
Other place	2.01	14.05	7.19	25.84	5.18	[3.19, 7.17]	

SOURCE: Elementary parents survey and youth survey.

NOTES: *p < .05; **p < .001.

Additional Information About Surveys

For both the elementary parents survey and the youth survey, we used the same guiding principles in developing the instruments. To the extent possible, in designing and deploying these instruments, we strove to

- minimize the burden on parents or students by keeping the surveys as brief as possible and not asking questions for which we could obtain the information from administrative sources or other sources
- draw on instruments from the literature that have been successfully used for collecting similar information from parents or students and have demonstrated desirable psychometric properties such as interrater reliability and validity
- align the content on the elementary parents survey and youth survey to the degree possible
- pilot test all instruments before deploying.

Elementary Parents Survey

We invited all parents of elementary students in grades K–6 in the 36 participating districts (18 4dsw and 18 5dsw) to complete an online survey that was open between January 6, 2020, and March 10, 2020. Districts distributed multilingual flyers inviting students to participate in the survey at the start of the spring semester. Flyers went home in students' backpacks and communication folders. We encouraged districts to share information about the survey in their regular communication to parents (e.g., newsletters) and by email. In many cases, district and school leaders encouraged participation through email messages to families. Districts with low response rates received a second set of flyers to send home with students.

We planned to accept one response each from 50 families in each of the 36 districts, or 1,800 total responses from individual families. The number of unique families in some districts was below or around 50. Anticipating response rates below 100 percent in these districts, we expanded the number of possible survey responses to 55 in each district. The first 55 respondents completed the survey, and then we closed the survey. On average, the total response rate for the elementary parents survey was 71 percent; the within-district response rates ranged from 10 percent to 110 percent because the survey allowed for 55 responses per district. Survey participants received a \$20 e-gift card to Amazon. In order to survey more families, one 5dsw district waived its hono-rarium to provide an additional 50 families with the opportunity to participate in the survey. Hence the final target sample for the elementary parents survey was 900 parents from 4dsw districts and 950 from 5dsw districts.

The topics covered by the survey included parents' satisfaction with the 4dsw (for 4dsw districts only); school climate; family engagement in school; parental stress; family food security; mode and time of student's transportation to school; student's sleep schedule, after-school activities, and time in each; student's fifth-day activities and time and cost for each (for 4dsw districts only); student's screen time; student's use of health care; and student's behavior. Understanding that families may have more than one elementary-age child, we asked respondents to think of one child when completing the survey. The survey randomly assigned families to think of the oldest or youngest child when completing the survey.

The survey link for each district directed the respondent to the consent form, which invited individuals to participate in the voluntary, confidential

District Characteristics	Our 4dsw Survey Districts	Matched 5dsw Survey Districts	National 4dsw Population
Number of schools in the district	2.83	3.17	2.61
Total students in district	460	677	481
Revenue per pupil (in thousands)	13.00	13.34	14.25
Student/teacher ratio	13.25	13.32	12.48

TABLE A.4 District Sample Characteristics Compared with National Four-Day-School-Week Districts

NOTE: National 4dsw population is from Thompson et al., 2020, for the 2012–2019 time period.

survey. Those who did not wish to participate discontinued the survey. We asked respondents to provide an email address to distribute the honorarium. Respondents who did not provide an email address skipped this item; these individuals did not receive an honorarium for time spent completing the survey. Table A.4 shows how the districts that participated in our 4dsw and 5dsw surveys compare with the population of 4dsw districts. Table A.5 presents the student characteristics for the 4dsw elementary parents survey and 5dsw elementary parents survey samples along with the student characteristics for the population of 4dsw districts. Appendix C (Kilburn et al., 2021) contains a copy of the elementary parents survey.

Youth Survey

We aimed to survey all students in grades 7–12 in each of the 36 districts. There were 9,465 students enrolled in grades 7–12 across the 36 districts. We prepared letters for students in each school that notified parents of the youth survey. Schools distributed letters to students, who, in turn, provided the letters to their families. Families that did not wish for their children to participate in the survey notified RAND that the children should be excluded from it. Parental refusal rates were very low (about 1 percent), resulting in 9,347 students eligible to take the survey (5,737 from 4dsw districts and 3,610 from 5dsw districts). RAND prepared materials for schools to administer the online survey to students whose families did not opt their students out.

TABLE A.5 Elementary Parents Survey and Youth Survey Sample Characteristics Compared with National Four-Day-School-Week Characteristics

District Characteristics	Elementary Parents Survey 4dsw Sample	Elementary Parents Survey 5dsw Sample	Youth Survey 4dsw Sample	Youth Survey 5dsw Sample	National 4dsw Population
Proportion female	0.44	0.46	0.49	0.47	0.49
Proportion American Indian	0.14	0.09	0.20	0.14	N/A
Proportion Asian	0.01	0.01	0.03	0.03	0.00
Proportion Hispanic, any race	0.19	0.25	0.25	0.42	0.13
Proportion Black	0.01	0.02	0.05	0.04	0.01

NOTE: National 4dsw population is from Thompson et al., 2020, for the 2012–2019 time period.

Districts identified a convenient date and time to administer the survey to students during the school day; schools identified the most convenient class for online administration (e.g., homeroom, advisory, science). The survey presented students with an assent. Students who agreed to participate in the survey proceed to the items, and administration for students who refused to participate was discontinued. Youth survey responses were available from 34 of 36 districts, with COVID-19 disrupting the survey schedule for two Oklahoma comparison districts. Among the districts that participated in the survey, the response rate in 4dsw districts was 69 percent on average and 76 percent on average for 5dsw districts. Closures due to weather and student absences presented challenges for some districts.

The topics covered by the youth survey included student's satisfaction with the 4dsw (for 4dsw districts only); school climate; family food security; mode and time of student's transportation to school; student's sleep schedule, fatigue, after-school activities, and time in each; student's fifth-day activities and time and cost for each (for 4dsw districts only); student's screen time; student's use of health care; and student's behavior. Table A.5 presents the student characteristics for the 4dsw youth survey and 5dsw youth survey samples along with the student characteristics for the population of 4dsw districts. Appendix C (Kilburn et al., 2021) contains a copy of the youth survey.

Measures

As discussed in Section 5.2, we utilized existing item scales from the SDQ to explore several student well-being domains, including emotional problems and conduct problems, appearing on both surveys, and peer problems and hyperactivity, appearing on the elementary parents survey. We used established approaches to create the scales used for analysis of the SDQ. We calculated scale scores for each student from the item responses given on either the elementary parents survey or the youth survey (Youth in Mind, 2020). We then coded each scale score as to whether it was in the range indicating medium to high difficulty on the scale (also referred to as borderline or abnormal scores). The difficulty categories are based on published cutoff for U.S. reference populations, with either the parent (Bourdon et al., 2005) or the student responding.¹ The high- and medium-difficulty cutoffs are based on the upper 10th and 20th percentiles of the reference population, respectively (Bourdon et al., 2005). We coded an indicator of 1 if the scale score was in the medium- or high-difficulty range, or 0 otherwise. For our surveys, the percentage scoring at least medium ranges from 11.5 percent to 28.8 percent across the four parent-reported and two student-reported scales, disaggregated by district 4dsw status. Our formal models of the survey results inform whether there are statistically significant differences between 4dsw and 5dsw students in the likelihood of experiencing at least medium difficulty on each of the scales.

Survey Design and Analysis

We used the same analysis strategy for the elementary parents survey and youth survey data. As noted earlier, once 4dsw districts were recruited, we use propensity scoring to identify and recruit a 5dsw district in the same

¹ Information on scale creation and difficulty categories was resourced from Youth in Mind, 2020.

state that provided the best available match for each participating 4dsw district. The propensity scores were estimated using a generalized boosting model (a.k.a., a gradient boosting machine; Ridgeway, Madigan, and Richardson, 1999), a nonparametric tree-based machine learning algorithm for identifying optimal functional form. Because the recruited 4dsw districts spanned a series of 4dsw commencement years, we could not run a single propensity score model from which to draw all matches. Instead, we ran a separate propensity score model within each state for each baseline year (i.e., the year before the 4dsw was adopted) present in our recruited 4dsw sample. A common set of district covariates was used to fit all propensity models. These variables are listed in Table A.6 and include school district data from the CCD and local economic conditions from the ACS.

Not all optimal matches were willing to participate, and in some instances, the same 5dsw district was the optimal match for multiple 4dsw districts. We used the fitted propensity scores to guide the selection of the best set of 5dsw matches among those willing to participate. This was often an iterative process, as we received information on whether the individual 5dsw districts we selected were willing to participate. Table A.6 presents the average 4dsw and 5dsw district characteristics among the 36 districts included in our sample, along with two measures of how well the 4dsw and 5dsw district averages for each variable. The first balance measure is a nonparametric Kolmogorov-Smirnov statistic for whether the distribution of a given variable is the same within the 4dsw and 5dsw samples.

The second balance measure is a test for the difference in means between the 4dsw and 5dsw districts. Neither of these measures indicates the presence of imbalance in the form of a formal statistical test. However, the full sample of 36 districts that took the surveys is small and there is little power to detect imbalances should they exist. The final column places the magnitude of the difference in means on an effect size scale. This measure raises the possibility of important practical differences in the district student population and median household income within the district. Several other district characteristics show a relatively large effect size, but the practical significance of the difference is very limited, such as a difference in the average district Black population of 1 percent for 4dsw districts versus 3 percent for 5dsw districts. These variables are included as additional controls in the survey outcome

TABLE A.6 Survey Sample Characteristics and Balance Between District Type

Matching Variable	4dsw	5dsw	KS	Test Statistic	<i>p</i> -Value	Effect Size
Number of schools in the district	2.83	3.17	0.17	0.92	0.36	0.30
Total students	460.22	677.22	0.22	1.22	0.23	0.40
Number of teachers in the district	251.83	270.29	0.22	0.13	0.90	0.04
Revenue per pupil (in thousands)	13.00	13.34	0.17	0.19	0.85	0.06
Student/teacher ratio	13.25	13.32	0.17	0.05	0.96	0.02
Proportion female	0.48	0.48	0.22	-0.32	0.75	-0.10
Proportion Native American	0.12	0.14	0.28	0.39	0.70	0.13
Proportion Asian	0.01	0.00	0.33	-0.48	0.63	-0.16
Proportion Hispanic, any race	0.30	0.25	0.22	-0.51	0.62	-0.17
Proportion Black	0.01	0.03	0.22	1.29	0.21	0.42
Proportion non-Hispanic white	0.56	0.54	0.22	-0.21	0.84	-0.07
Proportion Pacific Islander	0.00	0.00	0.28	-0.87	0.39	-0.29
Proportion two or more races	0.01	0.04	0.22	1.59	0.12	0.52
Proportion English-language learners	0.06	0.07	0.17	0.22	0.83	0.07
Proportion special education	0.16	0.14	0.33	-1.18	0.25	-0.39
Proportion free or reduced lunch	0.71	0.67	0.17	-0.57	0.58	-0.19
Proportion of adults in labor force	0.57	0.55	0.22	-0.39	0.70	-0.13
Median household income (in thousands)	41.96	45.17	0.17	0.92	0.37	0.30
Proportion of families receiving SNAP assistance	0.13	0.11	0.28	-0.94	0.35	-0.31
Proportion of district residents in poverty	0.14	0.13	0.22	-0.47	0.64	-0.16
Proportion of families in poverty	0.21	0.21	0.22	0.07	0.95	0.02

NOTES: SNAP is the federally funded Supplemental Nutrition Assistance Program. KS is the Kolmogorov-Smirnov statistic for whether the 4dsw and 5dsw distribution of the variable is the same. The test statistic is for a test of a difference in means between 4dsw and 5dsw districts, with the associated *p*-value and effect size displayed in the adjacent columns.

models, as discussed later. We examine survey outcomes with three different data types: continuous (e.g., school-night sleep), binary (e.g., whether a student is experiencing food insecurity), and counts (e.g., the number of student absences). A full list of the outcomes considered is in Tables B.1 and B.2. We analyze the continuous survey response data for differences in outcome means using a standard hierarchical generalized linear modeling structure (Raudenbush and Bryk, 2002) with the following foundational system of equations:

$$Y_{ij} = \beta_{0j} + X_{ij} \beta_{1j} + \varepsilon_{ij}$$
(1)

$$\beta_{0j} = \gamma_0 + \gamma_1 I_j + W_j \gamma_2 + \omega_j \tag{2}$$

Here, Y_{ij} is the continuous outcome for the surveyed unit (student or parent) *i* in district *j* with a unit-level vector of covariates X_{ij} . Equation 1 is adapted for binary outcomes by modeling the $logit(Y_{ij})$, and, for count outcomes, by modeling $log(Y_{ij})$, to detect differences in odds ratios and rate ratios, respectively, with the error term ε_{ij} omitted in these cases. The district mean β_{0j} is modeled as a function of 4dsw status I_j and a vector W_j district covariates, including state fixed effects. The 4dsw treatment effect is captured by γ_1 . Our modeling approach differs slightly from more standard doubly robust applications (Bang and Robins, 2005) using propensity matching (Stuart, 2010) in that multiple propensity score models are needed to identify the matches. Table A.7 lists the unit-level (i.e., student) and district variables included in the outcome models.²

Equations (1) and (2) were fit using the lme4 package (Bates et al., 2015) within R (R Core Team, undated). For some outcomes, the fitted model revealed that the district-level variance component was estimated to be 0; that is, the variance of the error term in Equation (2), ω_p , was estimated to be 0.

² Certain matching variables with very low variance were excluded from the outcome models. These are included in Table A.6 but excluded from Table A.7. We also considered incorporating the propensity scores as an additional covariate in the model. As the scores are not exchangeable across baseline years and states, we calculated the percentile of the propensity score for each district in the sample in its respective propensity model and also controlled for this percentile in the outcome models. This propensity score percentile did not provide additional explanatory power after controlling for the covariates indicated in Table A.7.

Student Variables	Data Source	Included in Elementary Parents Survey Models	Included in Youth Survey Models
Number of adults in the household	Elementary parents and vouth surveys	×	×
Family income	Elementary parents	x	
Student grade	Elementary parents survey	×	
Age	Youth survey		x
Gender	Youth survey		x
Hispanic indicator	Elementary parents and youth surveys	×	×
American Indian indicator	Elementary parents and youth surveys	×	×
District Variable			
State		×	x
Total students	CCD	×	x
Number of district schools	CCD	×	×
Proportion free or reduced lunch	CCD	×	×
Proportion special education	CCD	×	×
Proportion female	CCD	×	x
Proportion Hispanic, any race	CCD	×	×
Proportion Native American	CCD	×	×
Proportion English- language learners	CCD	×	×
Student/teacher ratio	CCD	×	×
Revenue per pupil	CCD	×	×

TABLE A.7 Covariates Used in Parent and Student Outcome Models

District Variables			
Median household income	ACS	x	x
Proportion of adults in labor force	ACS	×	×
Proportion of families in poverty	ACS	×	×
Proportion of families receiving SNAP	ACS	×	×

TABLE A.7-Continued

NOTE: ACS is the American Community Survey reported at the school-district level.

In these cases, we instead used a simpler generalized linear model, eliminating the district variance component. Results for all outcome models are found in Tables B.1 and B.2, including an indication of whether the district variance component was ultimately included in the model.

Additional Information About Time Series Analysis

In this part of the technical appendix, we detail the data sources, analytic sample, and statistical approach we used in our time series analysis. We include supplementary results and robustness checks as well.

Data Sources

We leverage publicly available and restricted-access data from multiple sources to construct the analytic sample. In what follows we describe the population, time frame, and information for each data source. Our analysis collectively covers six states: Colorado, Idaho, Missouri, New Mexico, Oklahoma, and South Dakota. We described why we included these six states in the main text of the report.

Four-Day-School-Week Schedules

For each of the aforementioned states, we obtained files that delineated which districts had adopted the 4dsw in each school year. For Idaho and

South Dakota, we were able to obtain yearly lists of 4dsw districts for school years 2009–2010 through 2017–2018, and for the remainder of the states we obtained yearly lists of 4dsw districts for school years 2010–2011 through 2017–2018. These yearly lists allowed us to identify which school districts adopted the 4dsw during our time frame, which had adopted the policy before our time frame, and which never adopted the policy during our time frame. In our analyses we used all years available for each state.

National Center for Education Statistics Common Core of Data We obtained covariate data and selected outcome data from the NCES's CCD. All of these variables were at the district level and included proportion of students who were eligible for free or reduced-priced lunch, proportion identifying as white, total enrollment, and the urbanicity of the district. We also collected the number of full-time-equivalent teaching positions and student-teacher ratio, which were used as outcome measures in the analyses.

American Community Survey

We supplemented the covariates obtained from the CCD with neighborhood estimates from the ACS. Specifically, we used the ACS five-year estimates from 2010 through 2018. Each year's estimates span the calendar year of interest and the four calendar years that precede it. We used estimates for the geographical region that spans the catchment area of each district. The ACS provides the estimates linked to the district's NCES ID. Covariates of interest from the ACS included percentage of households on SNAP, percentage of individuals 16 or older in the labor force, median household income, percentage of families and residents in the district with income below the poverty level, and percentage of families and people with incomes below the poverty level and with related children of the householder under 18 years old.

District Attendance

We used publicly available files from state departments of education to obtain district-level attendance rates over time. We obtained these data for school years that matched the school years for which we have 4dsw schedules for the state. This analysis includes all states except South Dakota because publicly available data from South Dakota only contain a measure of chronic absenteeism and not attendance. The other states define attendance differently:

- Colorado defines the attendance rate as the number of days a student did not miss school for any reason, divided by the number of school days.
- Idaho defines the attendance rate as the student's aggregate daily attendance divided by the total number of days school is in session. If a student attends 4 hours or more of instruction, he or she receives credit for a full day. If a student attends between 2.5 and 4 hours of instruction, he or she receives half a day of credit. If a student attends less than 2.5 hours of instruction, he or she receives no days of credit.
- Missouri takes an hour-by-hour approach to attendance. A student's attendance is calculated by taking the number of hours the student attends school divided by the possible number of hours a student has school.
- New Mexico calculates attendance by taking the total number of days the student was present and dividing by the total number of days of school. A student can earn half a day if he or she is present for half the instructional time.
- Oklahoma calculates the attendance rate as the number of days a student is present divided by the number of days taught. To be considered as having attended for a full day, a student must have attended two-thirds of the morning instructional time and two-thirds of the afternoon instructional time. If a student attends two-thirds of one of the instructional periods, he or she is given a half day of attendance. Further, the student's average daily attendance and membership are weighted by grade for all public schools.

We merge these data via state school district IDs contained in the file.

English Language Arts and Mathematics Achievement

We analyze data on achievement in ELA and mathematics for five states: Idaho, Missouri, New Mexico, Oklahoma, and South Dakota. In order to facilitate comparisons across states, we use data from the EOP at Stanford University (formerly the Stanford Education Data Archive) that link each state's test score data for grades 3–8 to a common scale (Reardon et al., 2021). The scale it uses is the scale for the National Assessment of Educational Progress (NAEP). The EOP provided us with cohort-standardized estimates of performance. These are estimates that are standardized to the average of four national cohorts that were in fourth grade in 2009, 2011, 2013, and 2015. The result is effect sizes relative to the standard deviations of the performance of those national cohorts.

EOP publicly available data contain grade-specific estimates for each district and year but suppress results for district-grade-year cells that are fewer than 20 students. As many of the 4dsw districts and their comparison districts are small and rural, this suppression posed a problem. To avoid suppression, the EOP took the restricted data and pooled the grade-specific estimates to create an overall district-year average. These data would only be suppressed if fewer than 20 students attended an entire district, and this condition did not hold for any of the districts in our analysis sample.

The EOP data were missing estimates from years in which the data the EOP received did not meet its quality-assurance standards. For these reasons, districts in Idaho and South Dakota are missing all test score data in 2014, data for Missouri do not include eighth-grade math scores for 2013–2018, and estimates for Oklahoma do not include eighth-grade math scores for 2012. We did not obtain EOP data directly for Colorado and New Mexico as estimates were not created for all districts for more than one school year because of data quality assurance issues.

We were able to include New Mexico in our analysis because we obtained student-level data directly from the state. We use the following linking procedure detailed in Reardon, Kalogrides, and Ho (2019) and technical documentation obtained directly from the EOP:

- 1. We created district-grade-year scale score averages of student performance on ELA and math state assessments.
- 2. We standardized the scale scores by grade-year so that the resulting distributions have a mean of 0 and a standard deviation of 1.
- 3. We transformed the standardized scores to the NAEP scale score via the following equation:

$$\hat{\mu}_{dygb}^{naep} = \hat{\mu}_{sygb}^{naep} + \frac{\mu_{dygb}^{state}}{\sqrt{\hat{\rho}_{sygb}^{state}}} \cdot \hat{\sigma}_{sygb}^{naep}.$$
 (1)

Where $\hat{\mu}_{dygb}^{naep}$ is an estimate of the state test score on the NAEP scale for district *d* in year *y* for grade *g* and subject *b*, $\hat{\mu}_{sygb}^{naep}$ is the estimate of the state's average NAEP score, μ_{dygb}^{state} is the standardized district score calculated in step 2, $\sqrt{\hat{\rho}_{sygb}^{state}}$ is an estimate of the reliability of the state standardized tests, and $\hat{\sigma}_{sygb}^{naep}$ is an estimate of the standard deviation of the state's average NAEP score. The $\hat{\mu}_{sygb}^{naep}$, $\hat{\rho}_{sygb}^{state}$, and $\hat{\sigma}_{sygb}^{naep}$ parameters were provided by the EOP.

4. We created the aforementioned cohort-standardized estimates of the NAEP scores via the following transformation:

$$\hat{\mu}_{dygb}^{cs} = \frac{\hat{\mu}_{dygb}^{naep} - \hat{\mu}_{avg,gb}^{naep}}{\hat{\sigma}_{avg,gb}^{naep}}.$$
(2)

Where $\hat{\mu}_{dygb}^{cs}$ is the cohort-standardized estimate, $\hat{\mu}_{dygb}^{naep}$ is the NAEP scale score calculated in step 3, $\hat{\mu}_{arg,gb}^{naep}$ is the average NAEP scale score of the aforementioned reference cohort, and $\hat{\sigma}_{avg,gb}^{naep}$ is the standard deviation of the average scale score of the reference cohort. Again, we obtained $\hat{\mu}_{avg,gb}^{naep}$ and $\hat{\sigma}_{arg,gb}^{naep}$ directly from the EOP.

5. Finally, for each district, we pool all grade-year estimates and calculate an estimate of the yearly district performance with the following pooling model:

$$\widehat{mn}_{dgyb} = \beta_1 (grade - 5.5) + \mathbf{YB} + \varepsilon_{dgyb}.$$
(3)

Where \widehat{mn}_{dgyb} represents the district-grade-year-subject average calculated in step 4, grade -5.5 is the grade level centered on 5.5, **Y** is a vector of year fixed effects, and ε_{dgyb} is an idiosyncrative error term. We use 5.5 as the centered grade level because it is the midpoint between grades 3-8 for which we have test score data. The yearly district averages are the vector of coefficients on the year fixed effects, **B**. We use these estimates in our statistical models.

We were not able to link test scores from Colorado to the NAEP via this method because we were only able to find publicly available grade-level data. Those data suppressed results for any grade that served fewer than 16 people, which resulted in a suppression rate that was too high to include in our analyses. Colorado is therefore not included in the analysis of test score outcomes.

The EOP provided us with estimates and parameters for school years 2008–2009 through 2017–2018. For each state, we used the estimates that comported with the time period for which we had 4dsw adoption schedules.

Constructing the Analytic Data Set

Defining Pool of Four-Day-School-Week Districts and Possible Comparison Districts

The analytic data set was created by merging the data sources described earlier using the district identifiers assigned by the NCES and states. The resulting data set contained one observation per district per year. The earliest year in the data set was the 2009–2010 school year and the latest was the 2017–2018 school year. The districts in the analytic data set were restricted in the following ways:

- 1. Only traditional public school districts were included in the analysis. All charter school districts and alternative school districts were excluded.
- 2. Of the remaining districts, only those with an NCES urbanicity code of "town" or "rural" were kept. Those with a code of "city" or "suburban" were dropped. The vast majority of 4dsw districts had the chosen urbanicity codes, which indicates that this pool of districts contains the most appropriate comparison school districts. This restriction has been used in other studies of the 4dsw, such as Morton (2021).
- 3. As at least one year of baseline data is needed for matching, the analysis contains districts that adopted the 4dsw between the 2010–2011 and 2017–2018 school years in Idaho and South Dakota and between the 2011–2012 and 2017–2018 school years in other states. Thus, any district that had adopted the 4dsw before these time periods were dropped.

After applying these restrictions, the data contained the districts that adopted the 4dsw during the aforementioned time period and a pool of *possible* comparison districts. In the next section we explain the process of choosing the final set of comparison districts used in the analyses. Importantly, these comparison districts had never adopted 4dsw during the aforementioned time period.

Choosing Matched Comparison Districts

One approach is to use all of 5dsw districts that satisfied the above conditions as comparison districts in our models. When estimating these models, however, we found evidence that the common trends assumption underpinning these models may be violated. First, we find that district covariates between 4dsw and 5dsw districts are not balanced in the difference-in-difference framework. Second, event study models on this full sample show a prominent upward pre-trend in student achievement. Given these results, we opted to use nearest-neighbor matching with replacement via propensity scores to identify the 5dsw districts that were most similar to the 4dsw districts. We used the following procedure:

- 1. Within each state, cycle through each year starting from the earliest.
- 2. For each year, identify the 4dsw districts for which that year serves as the *baseline* year (i.e., districts adopted the policy the next year).
- 3. Using the 4dsw districts identified in step 2 and all possible comparison districts (excluding 5dsw districts that adopt 4dsw in subsequent years), predict take-up of the 4dsw with a probit model. Predictor variables in the probit are attendance, ELA, and math. Two values for each predictor variable were used, one from the earliest year for that state and the other from the baseline year for the 4dsw districts included in that cohort.
- 4. Predict the propensity scores from the probit model.
- 5. Perform a nearest-neighbor match with replacement based on the propensity scores from the probit model.
- 6. After iterating through each year, for each state, compile the data set that contains the 4dsw districts and their matched comparison districts.

By using matching with replacement, we ensured that only the best comparison matches were included in the analyses. Further, the order of years in which we cycled through the cohorts would not systematically affect the quality of matches across cohorts, as would be the case if we matched without replacement. Though this process resulted in fewer comparison school districts than 4dsw districts, the number of comparison districts was of sufficient size to support our analyses.

We used a parsimonious model when calculating propensity scores from probit models because in many cases only a few districts adopted the 4dsw within a state-year cell.³ The variables used provided the best balance among covariates. We included the first year and the baseline year values for each covariate to account for a trend in each variable during the pre-period.⁴

Table A.8 shows the final analytical sample, by 4dsw status and state. Across all states the analytic sample contains 206 4dsw districts and 170 comparison districts for a total of 376 districts. In absolute terms, Oklahoma experienced the greatest increase in 4dsw adoption, with 85 school districts adopting the policy during this time frame. New Mexico experienced the smallest increase, with 15 districts adopting the policy during this time period.

Table A.9 shows the covariate balance between the 4dsw districts and matched 5dsw districts in the analytic sample in the baseline year. Of the eight characteristics tested, only one, the total number of students enrolled in the district, is statistically significantly different. Districts that adopted the 4dsw are significantly smaller than their matched 5dsw counterparts. Our identification strategy, detailed later, does not necessarily require balance on baseline measures; rather, it requires balance on trends in measures. We later show that total number of students in the district is also balanced within the statistical framework used to identify effects of the 4dsw policy. While they were not used as covariates in the time series models, we also

³ Generalized boosted models (GBMs) were used in selecting the matched comparison group for the survey effort because all districts that adopted the 4dsw policy up to a certain year were included in the propensity score models. This larger set of 4dsw districts allowed a fuller set of covariates to be used in the models and generalized boosted models created better balance on covariates.

⁴ There were some exceptions to the predictor variables used in the matching. As South Dakota does not have attendance data, probit models for that state only contain ELA and math scores. As Colorado does not have ELA and math scores, probit models for that state contain attendance, full-time-equivalent teachers, and student-teacher ratios. In 2013, models in New Mexico would only converge if the probit model contained only attendance in 2011.

State	Number of 4dsw Districts	Number of Comparison Districts	Total
Colorado	31	20	51
Idaho	29	18	47
Missouri	26	26	52
New Mexico	15	11	26
Oklahoma	85	78	163
South Dakota	20	17	37
Total	206	170	376

TABLE A.8 Time Series Analytic Sample Size by State and District Type

TABLE A.9 Time Series Characteristics and Balance Between District Type

District Characteristic	4dsw	5dsw	<i>p</i> -Value	Effect Size
Proportion free or reduced- price lunch	0.626	0.614	0.538	0.064
Proportion non-Hispanic white	0.659	0.652	0.796	0.027
Total students	586.66	947.34	0.005	-0.307
Proportion of families receiving SNAP assistance	12.470	12.536	0.924	-0.010
Percent of 16+ in labor force	57.748	58.317	0.501	-0.070
Median household income (in thousands)	43,005.92	44,301.77	0.185	-0.139
Proportion of district residents in poverty	0.123	0.127	0.442	-0.082
Proportion of families with children in poverty	0.193	0.198	0.605	-0.054

examined balance for percentage Hispanic ethnicity and percentage Native American students and did not find that they were significantly different in 4dsw and 5dsw districts in our sample.

Matched Difference-in-Difference and Event Study Analyses

Using the 4dsw districts and their matched comparison districts in the analytic sample, we estimate the effect of the 4dsw on five outcomes of interest: attendance rates, performance on grades 3–8 state ELA tests, performance on grades 3–8 state math tests, number of full-time-equivalent teachers, and student-teacher ratios.

Our main analyses leverage event study models of the following form (Callaway and Sant'Anna, in press; Gopalan, Rosinger, and Ahn, 2020):

$$Y_{dt} = \sum_{\tau=-x, \tau\neq 0}^{y} \delta_{\tau} 4 ds w_{dt}^{\tau} + X_{dt} \beta_{1} + \alpha_{d} + \gamma_{t} + \varepsilon_{dt}.$$
 (4)

Where Y_{dt} is the outcome of interest for district *d* in year *t*; X_{dt} is a vector of time-varying district and neighborhood covariates including percentage of students eligible for free or reduced-priced lunch, percentage white, enrollment, proportion of individuals and households on SNAP, proportion of individuals 16 or older in the labor force, median household income, percentage of individuals and families with incomes under the poverty line, and percentage of individuals and families with children under 18 and incomes below the poverty line;⁵ α_d are district fixed effects; γ_t are year fixed effects; and ε_{dt} is a district-level idiosyncratic error term. Further, we center time, τ , on the year before a 4dsw district adopts the policy such that $4dsw_{dt}^{\tau}$ are indicator variables of the distance in years from that centered time. Thus, $4dsw_{dt}^{-1}$ is the indicator for two years before adopting the 4dsw, $4dsw_{dt}^{0}$ the year before adopting the policy, $4dsw_{dt}^{1}$ the first year after adopting the policy, and so forth. For all districts that never adopted the policy during our time period, all observations take the form of $4dsw_{dt}^{0}$, which is also the

⁵ There was a small amount of missing covariate data from the CCD and ACS files. We therefore performed multiple imputation via Stata's *mi* command. No missing outcome data were imputed.

omitted category. This model estimates the outcomes separately for each year before and after adopting the 4dsw, minus stable differences between districts and years. For example, $4dsw_{dt}^{-1}$ will estimate the difference in outcomes between 4dsw districts two years before adopting the policy and the 5dsw districts in the sample. Similarly, $4dsw_{dt}^1$ will estimate the difference in outcomes between 4dsw districts one year after adopting the policy and the 5dsw districts in the sample. In our models, τ ranges from -5 to 8, thus estimating effects from 6 years before the adoption of the policy to 8 years after. We cluster standard errors at the district level to account for the multiple observations over time per district.

The identifying assumption is that outcomes of comparison districts are a valid counterfactual for the outcomes of 4dsw adopters. Illustrating a common pre-trend in outcomes between the two groups provides some evidence for this assumption. This model allows for a test of this assumption. If the comparison and 4dsw districts were experiencing parallel trends in outcomes before the adoption of the policy, we would expect $\delta_{\tau}=0$ for all $\tau<0$. Choosing a comparison group that is as similar as possible to the treatment group also increases the probability of satisfying this assumption. In this case comparison districts were limited to be of similar urbanicity as the 4dsw districts. Among that pool of comparison districts, our matching procedure chose the districts that are closest in terms of pre-trends in three of the five outcomes for each 4dsw district.

Conversely, any factor that differentially affects the two groups over time would undermine the identification strategy. The inclusion of X_{dt} partially safeguards against this possibility because it contains a broader set of time-varying district and neighborhood characteristics beyond those used for matching. Further, these characteristics account for the size of the district as well as the racial and economic makeup of the district and neighborhood, factors that are highly predictive of student outcomes. Thus, any unobserved time-varying factors would have to predict take-up of the 4dsw and affect student outcomes beyond the matching based on pre-trends in the outcomes and the time-varying characteristics in the model.

In addition to this event analysis model, we also estimate a traditional difference-in-difference specification of the following form:

$$Y_{dt} = \beta_0 + \beta_1 \, 4ds w_{dt} + X_{dt} \, \beta_2 + \alpha_d + \gamma_t + \varepsilon_{dt}.$$
⁽⁵⁾

All variables in this model are identical to those in equation (4), except now $4dsw_{dt}$ is an indicator variable for whether a district has adopted the 4dsw in a particular year. For all years before adopting the policy, the indicator takes on a value of 0, and for all years after adopting the policy, the indicator takes on a value of 1. Again, comparison districts take on a value of 0 for all years. This model will compare the trends in outcomes of 4dsw districts before and after the adoption of the policy with those in comparison districts. The identifying assumptions of this model, and our approach to satisfying those assumptions, are identical to those of the event study model. This model, however, does not estimate the effect of the 4dsw policy separately in each year. Instead the coefficient of interest, β_1 , is the average, linear effect of the 4dsw on outcomes. We estimate these effects for completeness and to provide a point of comparison to effect estimates from similar models seen in previous studies of the 4dsw. Once again, all standard errors are clustered at the district level to account for the multiple observations of each district over time.

In sum, we consider the traditional event study models as our main specification, with the traditional difference-in-difference estimate included to aid a complete comparison with the previous literature. We include the Callaway and Sant'Anna (in press) inverse probability weighted and regression version of the event study models and the difference-in-difference estimates to ensure that bias in the traditional estimates is not driving our results.

Potential Bias in Difference-in-Difference and Event Study Analyses

Recent scholarship has indicated that difference-in-difference estimands and event study estimands may be biased in situations where a policy adoption is staggered throughout time, as is the case with the 4dsw. In particular, bias may occur if treatment effects differ by treated units or if treatment effects differ over time (Baker, Larcker, and Wang, 2021; Callaway and Sant'Anna, in press). Theoretically both types of bias are possible in our situation. There is no theoretical reason to believe that the effects of the 4dsw will be identical for every district that adopts it, nor is there a reason to believe that the treatment effects would be the same for each cohort of adopters. Several procedures have been posited in the literature that would account for these sources of bias to recover unbiased estimates (see Baker, Larcker, and Wang, 2021). The relative novelty of this line of literature means that no one solution has yet been accepted as standard.

To ensure that the effects seen in our study are not driven by bias, we implement two alternative estimands detailed in Callaway and Sant'Anna (in press). We choose these estimands because this flexible approach is more general and rests on some weaker assumptions than other proposed estimands (Callaway and Sant'Anna, in press) such as those proposed by de Chaisemartin and D'Haultfoeuille (2020) and Sun and Abraham (2020). This approach involves estimating the effects for each cohort of adoptees and aggregating cohort-specific effects to one final estimate. In particular, we employ (1) the "outcome regression" estimand, which relies on the regression model to properly specify the conditional expectation of the outcome evolution for the comparison groups, and (2) the inverse probability weighted estimand, which models the conditional probability of belonging to a cohort of adopters. Callaway and Sant'Anna also posit a third doubly robust estimator that exploits and combines both of the previous approaches, but these models would not converge with our data. The authors note that any of the three estimands will produce unbiased estimates, though with slightly different assumptions. In Appendix B we present the robustness of our main results.

APPENDIX B

Detailed Results

This appendix reports more detailed results of the analysis.

Detailed Results in Chapter Four

Elementary Parents Survey and Youth Survey Results

Two survey outcomes, absences and use of the fifth day for medical appointments, were discussed in Chapter Four. Table B.1 provides additional documentation of these results, including the confidence intervals displayed graphically in Chapter Four and whether the district variance component was included in the final model (see the Survey Design and Analysis section of Appendix A for discussion on inclusion of the district variance component).

TABLE B.1(a) Survey Modeling Results for Chapter Four Count Outcomes

Outcome	District Variance Survey Component Source Included		Rate Ratio Estimate	95% CI	Appears in Report Section
Days absent	Elementary parents	Yes	0.738*	(0.624, 0.872)	4.3
	Youth	Yes	0.818*	(0.670, 0.999)	

NOTE: * Indicates p < 0.05.

Outcome	Survey Source	District Variance Component Included	Odds Ratio Estimate	95% CI	Appears in Report Section
Fifth-day doctor's appointment	Elementary parents	Yes	19.929*	(10.001, 39.715)	4.3
	Youth	Yes	11.588*	(5.330, 25.194)	

TABLE B.1(b) Survey Modeling Results for Chapter Four Binary Outcomes

NOTE: * *p* < 0.05.

Satisfaction with the Four-Day School Week

When asked, "How much has the four-day school week met the needs of your family?" 74 percent said, "I like it a lot"; 19 percent said, "I mostly like it"; 4 percent said, "I neither like it nor dislike it"; and 3 percent said, "I don't like it that much" (Figure B.1).

Detailed Results in Chapter Five

Elementary Parents Survey and Youth Survey Results

Multiple survey outcomes were discussed in Chapter Five. Table B.2 provides additional documentation of these results, including the confidence intervals displayed graphically in Chapter Four and whether the district variance component was included in the final model (see the Survey Design and Analysis section of Appendix A for discussion on inclusion of the district variance component).

Academic Achievement

Event Study Results

Figure B.2 shows the main results across all five outcomes. The figures for the attendance rate, ELA, and math outcomes are reproductions of those in the main body of the report. As stated in the report, event study analyses show no differential pre-trends in attendance rates or ELA and math performance. After the adoption of the 4dsw, there are few statistically significant effects in attendance. Generally, there is a pattern where estimates increase

FIGURE B.1 Responses to the Question, "How Much Has the Four-Day School Week Met the Needs of Your Family?"



SOURCE: Elementary parents survey, N = 764.

over time and become significant only in year seven. In contrast, ELA and math achievement levels begin a downward trend immediately after adoption of the 4dsw, with estimates becoming significant starting in year three.

Pre-trends for the number of full-time-equivalent teachers and the student-teacher ratio indicate that our models may not completely satisfy the common trend assumption. Though no estimate is significant, there is a positive pre-trend for each of these outcomes. After adoption, the positive trend continues for each, with the effect on full-time-equivalent teachers reaching significance starting in year seven. No postadoption estimate is significant for the student-teacher ratio. Given the pre-trends observed, however, we refrain from making any strong claims that the policy caused an increase in full-time-equivalent teachers in later years.

Finally, Figures B.3–B.7 present these results for each state individually. We organize these graphs by outcome so as to facilitate cross-state

Outcome	Survey Source	District Variance Component Included	Difference in Means Estimate	95% CI	Appears in Report Section
School-week sleep hours	Elementary parents	Yes	1.486*	(0.675, 2.297)	5.2
	Youth	Yes	0.150	(–1.672, 1.973)	
Fifth-day sleep hours	Elementary parents	Yes	1.334*	(0.999, 1.669)	5.2
	Youth	Yes	1.126*	(0.716, 1.536)	
School-night sleep hours	Elementary parents	Yes	0.040	(–0.118, 0.198)	5.2
	Youth	Yes	-0.250	(-0.634, 0.134)	
Parent stress	Elementary parents	Yes	-0.646	(–1.459, 0.167)	5.3
Family Engagement (Panorama)	Elementary parents	No	-0.079	(-0.266, 0.108)	5.4

TABLE B.2(a) Survey Modeling Results for Chapter Five Continuous Outcomes

NOTES: * p < 0.05. "Panorama" indicates that the Panorama Family-School Relationships Survey was used as a resource for the outcome.

comparisons. Because of the smaller sample sizes, both pre- and post-trends are noisier, precluding strong conclusions on any one state. Further, the quality of pre-trends varies by outcome and state. However, the results indicate that a single state is not driving any particular result, with many states exhibiting similar trends in outcomes. These results illustrate the efficiencies gained by pooling data across states, thus increasing sample size and reducing the influence of statistical noise.

Difference-in-Difference Results

Before presenting the main results from the difference-in-difference specifications, we present covariate "balance" tests as a partial test of the validity of the model. In these models we remove the vector X_{dt} from equation (5) and iteratively place each element of that vector as an outcome in the remaining difference-in-difference specification in equation (5). One would not expect

Outcome	Survey Source	District Variance Component Included	Odds Ratio Estimate	95% Cl	Appears in Report Section
Food insecurity	Elementary parents	Yes	0.910	(0.501, 1.655)	5.2
	Youth	No	1.133	(0.761, 1.686)	
Feeling tired	Elementary parents	No	2.678	(0.858, 9.097)	5.2
	Youth	No	0.598*	(0.424, 0.840)	
Feeling tired K-grade 1 only	Elementary parents	Yes	5.690	(0.664, 48.759)	5.2
Emotional problems (SDQ)	Elementary parents	No	0.950	(0.502, 1.815)	5.2
	Youth	No	0.917	(0.617, 1.362)	
Conduct problems (SDQ)	Elementary parents	No	0.920	(0.474, 1.800)	5.2
	Youth	No	0.815	(0.520, 1.275)	
Peer problems (SDQ)	Elementary parents	No	0.817	(0.485, 1.381)	5.2
Hyperactivity (SDQ)	Elementary parents	No	1.257	(0.635, 2.547)	5.2
Physical activity	Youth	No	1.137	(0.801, 1.614)	5.2
Positive student learning environment	Elementary parents	No	1.064	(0.566, 1.990)	5.4
(CSCHLS)	Youth	Yes	1.065	(0.652, 1.738)	
Positive interpersonal relationships (CSCHLS)	Youth	Yes	1.168	(0.636, 2.145)	5.4

TABLE B.2(b) Survey Modeling Results for Chapter Five Binary Outcomes

NOTE: * *p* < 0.05.





NOTES: Standard errors are clustered at the district level. All regressions include district and year fixed effects. Covariates include percent free or reduced priced lunch, percent non-Hispanic white, and enrollment in the district. Covariates also include percent of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income.





NOTES: Standard errors are clustered at the district level. All regressions include district and year fixed effects. Covariates include percentage free or reduced-price lunch, percentage non-Hispanic white, and enrollment in the district. Covariates also include percent of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income.





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NOTES: Standard errors are clustered at the district level. All regressions include district and year fixed effects. Covariates include percentage free or reduced-price lunch, percentage non-Hispanic white, and enrollment in the district. Covariates also include percentage of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income.

the 4dsw policy to affect these district and neighborhood background characteristics. Thus, in these models we would expect β_1 to be quantitatively small and statistically insignificant. Tables B.3 and B.4 shows the results overall and by state, respectively. Overall the covariates look balanced when pooling states. The only state that has a more substantial imbalance is Colorado. In that state, the percentage free or reduced-priced lunch and district enrollment is significant to the 5 percent level. Recall that the matching models could not include test scores of ELA and math in Colorado, potentially contributing to the less favorable covariate balance.

Table B.5 presents the results on our five outcomes of interest across all states. The only effects that approach statistical significance are on mathematics achievement. Without covariates, the 4dsw decreases math scores by 0.046 standard deviations (p < .05). After controlling for covariates, the estimate remains relatively stable at -0.044 (p < .10). Though the effect on ELA scores is about half the size and statistically insignificant, the results are directionally consistent with the negative effects seen in the event study models. Further, though the effects on attendance rates are an insignificant 0.4 percentage points, directionally these are consistent with the potentially positive effects seen in the event study models. Effects on full-time-equivalent teachers are again indeterminate.

Looking at difference-in-difference results across states (Table B.6), the limited sample size precludes strong conclusions on any one variable. Across most states, estimates on the performance on ELA and math assessments are directionally negative. They only approach statistical significance in Oklahoma with an estimate of -0.049 standard deviations (p < .10). These results confirm that the overall negative results are not driven by any one state in particular. Also, in accordance with the overall results, estimates on attendance are largely null or positive. Only in New Mexico do they approach significance where the estimate reaches a 0.7 percentage point increase in attendance (p < .10) when controlling for covariates. Overall, however, one state is not driving the directionally positive results seen in the aggregate results. The results on full-time-equivalent teachers and student-teacher ratios are more indeterminate, with some states producing positive estimates and others producing negative estimates. No estimate on full-time-equivalent teachers is consistently positive, and the only estimate on student-teacher ratios that approaches significance is in New Mexico.

TABLE B.3 Covariate Balance in Difference-in-Difference Framework, All States

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(8)	(9)	
	Percentage free or reduced-price lunch	Percentage non-Hispanic white	Enrollment	Percentage on SNAP	Percentage in labor force	Median household income	Percentage income below poverty	Percentage poverty with children	
Adopt 4dsw	0.011 (0.008)	0.000 (0.003)	–3.886 (6.673)	0.164 (0.331)	-0.557 (0.357)	-632.880 (432.868)	0.294 (0.344)	1.219 (0.645)	
Observations	3,011	3,013	3,014	2,996	2,996	2,996	2,996	2,996	
R-squared	0.878	0.985	0.998	0.848	0.870	0.878	0.794	0.710	

NOTES: * p < 0.05. Standard errors are clustered at the district level. All regressions include district and year fixed effects. Observations are district-year observations.

	(1)	(2)	(3)	(4)	(5)	(6)	(8)	(9)	
Variables	Percentage free or reduced- price lunch	Percentage non-Hispanic white	Enrollment	Percentage on SNAP	Percentage in labor force	Median household income	Percentage income below poverty	Percentage poverty with children	
Colorado	0.046*	0.011	-45.217*	0.800	-0.548	–1,130.009	0.667	1.455	
	(0.018)	(0.007)	(21.012)	(0.851)	(0.695)	(1,250.378)	(0.911)	(1.625)	
Idaho	-0.029	-0.006	-7.791	0.615	-0.972	–996.937	0.244	0.284	
	(0.021)	(0.009)	(15.521)	(0.805)	(1.408)	(1,113.754)	(0.755)	(1.861)	
Missouri	0.003	-0.003	0.596	-0.856	-0.289	–216.713	-0.447	1.847	
	(0.023)	(0.006)	(9.599)	(0.720)	(0.773)	(1,173.398)	(0.799)	(1.700)	
New Mexico	0.030	0.001	–27.077	–2.511	-1.498	1,414.784	–1.472	0.330	
	(0.028)	(0.010)	(60.143)	(1.337)	(1.232)	(2,291.278)	(1.265)	(3.129)	
Oklahoma	-0.001	0.002	16.090	0.151	0.109	–184.107	0.444	1.437	
	(0.011)	(0.006)	(8.600)	(0.525)	(0.523)	(661.602)	(0.587)	(1.008)	
South Dakota	0.031	-0.006	-3.301	0.686	-1.172	–1,768.570	1.679	2.070	
	(0.024)	(0.007)	(11.046)	(0.893)	(1.030)	(1,184.193)	(1.308)	(2.623)	

TABLE B.4 Covariate Balance in Difference-in-Difference Framework, by State

NOTES: * p < .05. Standard errors are clustered at the district level. All regressions include district and year fixed effects. Observations are district-year observations.

TABLE B.5 Effects of the Four-Day School Week on Outcomes, Difference-in-Difference, All States

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	Attenda	nce rate	Full-time eo teach	Studen	t-ratio	ELA		Math		
4dsw	0.004 (0.004)	0.004 (0.004)	-0.103 (0.512)	0.065 (0.426)	0.377 (0.296)	0.497 (0.323)	-0.029 (0.018)	-0.028 (0.018)	-0.046* (0.022)	-0.044 (0.023)
Observations	2,702		3,011		3,005		2,441		2,439	
R-squared	0.281		0.996		0.476		0.773		0.769	
Covariates		×		×		×		×		×

NOTES: * *p* < 0.05. Standard errors are clustered at the district level. All regressions include district and year fixed effects. Observations are district-year observations. Covariates include percentage free or reduced-price lunch, percentage white, and enrollment in the district. Covariates also include percentage of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income. Missing covariates imputed with multiple imputation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Variables	Attendance rate		Full-time equivalent teachers		Student-ratio		ELA		Math		N
Colorado	0.005 (0.014)	-0.002 (0.009)	-2.479* (1.072)	–1.425 (0.904)	-0.388 (0.448)	0.002 (0.249)	_	_	_	_	400-402
Idaho	0.008 (0.022)	0.009 (0.022)	0.450 (1.349)	0.742 (1.122)	0.086 (0.336)	0.147 (0.343)	-0.027 (0.035)	-0.044 (0.030)	-0.017 (0.048)	-0.035 (0.043)	343–422
Missouri	0.006 (0.007)	0.006 (0.007)	-0.421 (0.802)	-0.165 (0.833)	0.314 (0.369)	-0.227 (0.468)	-0.014 (0.041)	-0.019 (0.036)	-0.024 (0.040)	-0.024 (0.037)	394–400
New Mexico	0.006 (0.004)	0.007 (0.004)	4.502 (5.634)	4.714 (3.843)	-0.535* (0.239)	-0.509 (0.251)	-0.079 (0.111)	-0.084 (0.125)	-0.240 (0.220)	-0.238 (0.197)	177–200
Oklahoma	-0.000 (0.001)	-0.000 (0.001)	0.686 (0.541)	0.299 (0.449)	0.710 (0.678)	-0.295 (0.421)	-0.018 (0.025)	-0.021 (0.025)	-0.049 (0.029)	-0.049 (0.030)	1262–1280
South Dakota	_ _	_ _	0.246 (0.731)	0.393 (0.893)	0.102 (0.323)	0.182 (0.307)	0.006 (0.050)	-0.005 (0.050)	-0.022 (0.054)	-0.031 (0.053)	263–309
Covariates		x		×		x		×		×	

TABLE B.6 Effects of the Four-Day School Week on Outcomes, Difference-in-Difference, by State

NOTES: * *p* < 0.05. Standard errors are clustered at the district level. All regressions include district and year fixed effects. Observations are district-year observations. Covariates include percentage free or reduced-price lunch, percentage white, and enrollment in the district. Covariates also include percentage of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income. Missing covariates imputed with multiple stochastic imputation.

When controlling for covariates, there the 4dsw decreases the student–teacher ratio by about 0.510 students (p < .10).

Consistency of Oklahoma Results with Prior Research

A recent analysis of the 4dsw in Oklahoma by Morton (2021) shows qualitatively different results from those seen in this study. Morton analyzed districts that adopted the 4dsw between 2008–2009 and 2015–2016 and estimated the effect on ELA and math scores. Her analysis found null results. This is in contrast to our overall negative effects on student achievement, which we also observe in our Oklahoma-specific results. Figures B.4 and B.5 show a negative trend in achievement on ELA and math in Oklahoma that becomes substantial in later years but largely remain insignificant because of limits on statistical power. Similarly, difference-in-difference estimates in Table B.6 show directionally negative effects in ELA and math, with a marginally significant –0.049 standard deviation decrease in math scores.

Both studies use similar modeling strategies, leaving the difference in time periods analyzed as a possible source for the discrepancy in results. In order to interrogate whether this is the case, we re-create Morton's results to the extent possible. We do this by truncating our sample at the 2015–2016 school year and analyzing results on districts that adopted the 4dsw between 2010–2011 and 2015–2016. We then employ the event study models on two samples. The first sample contains all comparison districts after eliminating suburban and city districts. This is akin to Morton's preferred sample. The second sample is applying our matching strategy to this pool of potential comparison districts to ensure that our matching method does not yield different results. If results on both samples yield null estimates, then the differences in time periods analyzed likely account for the differences in results seen between the two studies.

Figure B.8 presents the results of the event study model on both samples in ELA. All estimates in both the pre- and post-periods are quantitatively small and insignificant, implying that there is no effect on achievement when using Morton's preferred sample or applying our matching algorithm to her preferred sample. Figure B.9 presents the results of the event study model on both samples in math. With the exception of the estimate in year five, we see the same pattern for math outcomes. Thus, overall, we are able to largely re-create Morton's null results with the portion of Oklahoma 4dsw districts that overlap in both studies.



These results indicate that including later years, not yet available at the time of Morton's publication, may change the inferences made in her analyses. Further, a substantial number of districts have adopted the 4dsw in Oklahoma in the past few years. Our data indicate that between the 2010–2011 and 2015–2016 school years, 37 districts adopted the 4dsw policy.

	(1)	(4)	(6)	(8)	(10)
	Attendance	Full-time equivalent teachers	Student- teacher ratio	ELA	Math
Original estimates	0.004 (0.004)	0.065 (0.426)	0.497 (0.323)	-0.028 (0.018)	-0.044 (0.023)
Outcome regression	0.0107 (0.0112)	-0.8118 (1.3725)	0.292 (0.450)	-0.0867* (0.0234)	-0.0993* (0.0276)
Inverse probability of treatment	0.0085 (0.0112)	–0.5575 (1.515)	0.2074 (0.4748)	-0.0565* (0.0233)	-0.0517 (0.0293)
Observations	2,702	3,011	3,005	2,441	2,439
Covariates	×	×	×	×	×

TABLE B.7 Robustness of Difference-in-Difference Estimates, All States

NOTES: * p < 0.05. Standard errors are clustered at the district level. All regressions include district and year fixed effects. Observations are district-year observations. Covariates include percentage free or reduced-price lunch, percentage white, and enrollment in the district. Covariates also include percentage of district catchment area on SNAP, in labor force, with incomes below the poverty line, with households with income below the poverty line with children, and median household income. Missing covariates imputed by yearly mean.

This comports with Morton's study that analyzed the effect among 49 4dsw districts. Our data indicate that another 48 districts adopted the 4dsw between the 2016–2017 and 2017–2018 school years. Thus, including two additional years would double the number of 4dsw districts in her analyses.

Consistency of Results with Callaway and Sant'Anna Estimands As stated in Appendix A, recent scholarship has indicated that traditional difference-in-difference and event study estimates may be biased in situations where a policy is adopted in different geographic locations at different times. Here we investigate the robustness of our results to two estimands in Callaway and Sant'Anna (in press). Callaway and Sant'Anna note that both should recover unbiased estimates, though with slightly different assumptions.

Table B.7 shows how the pooled estimates from these estimators compare with our traditional difference-in-difference estimates. Pooled estimates were calculated by taking average cohort-specific effects and averaging them across cohorts. The results show that for attendance, ELA, and math, estimates from robustness checks are of the same sign and larger in magnitude. In some models, the robustness checks show significant effects where the original estimates did not. In all cases, the standard errors of the alternative estimates are larger. These results indicate that original difference-in-difference results may be biased toward zero and larger and more significant negative effects are possible.

Results are less robust for the full-time-equivalent teacher and studentteacher ratio outcomes. Full-time-equivalent teacher estimates in the robustness regression are larger and of the opposite sign compared with the original estimates. Student-teacher ratio estimates are about half the size in the robustness checks, though of the same sign. In all cases, no estimate is significant. These results indicate that our original estimates for these outcomes have potentially more bias, though we refrained from making inferences on our original estimates.

Figure B.10 shows the robustness of the event study estimates to the Callaway and Sant'Anna (in press) estimators. In these plots, each color represents the results from the original model, the outcome regression robustness model, or the inverse probability weighted robustness model. Filled dots indicate that the estimate is statistically significant, and unfilled dots indicate estimates are not statistically significant.

Results show that all estimates on attendance are robust except for the estimate eight years after adoption of the 4dsw policy. Robustness estimates are either smaller or even negative in that case. As most of the estimates in the original event study were not significant, we did not find evidence that the policy influenced attendance.

Results on achievement in math and ELA are also of approximately the same magnitude in robustness models. In some cases, robustness estimates are larger and in other cases they are slightly smaller. However, the significance of the estimates from the original event study models is not consistently re-created in the robustness models because the robustness models produce larger standard errors. In total, the preponderance of evidence indicates that results are negative with a downward trend over time (i.e., the magnitude of the negative effects gets larger over time in absolute value), though statistical significance varies by model.

Results on student-teacher ratios are more robust in that all models show a small, positive, but insignificant increase in the ratio in all years

FIGURE B.10 Robustness of Event Study Estimates, All States





FIGURE B.10-Continued

except the last year. In addition, the robustness models provide cleaner pre-trends than the original event study model. However, because of the statistical insignificance of all estimates, we do not make inferences on this outcome.

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Advocates of the 4dsw argue that the shorter week saves money, improves student attendance, and helps recruit and retain teachers in rural districts. Cost savings related to the four-day model were relatively small, but savings due to a 4dsw may be used to maintain the level of instructional expenses in the face of revenue shortages. There was no quantitative evidence that the 4dsw improved student attendance.

Qualitative data supported the view that the model helps attract and retain teachers. Families and students reported highly valuing the extra time that the 4dsw allowed them to spend together, and the data showed that, overall, stakeholders experienced high levels of satisfaction with the 4dsw. However, a comparison of English language arts and math test scores showed that students on the 4dsw have lower scores, over time, when compared with peers on a five-day schedule. Given these mixed findings, communities are likely to make different choices about the 4dsw depending on their goals and the local context.



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