Schooling Methods in Student Test Scores*

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An increasing number of schools and universitities have adopted virtual or hybrid teaching methods ever since the COVID-19 pandemic in 2020. Using data from the National Center for Education Statistics and from various district-level assessements, this paper investigates the impact of schooling modes on students' pass rate in state standardized assessments in grades 3-8 during the 2020-2021 school year. The exploration of the data across 11 states suggests that the overall student pass rates declined during the pandemic school year. The pass rates have also seen more drastic changes in schools with larger share of black students as well as in schools who had a higher share of virtual and hybrid schooling. The results of this study are significant as they can be used by educational authorities and policymakers to support student learning.

NOTE TO SELF : I WANT TO CHANGE THE FIRST SENTENCE IN ABSTRACT

1 Introduction

In 2020, the World's Health Organization (WHO) declared the coronavirus disease, commonly known as COVID-19, a public health emergency of international concern (World Health Organization 2020). As an airborne disease, COVID-19 was highly contagious from person to person, which made virtually all lifestyle activities a health risk during the pandemic. During this time, hosting in-person classroom activities and instructional periods were also considered a health hazard and were strongly discouraged. It attempts to support students and staff despite the uncertainty and unpredictability of the pandemic, school leaders and authorities implemented alternative learning models which offered students the opportunity to continue their studies in a safe way. In the United States, hybrid and virtual schooling modes were commonly adopted in 2020-2021 in response to the pandemic. **ANOTHER TRANSITION SENTENCE?**

*Code and data are available at: LINK.

In this paper, I am interested in the impact of different schooling methods on US students' pass rates on state standardized exams in the pandemic school year in 2020-2021. Using district-level databases from 11 states and well as data from the Natiocal Center of Educational Statistics (NCES), I explore the changes in students' pass rates in 2020-2021 for more insights on the influence of the district's chosen learning model on the overall learning outcomes I find that, despite having the same curriculum, the decline in student pass rate is notably more obvious for schools who had a higher share in virtual or hybrid schooling modes. More specifically, (pass rates in English + Math) which results in an overall decline of _____% during the pandemic year. Also, I also find that schools with higher shares of Black and Hispanic students saw a greater decline in student pass rates. **MODIFY THIS IF NEEDED AFTER DISCUSSION** I can maybe show some stats here already??

The remainder of this paper is structured as follows. Section 2 discusses the data collection and the studied variables. Section 3 builds a model that suggests a relationship between learning models and student pass rates. Section 4 presents results and findings of the exploration for the dataset with the help of visualized data. Section 5 explores further insights from section 4 and discusses a few weaknesses and limitations of this study. This section also suggests potential next steps following this paper.

2 Data

2.1 Source and Data Collection

The paper and raw data used for replication is obtained from "Pandemic Schooling Modes and Student Test Scores: Evidence from US School Districts" (Jack et al. 2023), published in the American Economic Association's *American Economic Review: Insights* (AEA 2024). The downloaded data is built from district-level schooling mode data from the 2020-2021 schooling year and from district-level standardized assessment data from Spring 2019-2019 and 2021. I also downloaded additional district-level demographic data for this investigation. Detailed explanation of each data source and data collection method is given below.

2.1.1 District-Level Schooling Methods

Data on district-level schooling methods are downloaded from the COVID-19 School Data Hub (COVID-19 School Data Hub 2021). This is a public database which aggregates state-sourced data to provide information on schooling modes and learning models by school districts during the 2020-2021 school year. Typically, the state-sourced data are State Education Agencies (SEA).

For each district in the United States, this database provides information on the percentage of the academic spent in each of type of schooling methods. To collect this data, the COVID-19 School Data Hub Team submitted data requests to state education agencies. They requested

records of learning models used by schools and/or districts in the 2020-2021 academic school year. The renewal frequency of the data depends on on each school and districts where some would send new records weekly, while others would send the records in monthly. States who provided data monthly, bi-weekly or weekly during 2020-2021 year were included in this analysis.

2.1.2 District-Level Assessment Data

Data on district-level assessment results are collected from the Departments of Educations for the studied states. The respective departments collect data via surveys from constituent schools, school authorities and school boards (US Department of Education 2023). To evaluate changes in students' pass rates in math and ELA, data on test scores between Spring 2016-2019 and 2021 were extracted. This data is organized by year of study between grade 3 and grade 8.

The downloaded dataset includes states which had at least two years of pre-pandemic test data available and had no significant changes to the assessment content. Certain states such as Alaska, Nevada and New York were were excluded from the analysis as these states presented low assessment participation rate in 2021.

2.1.3 District-Level Demographic Data

Our final sample includes 11 states: Colorado, Connecticut, Massachusetts, Minnesota, Mississippi, Ohio, Rhode Island, Virginia, West Virginia, Wisconsin and Wyoming.

2.2 Variables of Interest

The data was cleaned and processed using the statistical programming language R (R Core Team 2022). Statistical libraries such as `tidyverse` (Wickham et al. 2019), `knitr` (Xie 2021), `arrow` (Richardson et al. 2023) and `here` (Müller 2020) are leveraged in the data processing as well.

2.2.1 Schooling Modes

The possible schooling modes are in-person, virtual and hybrid learning models. In the analysis data, the schooling modes are defined and determined as follows:

- In-person: All or most students have access to traditional in-person instruction five days a week.

- Virtual: All or most students receive instruction online five days a week. Online instruction includes synchronous, asynchronous or a combination of synchronous and asynchronous activities.
- Hybrid: Schooling modes that do not correspond to any of the previous two models. Usually, this is a combination of the previous two.

Table 1: First Ten Rows of the Schooling Modes Data by District ID in 2020-2021 School Year

District ID	In-person Model (%)	% Virtual Model (%)	Hybrid Model (%)
802430	85.87	6.01	8.13
805550	93.99	6.01	0.00
802580	0.00	27.56	72.44
801950	0.00	57.60	42.40
806750	21.55	6.01	72.44
806900	21.55	46.64	31.80
807230	85.87	14.13	0.00
801950	0.00	57.60	42.40
807230	85.87	14.13	0.00
802430	85.87	6.01	8.13

In Table 1, the percentage of each learning model for each district is calculated by dividing the number of days of each schooling mode by the total number of school year days. The original dataset excludes the Thanksgiving week in 2020 and the last two weeks of December 2020 in the calculations.

2.2.2 Pass rates

Pass rates are calculated by dividing the number of students who passes standardized assessment by the number of students who took the exam in the district. For the purpose of this analysis, the pass rates for math and ELA assessments were considered. To count a pass, the student must score proficient of above on the selected state assessments.

Table 2: First Ten Rows of the Pass Rates by District ID, Subject and Grade from 2016-2019

District ID	Subject	Year	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
801950	math	2016	17.2	11.2	7.9	8.6	8.3	3.8
801950	ela	2016	13.8	16.3	12.9	12.3	17.5	22.9
802430	ela	2016	28.9	46.3	41.2	27.1	27.8	26.5
802430	math	2016	24.4	37.1	25.3	27.8	20.5	6.7
802580	math	2016	37.3	26.1	31.1	21.7	21.7	13.7

District ID	Subject	Year	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
805550	ela	2016	21.7	25.2	24.3	18.8	27.4	30.2
806750	math	2016	44.9	51.7	42.6	23.0	10.1	25.6
806900	ela	2016	33.3	41.8	39.0	32.8	37.1	39.8
807230	math	2016	18.0	11.1	16.0	10.7	9.0	8.4
807230	ela	2016	15.8	20.9	19.3	18.4	18.6	22.1

2.2.3 Demographic Characteristics

3 Model

The goal of our modelling strategy is twofold. Firstly,…

Here we briefly describe the Bayesian analysis model used to investigate… Background details and diagnostics are included in

3.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$y_i|\mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \tag{1}$$
$$\mu_i = \alpha + \beta_i + \gamma_i \tag{2}$$
$$\alpha \sim \text{Normal}(0, 2.5) \tag{3}$$
$$\beta \sim \text{Normal}(0, 2.5) \tag{4}$$
$$\gamma \sim \text{Normal}(0, 2.5) \tag{5}$$
$$\sigma \sim \text{Exponential}(1) \tag{6}$$

We run the model in R (**citeR?**) using the `rstanarm` package of Goodrich et al. (2022). We use the default priors from `rstanarm`.

3.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular…

We can use maths by including latex between dollar signs, for instance θ.

4 Results

Our results are summarized in.

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

5.2 Second discussion point

5.3 Third discussion point

5.4 Weaknesses and next steps

weakness 1 : missing data weakness 2 : definiton of in-person instruction. Access to in-perosn does not mean everyone actually did it online. Some may have opted to do it online for health reasons. weakness 3: different testing conditions (p.6 OG) some people had post-pandemic testing online or even had more time via a governmental waiver.

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