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Impact of COVID-19 on 7th Grade Student Performance in Mathematics - Webb County, Texas

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Abstract: The COVID-19 pandemic profoundly impacted education, including among the middle school students. This study examines the effects of the pandemic on 7th-grade students and assesses the influence of virtual classes on student learning. Five variables were analyzed, comparing their 2019, 2021, and 2022 performance scores to explore the relationship between virtual classes and academic performance. The study focused on students in the United ISD in South Texas, considering economic disparities, prevalence of positive COVID-19 cases, absences, vaccine access, student performance, and equity issues that also include levels of language proficiency, special population, second language acquisition on students and 504 programs. The aim was to determine if virtual instruction exacerbates educational inequity due to limited preparedness and the digital divide. Analysis used public data for the graduating class of 2025-2026 in Webb County, Texas. Findings reveal significant learning losses during the pandemic, with only one student reaching the master's level in Mathematics for STAAR. Disadvantaged students experienced a decline of 6 percentile points compared to their peers. Performance varied significantly between Laredo's north and south sides, with the north side showing more improvement. Addressing educational inequities and implementing effective strategies for virtual instruction is crucial, particularly for disadvantaged students.

Keywords: COVID-19, virtual classes, disadvantaged homes, learning loss, regression, correlation

1 Introduction

This project is primarily focused on the challenges that students from 7th grade level classes faced during the period of 2020 to 2022, due to the pandemic produced by the virus COVID-19. Once the pandemic started in Texas, all schools and universities decided to move all in-person classes to virtual effective on March 2020. This included two independent school districts, United Independent School District (UISD) and Laredo Independent School District (LISD), the only university, Texas A&M International University (TAMIU), and the only community college, Laredo College (LC). This situation has been difficult to keep everyone around the world, the stress, pressure, sadness that families are still trying to adapt their lives in a state where the COVID-19 cases increase daily. For some students it is hard to have good learning in the schools because their families are facing hardship. For example, Anna Novak of the Texas Tribune depicts that the state of Texas lost 1.4 million jobs in Spring 2020 due to COVID-19, making an unemployment rate of 12.9% in April 2020 [1]. Students carry all the negative situations from their families to their learning environment. It may be a loss of a job, lack of money, or maybe the loss of a family member. Nationwide, school districts have been rushing to provide in-person instruction to reverse the impact of distance learning on children from kindergarten to 12th grade students. Even so, many families are still affected by COVID-19, and the students still present with more facts that affect their school's performance. All stakeholders must take in view of the facts that they are required to have a good school performance during the pandemic, and it is important to give a good quality education in online classes. It is required that virtual classes have the same quality as face-to-face classes. In fact, it constitutes a real challenge for those who choose to start or continue their studies under this modality. It implies greater concentration, willingness to learn, mastering discipline, organization, etc. Other factors that affect student performance are access to Internet connection tools, as well as the economic resources to cover expenses. This gap is decisive in developing and underdeveloped countries. The fact of adaptability, the impact of the pandemic due to the circulation of the COVID-19 virus has revealed the inability to adapt quickly enough to changes in

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the environment. The delays in changing teaching strategies have shown the lack of training of human resources, the lack of sufficient technologies in homes and study centers, rigidity of platforms and virtual classrooms, speed, and capacity of servers, among others.

2 Preliminaries

The COVID-19 pandemic posses a threat to global education due to its dual impact. The immediate impacts of closing schools and universities, and the impacts of the crisis caused by the response to the pandemic. Students testing K-12 and under in 2021 were about ten points behind in math and nine percentage points behind in reading compared with matched students in previous years [2]. This double whammy has already begun and will intensify for some time. As the 2020–2021 school year began, just 40 percent of k-12 students were in districts that offered any in-person instruction. By the end of the year, more than 98 percent of students had access to some form of in-person learning [3]. These impacts will be destroyed in a threat to the main factors that drive quality learning – prepared and engaged students, capable teachers, and supported, well-equipped classrooms, schools inclusive and safe, and good management systems. The countries that do not apply crucial actions to respond adequately, the impacts will imply long-term costs in terms of human capital and their well-being. The study of some negatively effect of virtual classes for students at UISD, Laredo, Texas is the primary focus.

Concentration difficulties: Idaho Connects Online School explains that many students for any ages, present additional mental distractions. The students gets distracted by other stuff they find online during the time they should be doing schoolwork. Also, ”students may be thinking too much about what they don’t get to do, or they may be worried about themselves or loved ones, or feeling fear about the unknown future, instead of focusing on online coursework [4].”

Technologies: All students in UISD have been provided all the information that both, the parents and students should need or ask during virtual classes. Both independent-school districts at Laredo Texas, UISD and LISD provide their needed students access to an iPad or chromebook, and also provide free Internet for disadvantaged homes. At the site [5], the UISD provided technical support, parent training guide, chrome-book tutorials, iPad tutorials, and more to endure an equity virtual classes support. LISD also provided similar item and support to their students. Unfortunately, most of the homes that previously did not count with technology access will be having struggles during the virtual classes. Two institutes, Zur Institute and Easy Tech Seniors have been identifying that older people refrained from technology due to personally held values about technology, wider concerns regarding its impact on society or some older adults, it was the fear of getting things wrong when using software that held them back. Also, facts such as vision loss, price, rushing, lack of perceived benefit or need does not allow many families to be able to help their children to go over a good quality understanding of their new technologies.

Negative impact on socialization: For children, socialization is fundamental to reach a good development in a school environment. The common social experiences between friends set a basis for shared understanding that may be at the root of cognitive development and children who are successful in using communications and interaction at school are more likely to jointly solve cognitive problems [6]. Social interaction demonstrates a strong awareness of the current theories of social psychology, while restricting itself in exposition to the observable aspects of human interaction that affect students performance would be detrimental [7].

Lack of complete pedagogical structure: More than 1.6 billion students in over 190 countries have already experienced disruptions to their education, and 24 million children and youth (including more than 11 million girls) may drop out permanently due to the pandemic. The rapid global shift to online learning has also exacerbated the digital divide: two-thirds of school-aged children worldwide have no access to internet at home and are unable to attend virtual classes [8]

Need for greater perseverance and discipline than in face-to-face classes: The absence of socialization in students displays low level of individual self-discipline or self-control [9]. Children and young adults who attends virtual classes should put an extra effort and discipline to reach a good performance during the classes.

Delays and inefficiency due to failures in technological tools: There exist many facts that may cause delays during virtual classes. For example, the professors or students may have a bad Internet connection during day, or the webpage to upload assignment is not working properly, even other reasons according to Learning Network [10]. Students with limited access to the basic resources necessary to thrive in a digital learning landscape, such as broadband connectivity are at highest risk of missing out on classroom instructions during the pandemic [11].

It lacks routine, and it can carry out a lack of control: For students used to attending school in-person, having a lack of structure for each day can be difficult to get used to. At school students get into routines and get used to the way each day flows. But at home, there is rarely that kind of structure for the day. Students may interpret that lack of structure to mean that they don’t have to do anything, or they may find themselves overwhelmed with too much to do and an inability to determine what order to do it in. Some students excel with this kind of freedom, but many need to have an even stricter structure to their day for them to be able to focus [4].

For sure, the quality of virtual classes, faculty, low or no access to Internet, absence in social interactions, are not the only

fact that may affect scores during the pandemic. ”A survey shows more than 1,100 public school teachers by education nonprofit (schools serving predominantly low-income and minority students by the 501(c)(3) corporation), students in low-income communities and minority students have been disproportionately impacted by the pandemic [12].” Other facts such as positive COVID-19 cases, access to COVID-19 vaccines, and unemployment rate in Laredo negatively effects students and families physically, emotionally, and economically.

2.1 Increment in COVID-19 in Laredo, TX

In the state of Texas, cases of COVID-19 have been increasing, above all on September 2021, the month in which school districts admitted new students, were many students and school employees were affected by the COVID-19 virus, as in Figure 1.

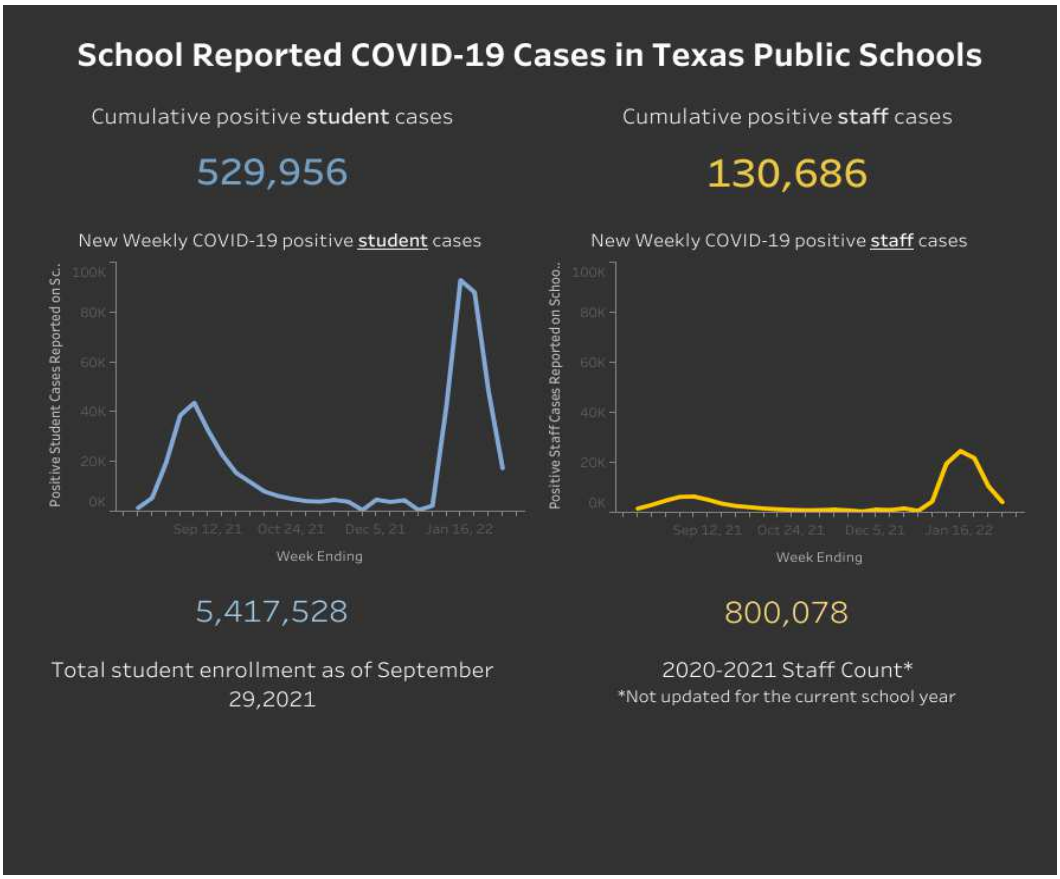


Figure 1. Positive COVID-19 Cases in Texas

Source: Texas Health and Human Services, 2011 [13]

On August 13, 2021, all data were reset for the 2021-2022 school year. Historical data for the 2020-2021 school year are available at Texas Health and Human Service: https://dshs.texas.gov/coronavirus/schools/texas-education-agency/. This data is open to the general public. All districts in different cities give the information of total student’s enrollment as of September 29, 2021, with the records of positive COVID-19 cases on students, staff, and administrators. The COVID-19 records highlight September 2021 as the month with the highest number of infections in students and staff, but no one expected the number of infections that would be generated in January 2022, as staff count remained at 800,078 throughout the period in Table 1.

Table 1. Self-Reported COVID-19 Cases in Public School at Texas

Week of:	Positive Student	Positive Staff	Student Enrollment
08/Aug/2021	1,323	1,486	5,340,108
15/Aug/2021	5,325	2,965	5,340,108
22/Aug/2021	19,491	4,707	5,340,108
29/Aug/2021	38,463	6,163	5,340,108
05/Sep/2021	43,501	6,294	5,340,108
12/Sep/2021	32,331	5,025	5,340,108
19/Sep/2021	22,750	3,456	5,340,108
26/Sep/2021	15,368	2.520	5,340,108
03/Oct/2021	11,696	2,039	5,417,528
10/Oct/2021	7.943	1,523	5,417,528
17/Oct/2021	6,113	1,200	5,417,528
24/Oct/2021	4,930	963	5,417,528
31/Oct/2021	4,064	796	5,417,528
07/Nov/2021	3,860	878	5,417,528
14/Nov/2021	4,523	1,067	5,417,528
21/Nov/2021	3,816	773	5,417,528
28/Nov/2021	448	324	5,417,528
05/Dec/2021	4,632	1,080	5,417,528
12/Dec/2021	3,736	915	5,417,528
19/Dec/2021	4,443	1,545	5,417,528
26/Dec/2021	477	596	5,417,528
02/Jan/2022	2,217	4,351	5,417,528
09/Jan/2022	42,641	19,461	5,417,528
16/Jan/2022	93,076	24,677	5,417,528
23/Jan/2022	88,425	22,140	5,417,528
30/Jan/2022	49,408	10,899	5,417,528
06/Feb/2022	20,616	4,901	5,417,528
13/Feb/2022	8,386	1,965	5,417,528

The dates of January 16, 2022 and January 23, 2022 for the 2021-2022 school year period presence the highest recorded cases for COVID-19 for both, students and staff alike. A total of 93,076 positive COVID-19 cases in students reported on January 16 that represent a 214% of positive cases in students from September 5, 2021, and 24,677 positive COVID-19 cases in staff reported on January 16 that represents a 392% of positive cases in staff from September 5, 2021. The percentage difference is terrifying, but the school districts at Webb County, Texas refused to offer virtual learning for 2021-2022 school year.

There is a total of 21 middle schools in Laredo, Texas. This includes 12 in UISD, 4 in LISD, 3 are private, and 2 are charter schools. For this study, only 7th graders at Antonio Gonzalez middle school are considered. The student community performance for the Antonio Gonzalez middle school reported of 206 students enrolled in 7th grade, only 192 took the benchmark assessment conducted on March 30, 2020. Comparing the virtual instruction during school year 2020-2021, only 202 out of 204 took the benchmark assessment in 2021, due to positive COVID-19 in the students or family members.

2.2 Low Access to Booster COVID-19 Vaccines in Hispanic US Citizens

According to the last update of the US Census Bureau data, a 95.4% of the population in Laredo TX, are Hispanic or Latinos. In all US, a total of 38,631,906 of Latinos (17.2% of US population) have received at least one dose of the COVID-19 vaccine regiment. An amount of 22,253,261 out of the 38,631,906 have the second dose and are eligible for the Booster vaccine. Unfortunately, just 39.5% have received the Booster dose, and a 60.5% of Latinos eligible for the Booster haven't had the vaccine yet. All, the official data, and graphs are available at https://www.cdc.gov [14]. This is also similarly reflected in the local data as in Figure 2.

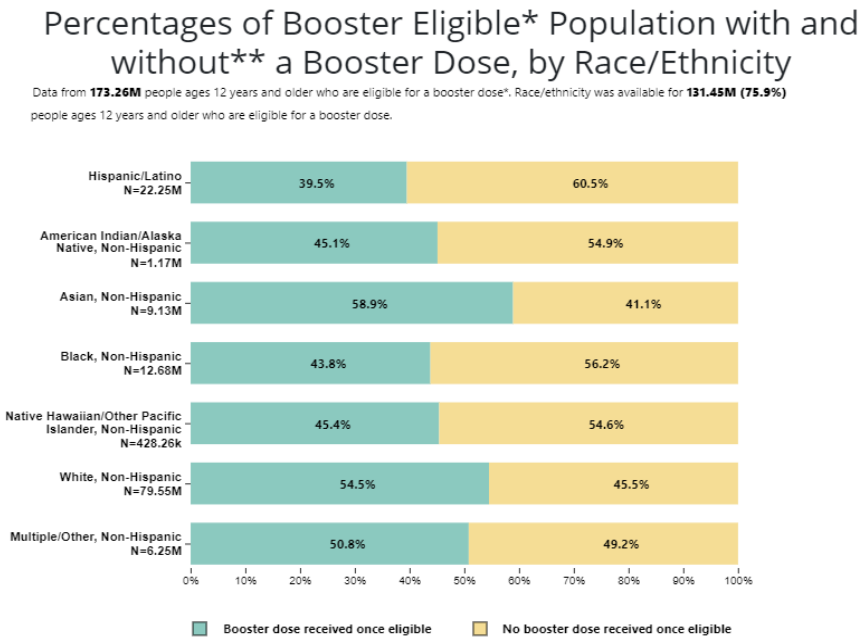


Figure 2. People Received COVID-19 Vaccinations in the United States

The 2013 National Survey of Latinos found that an approximation of 62% of US Hispanic adults speak English or are bilingual, but bilingualism decreases among the children and grandchildren of Hispanic immigrants. Leonel Martinez, a contributor to the South Kern Sol, redact in his publication that the third generation, a quarter of Latinos said they were bilingual, only one percent spoke mainly Spanish, and 70% of Latinos ages from 16 to 25 years can speak Spanish but not 100% fluent [15]. This means that an approximate of 38% of parents do not speak or understand English, and are unable to help their children or grandchildren to have good performance during virtual classes.

2.3 Increment of Unemployment in Laredo, TX

Another negative factor that affects the academic performance of students is the stress of job loss in family members, "The Texas Tribute" shows that in the state of Texas in the year of 2020, an approximate of 1.4 million people lost their jobs, giving an unemployment rate of 12.9% as in Figure 3.

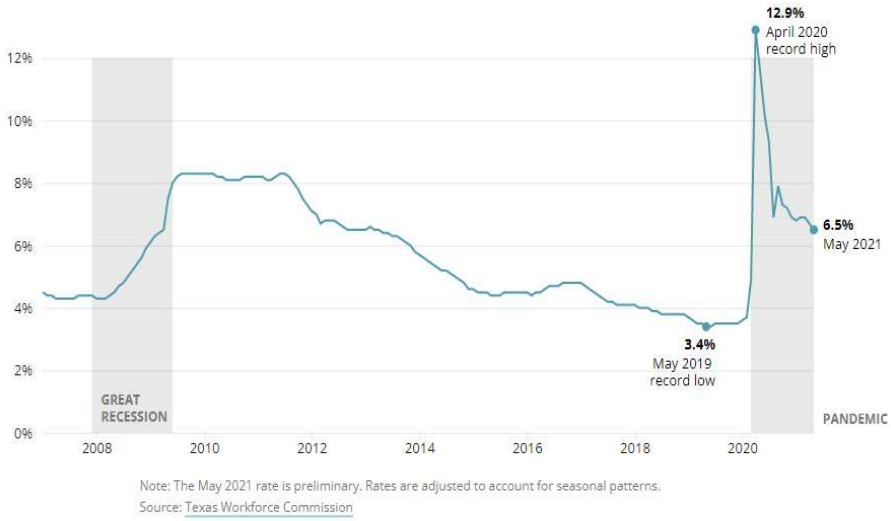
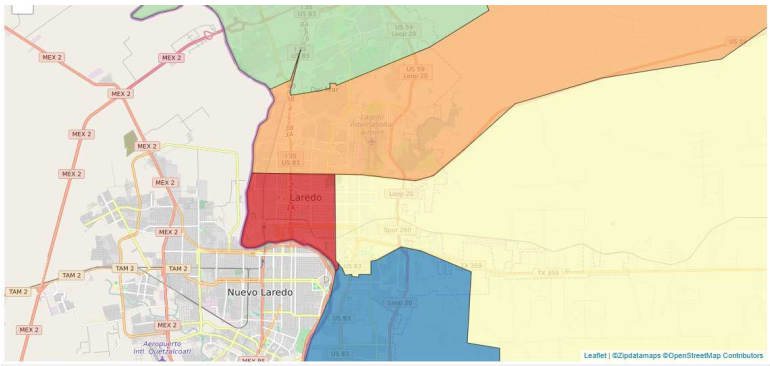


Figure 3. Unemployment Rate in Texas Due to COVID-19

The COVID-19 crisis began in late March 2020, and Laredo was under a full-blown stay at home order by April. This lasted through the whole month, but began to be lifted in part by May 1, when restaurants and retailers were permitted to open again by Gov. Gregory W. Abbott. Joblessness in the Laredo area shot up to 13.6% in April, with a total of 14,213 residents having filed unemployment claims brought on by the coronavirus crisis and subsequent crash in the oil and gas industry. In Laredo's largest industry (trade, transportation, and utilities) employment fell by 8% from March, a loss of about 2,500 jobs. Professional and business services jobs fell by 24%; jobs in "other service sectors" fell by 21%; information jobs fell by 13%; construction and oil and gas fell by 3%; and government jobs fell by about 1% [16].

3 Data Profile

The validity of the assumptions must be made before any conclusions are drawn from the analysis. The first assumption for this project is that students living in the south side of Laredo, TX, present lower grades due to the increments in COVID-19 cases, where in the background it was proved that more COVID-19 positive cases were reported in the south side of Laredo. Also, making the relations about how the economic resources from the north and south side affect the quality of how the students takes a virtual class. It is required to make three groups, north, middle, and the south sides, identify the zone of each UISD school is located at. Identify the zone with highest unemployment rate, highest COVID-19 cases, lowest income, to be able to find the dependence of these facts with the student's scores. Let remark that lower-social-class parents engage in fewer educationally supportive activities with young children [17] that fact also affect students grades for disadvantaged families. After analyzing the data, it is expected to find the dependence of the variables and a positive correlations of learning loss among students from disadvantaged homes.
This study analyses the butterfly effect of the COVID-19 pandemic in UISD schools in Laredo, TX, and how the positive cases, low income in disadvantaged homes, results in low learning rate at schools in Laredo, TX. First, Laredo is a city in Webb County, Texas, United States, on the north bank of the Rio Grande river in south Texas, across from Nuevo Laredo, Mexico. Laredo counts with approximate population of 248,210 people and all are distributed in five different zip codes as in Figure 4.



List of Zipcodes in Laredo, Texas

ZIP Code	ZIP Code Name	Population	Type
78040	Laredo	42083	Non-Unique
78041	Laredo	44153	Non-Unique
78043	Laredo	42713	Non-Unique
78045	Laredo	54713	Non-Unique
78046	Laredo	64548	Non-Unique

Figure 4. Map of Zip Codes for Laredo, TX
Source: ZipDataMaps.com [18]

The relation and effects between standardized math scores in 7th grade students in UISD district are affected. The national standardized tests are taken across three main subjects: math, spelling, and reading (SI Appendix, section 3.1). The student data at the south of Texas obtained for this project is base in the mathematics' score and we will find that students made little or no progress while learning from home. Learning loss was most pronounced among students from disadvantaged homes. We further impose a uniform distribution in our sample within cells defined by subject, grade, and testing occasion: midyear vs. end of year.
For the methodology, the UISD campuses located at the north, middle, or south of Laredo are first identified. The location is important because according to the data in "city-data.com," it shows an inequality of economic income in Laredo, TX. The northern part has better economic income compared to the middle and southern area of Laredo. At the north side with zip code 78045, the median price asked for vacant for-sale houses and condos in 2016 was valued at $213,181, an

estimated median household income of $68,393, and an unemployment rate of 3.5%. For a zip code 78041, also located at the north of Laredo shows that the median price asked for vacant for-sale houses and condos in 2016 was $180,641, an estimated median household income of $39,379, and an unemployment rate of 3.8%. At the middle of Laredo, zip code 78040 the median price asked for vacant for-sale houses and condos in 2016 was $129,775, an estimated median household income of $23,713, and an unemployment rate of 5.0%. For zip code 78043 the median price asked for vacant for sale houses and condos in 2016 was $146,777, an estimated median household income of $33,372, and an unemployment rate of 5.0%. Least, at the south side, zip code 78046 the median price asked for vacant for sale houses and condos in 2016 was $141,519, an estimated median household income of $35,759, and an unemployment rate of 6.3% as in Table 2 [19].

Table 2. Laredo, Texas: House Value, Income, and Unemployment Rate

Economic Rate			
ZIP Code	House Value	Householder Income	Unemployment Rate (2016)
78045	$213,181	$68,393	3.5%
78041	$180,641	$39,379	3.8%
78043	$146,777	$33,372	5.0%
78040	$129,775	$23,713	5.0%
78046	$141,519	$35,759	6.3%

For Laredo, TX, the current rate of unemployment is at 5.00%, the previous month rate was at 5.20%, six months ago the unemployment rate was at 7.60%, and last year was at 7.60% according zipdatamaps.com and shows in Figure 5.

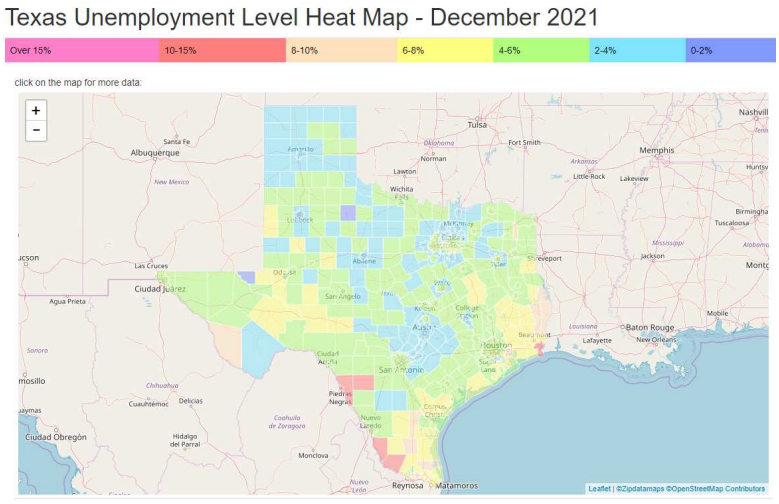


Figure 5. Unemployment Rates in Texas, 2021
Source: ZipDataMaps.com, December 2021 [20]

SAS, an analytic statistical software, is used to show the connections of unemployment rate vs. academic grades. With SAS, all of these tasks can be implemented including access to the data in almost any format and that of SAS tables. Briefly, the data makes a connection that the south side of Laredo was more affected economically during the pandemic like the students' scores. The process also includes positive COVID-19 cases, absences of classes due to positive cases, access to vaccines, students results and equity issues to determine if online instruction denies equity.

The scores of data for school years of 2020-2021 and 2021-2022 are obtained from the school administrators at Antonio Gonzalez middle school located at south of Laredo. Also information about absence of students due to COVID-19 is also provided to make the relation about how this factor affects the grades. There are a few missing values due to some parents simply not sending their children to school during the months with high spread of COVID-19, especially if family members have underlying health conditions [21]. As usual, the names of students were detached from the data set to preserve their anonymity. A common use of the aggregate computation, and the records of slim performances were abandoned in the source data. Based upon a set of groups by events, an empirical data is used to determine which data rows and columns to keep as a common heuristics approach.

The columns for exams are included for the following reasons. The Beginning of Year (BOY) exam does not affect the student scores, this exam is taken at the beginning of the semester. The idea for the BOY exam is essential to compare student's State of Texas Assessments of Academic Readiness (STAAR) scores at the end and to know if the student

improve their knowledge. For each year period the students are required to perform three of the Curriculum Based Assessments (CBA), the CBA1, CBA2, and CBA3 during the year to prepare the student for the STAAR exam. The benchmark assessment are assessments administered periodically throughout the school year, at specified times during a curriculum sequence, to evaluate students' knowledge and skills relative to an explicit set of longer-term learning goals [22]. The school districts at Webb County Texas use the benchmark scores to predict the STAAR's grades. Finally, the scores for STAAR exam are also included as a fundamental data. It is important to compare BOY and STAAR scores to predict if the students improve, keep, or present learning loss during the virtual classes. The target for STAAR's scores shows whether a student has mastered specific knowledge of a core subject at a certain grade level, for this case mathematics scores for 7th grade students. For grades 3-8th the exams are administered in a paper format only by the Texas Education Agency (TEA).
A total of 205 students has been enrolled from 2019, a total of 200 students have been enrolled from 2020, a total of 206 students have been enrolled from 2021, and a total of 206 students have been part for 2022. Randomly selected 5 students have been removed from the year 2019, 6 from the year 2021, and 6 from 2022 to have the same amount of data to compare three years of data together for the year periods of 2019-2020, 2020-2021, and 2021-2022.

4 Methodology

According to students, the pace of learning in an online course is slower than in a classroom-based course [23]. The following two techniques are used to perform the appropriate statistical analysis for the virtual year period of 2020-2021 at 7th grade in the Webb County and to compare results for in-person year of 2021-2020.

4.1 Paired Samples t-Test

The Paired Samples t-test compares the means of two measurements taken from the same individual, object, or related units. These "paired" measurements can represent the measurement taken at two different times, the pre-test and post-test scores with an intervention administered between the two time points, and the measurement taken under two different conditions, for this case completing a t-test for a disadvantaged student condition and a not disadvantaged student condition and the results obtained for BOY vs. STAAR difference. The data provides more than two groups with two dependent samples, and the paired t-test is the appropriate way to obtain precise results for the comparisons of learning loss for 2019-2020 and 2020-2021 scores. Also, the same procedure is repeated for 2019, 2020, and 2021 scores from two different UISD schools, one located at the south of Laredo and the second located at the north of Laredo. The purpose of the test is to determine whether there is statistical evidence that the mean difference between paired observations is significantly different from zero, in other words, $H_0 = \mu_\gamma = 0$ and $\mathrm{d}f = n - 1$.

4.2 Generalized Linear Models (GLM)

The generalized linear models (GLM) are used in addressing a variety of statistical problems and to the availability of software to fit the models [24]. Classifications and regression are two categories of models produced with GLM that includes multiple linear regression, as well as ANOVA and ANCOVA. The data requires for the MANOVA procedure with observations $H_0 = \mu_1 = \mu_2 = ... = \mu_t$, $\mathrm{d}f_1 = t - 1$, and $\mathrm{d}f_2 = N - t$ with interval multiple LHS and categorical multiple RHS.

5 Data Analyses

The data obtained from UISD, Laredo, TX, accounts for a total of 50 different campus including elementary, middle, high schools, recovery, and retention center, whereas 23 campuses are located in the north (zip codes 78041 and 78045), four campuses in the middle of Laredo (zip codes 78040 and 78043), and 23 campuses in the south (zip code 78046). A total of 39,115 new enrollments have been reported in UISD Laredo, TX, of which 19,890 students were enrolled in campus at the north side of Laredo, an equivalent of 50.850%. Another 1,600 students were enrolled at the middle of Laredo, an equivalent of 4.091%, and 17,595 students enrolled at the south side, an equivalent of 44.983% of total enrollment on September 29, 2021. Adding the total enrollment for campus with zip codes 78040, 78043, and 78046, gives a total of 19,195 enrollments less than the 19,890 total enrollments in the north. The data shows more students taking classes in the north of Laredo, and the reports of COVID-19 cases are unfortunately incomplete. The exact information about COVID-19 cases and their respective campus are shown in Table 3.

Table 3. Positive COVID-19 Cases in UISD Schools

Positive COVID-19 UISD District at Laredo, TX

United ISD District Campus - Zip Code:	Enrollment	Student Cases	Staff Cases	On Campus	Off Campus	Unknown
United High School - 78045	3783	32	122	16	54	84
United South High School - 78046	3172	21	178	24	71	104
John B Alexander High School - 78041	3008	14	185	21	67	111
United Step Academy - 78046	94	-	5	-	-	-
Juvenille Justice Alternative Program - 78043	<10	-	-	-	-	-
Lyndon B Johnson- 78046	3130	31	199	9	75	146
Youth Village Detention Center - 78046	20	-	-	-	-	-
Youth Recovery Home - 78046	11	-	-	-	-	-
Casa Esperanza Recovery Home - 78040	<10	-	-	-	-	-
United Middle School - 78041	1091	-	62	-	-	-
United South Middle School - 78046	1160	-	53	-	-	-
Salvador Garcia Middle School - 78046	401	-	36	-	-	-
George Washington Middle School - 78045	1161	-	61	-	-	-
Clark Middle School - 78041	533	-	34	-	-	-
Los Obispos Middle School - 78046	903	-	79	-	-	-
Trautmann Middle School - 78045	619	-	40	-	-	-
Antonio Gonzalez Middle School - 78043	596	-	41	-	-	-
Lamar Bruni Vergara Middle School - 78046	1050	5	41	1	23	22
Raul Perales Middle School - 78046	536	-	56	-	-	-
Elias Herrera Middle School - 78045	1102	-	40	-	-	-
Nye Elementary School - 78041	626	-	53	-	-	-
Clark Elementary School - 78041	375	-	40	-	-	-
Salinas Elementary School - 78046	676	0	22	1	10	11
Newman Elementary School - 78041	330	-	32	-	-	-
Trautmann Elementary School - 78045	653	-	34	-	-	-
Sigifredo Perez Elementary School - 78046	490	-	27	-	-	-
Finley Elementary School - 78045	417	-	33	-	-	-
Amparo Gutierrez Elementary School - 78041	371	-	13	-	-	-
Ruiz Elementary School - 78046	597	-	35	-	-	-
Matias De Llano Elementary School - 78045	388	0	45	1	17	27
Kazen Elementary School - 78045	365	12	22	13	11	10
Juarez Lincoln Elementary School - 78045	540	-	39	-	-	-
Prada Elementary School - 78046	604	-	67	-	-	-
Charles Borchers Elementary School -78045	537	-	30	-	-	-
Kennedy Elementary School - 78046	335	-	21	-	-	-
Col Santos Benavides Elementary School - 78045	890	-	44	-	-	-
Franklin D Roosevelt Elementary School - 78046	547	-	19	-	-	-
Judith Zaffirini Elementary School - 78046	525	-	23	-	-	-
Henry Cuellar Elementary School - 78043	527	-	25	-	-	-
Julia Bird Elementary School - 78045	768	-	31	-	-	-
John W Elementary School - 78046	706	-	39	-	-	-
Bonnie L Garicia Elementary School - 78046	625	-	58	-	-	-
Rodolfo Centeno Elementary School - 78046	753	12	66	8	43	27
Dr Malakoff Elementary School - 78045	512	8	34	13	14	15
Barbara Fasken Elementary School - 78045	704	-	35	-	-	-
Radcliffe & Sue Elementary School - 78043	487	-	30	-	-	-
Veterans Memorial Elementary School - 78046	712	-	37	-	-	-
Freedom Elementary School - 78046	558	-	42	-	-	-
San Isidro Elementary School - 78045	779	9	35	1	18	25
Roberto J Santos Elementary School - 78045	338	-	32	-	-	-

About the students who tested positive for COVID-19, only 6 out of 23 campuses made the report in the north. They report that in 6 different campuses a total of 73 students were positive with COVID-19, meaning 0.367% of the students enrolled at the north side, tested positive (Note that only 6 out of 23 districts uploaded this information). No report was made for campuses with zip code 78040 and 78043. On the south side, the zip code is 78046, only 5 out of 23 campuses uploaded the information of students who tested positive to COVID-19. Only 69 students were identified with COVID-19, giving

a total of 0.392%, providing a point of view that more students enrolled at the north side, and the south side have less students but more percentage in positive COVID cases.
About staff, the last update made on August 13, 2021, before the student enrollment on September 29, 2021, declares that 1,096 employees in the north side tested positive, an equivalent of 47.756% of total COVID-19 cases in staff at UISD (note that 21 out of 23 campuses share the information of COVID-19 among employees). Three out of four campuses in the middle of Laredo, declare 96 staff members tested positive, an equivalent of 4.183%, and in the south side, 20 out of 23 campuses declared a total of 1,103 employees who tested positive, an equivalent of 48.061%. Undoubtedly, the percentage would increase if the remaining other 4 campus in the middle and south sides reported their actual cases. These positive cases of COVID-19 in students, staff, and administrators could have an explanation why the grades are more affected in south of Laredo.
It is noted that not only the south of Laredo had little higher percent of positive COVID-19 cases, by taking a look at the north and south sides of Laredo, the middle school at the north shows better grades than the south side. The webpage greatschools.org shows the data of top 5 schools of any city, based on a variety of measures, including academic performance and equity. In Laredo Texas, the top three middle schools, Trautman, United, and George Washington, are located at the north of Laredo with zip code 78045, meanwhile the 4th place is Antonio Gonzalez middle school located at the middle of Laredo with zip code 78043, and last one, Raul Perales middle school is located at the south with zip code 78046 [25].

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
CBA1	200	63.2330097	33.2347758	0	100.0000000
CBA2	200	60.4951456	28.3431495	0	100.0000000
CBA3	200	53.1262136	30.3469947	0	100.0000000

The CORR Procedure

3 Variables:	CBA1 CBA2 CBA3

Pearson Correlation Coefficients, N = 206 Prob > |r| under H0: Rho=0			
	CBA1	CBA2	CBA3
CBA1	1.00000	0.67681 <.0001	0.53896 <.0001
CBA2	0.67681 <.0001	1.00000	0.58759 <.0001
CBA3	0.53896 <.0001	0.58759 <.0001	1.00000

The SURVEYMEANS Procedure

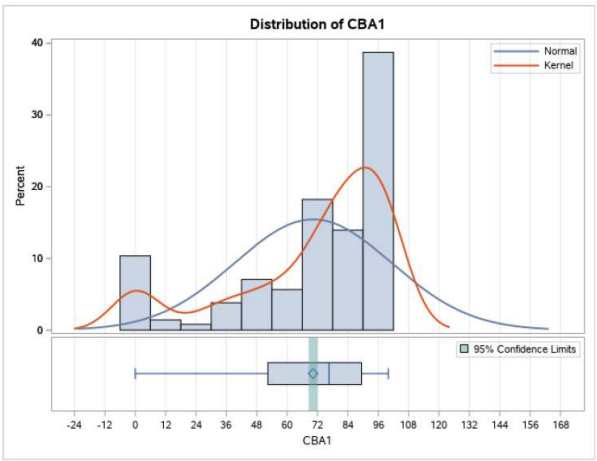
Data Summary	
Number of Observations	200
Number of Observations Used	181
Number of Obs with Nonpositive Weights	25
Sum of Weights	7908

Statistics		
Variable	Sum	Std Error of Sum
CBA1	555733	9402.696915
CBA2	516871	8665.458417
CBA3	466870	9082.205219

Figure 6. Mean, Correlation, and Survey Means

In Figure 6, the mean procedure shows how the mean of the CBA's grades have decreased instead of improved during in-person 2021-2022 year period. The survey mean procedure gives the values for school year 2021-2022 equal to 63.230 out of 100 for CBA1, 60.495 out of 100 for CBA2, 53.126 out of 100 for CBA3, and a standard deviation of 33.235, 28.343, and 30.347, respectively. The t-value for the assigned CBA in comparison with the rest CBA's always results in less than 0.0001. The significant difference is due to the fact that independence of each CBA's exam that drastically decreased grades.

For the virtual year period of 2020-2021, the results were 51.330 out of 100 for CBA1, 40.550 out of 100 for CBA2, 32.280 out of 100 for CBA3, and standard deviations of 26.720, 22.588, and 20.686, respectively. The virtual year period showed a mean decline of 11.90 points for CBA1, decline of 19.95 points for CBA2, and decline of 20.85 points for CBA3. The smallest standard deviation is for virtual classes meaning that most of the students got similar low scores than in-person classes.



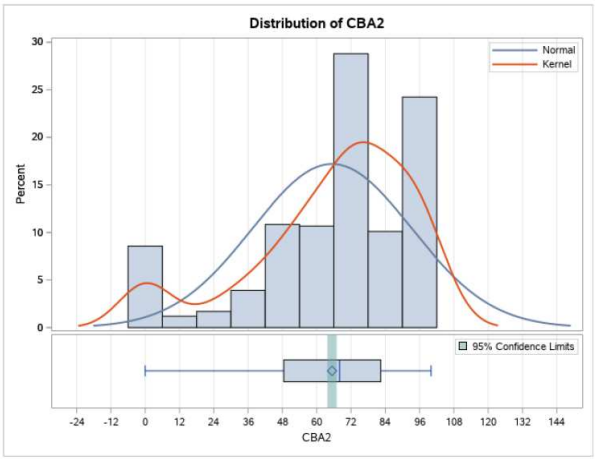


Figure 7. Normal and Kernel Distribution for CBA1 - Figure 8. Normal and Kernel Distribution for CBA2

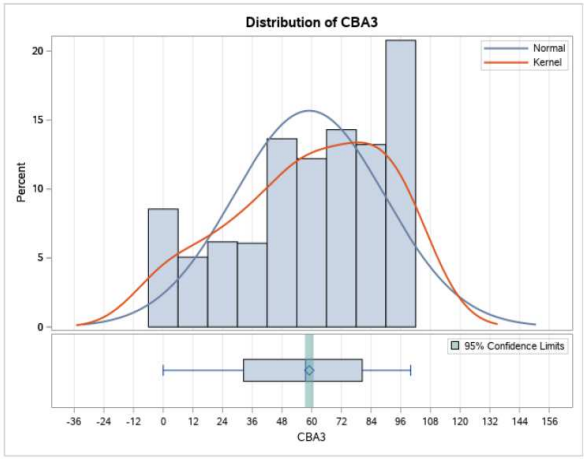
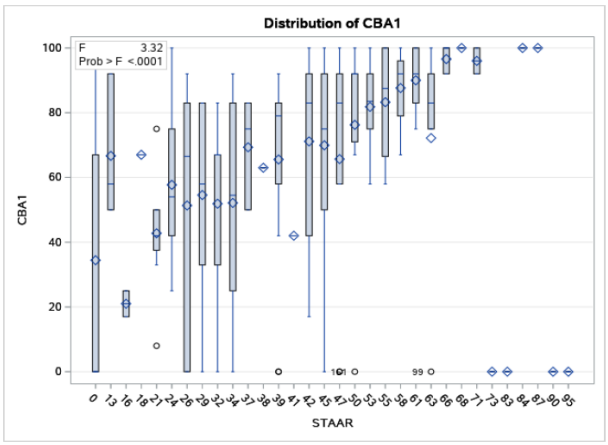
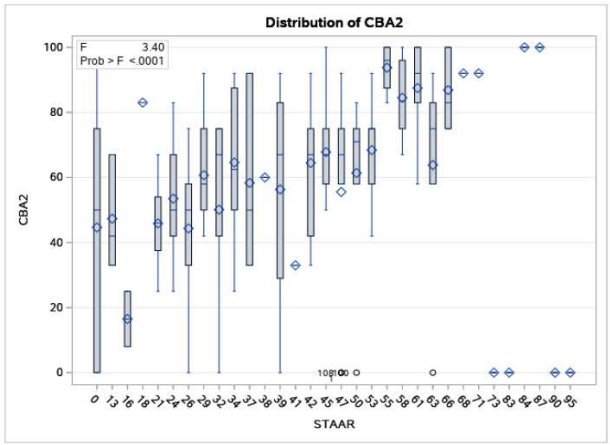


Figure 9. Normal and Kernel Distribution for CBA3

Figures 7, 8, and 9 are the distributions of CBA1, CBA2, and CBA3, respectively for in-person classes in year period 2021-2022. The distributions for each one are slightly skewed to the right. That is to say that there are fewer lower grades in the distributions. Each distribution is the results from the data provided by Antonio Gonzalez middle school. The blue line is for the normal distribution and the red line is for the kernel distribution that control the smoothness of the resulting density curve for each CBA's.





The GLM Procedure

Dependent Variable: CBA2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	31	62176.9925	2005.7094	3.40	<.0001
Error	174	102506.5027	589.1178		
Corrected Total	205	164683.4951			

R-Square	Coeff Var	Root MSE	CBA2 Mean
0.377554	40.12181	24.27175	60.49515

Source	DF	Type III SS	Mean Square	F Value	Pr > F
STAAR	31	62176.99249	2005.70944	3.40	<.0001

The GLM Procedure

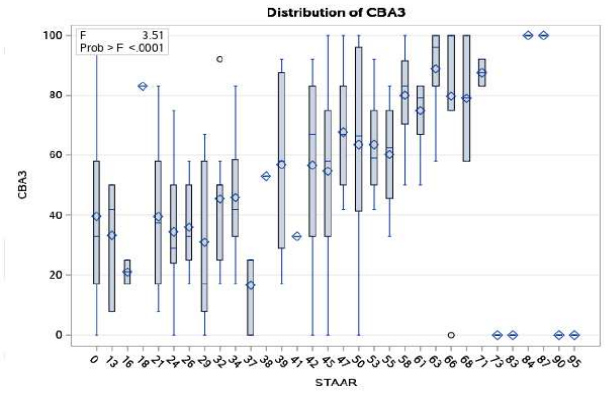
Dependent Variable: CBA3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	31	72611.5307	2342.3074	3.51	<.0001
Error	174	116181.1877	667.7080		
Corrected Total	205	188792.7184			

R-Square	Coeff Var	Root MSE	CBA3 Mean
0.384610	48.63898	25.84005	53.12621

Source	DF	Type III SS	Mean Square	F Value	Pr > F
STAAR	31	72611.53075	2342.30744	3.51	<.0001

Figure 10. Distribution of CBA1 Scores - Figure 11. Distribution of CBA2 Scores



The GLM Procedure
Multivariate Analysis of Variance

Characteristic Roots and Vectors of: E Inverse * H, where
H = Type III SSCP Matrix for STAAR
E = Error SSCP Matrix

Characteristic Root	Percent	Characteristic Vector V'EV=1 CBA1	CBA2	CBA3
0.86756684	73.08	0.00115211	0.00106740	0.00141858
0.21946614	18.49	-0.00053977	-0.00252652	0.00295452
0.10016594	8.44	-0.00290778	0.00277937	0.00060835

MANOVA Test Criteria and F Approximations for the Hypothesis of No Overall STAAR Effect
H = Type III SSCP Matrix for STAAR
E = Error SSCP Matrix

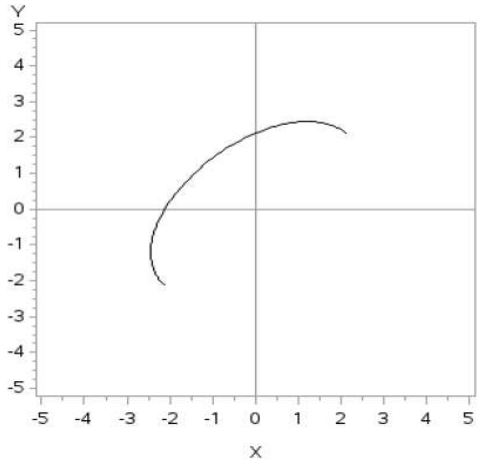
S=3 M=13.5 N=85

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.39911303	1.99	93	515.7	<.0001
Pillai's Trace	0.73555917	1.82	93	522	<.0001
Hotelling-Lawley Trace	1.18719892	2.18	93	455.47	<.0001
Roy's Greatest Root	0.86756684	4.87	31	174	<.0001

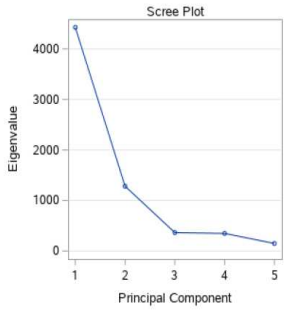
NOTE: F Statistic for Roy's Greatest Root is an upper bound.

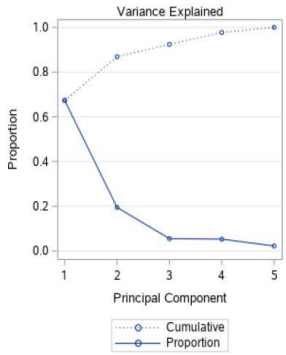
Figure 12. Distribution of CBA3 Scores

The distributions and statistical medians of each CBA's variables have been drawn in Figures 10, 11, and 12 as horizontal lines in each respective boxes and their respective outliers are also indicated separately and whiskers are dashed, thus ending with dashed crossbars.



Eigenvectors					
	Prin1	Prin2	Prin3	Prin4	Prin5
BOY	0.175501	0.355531	-.189666	0.201833	0.875264
CBA1	0.926461	-.374098	0.026697	-.021898	-.022973
CBA2	0.225342	0.537736	-.703964	-.098132	-.393529
CBA3	0.222810	0.624200	0.641163	-.380144	-.071628





Virtual vs In Person Instruction

The PRINCOMP Procedure

Observations	200
Variables	5

Simple Statistics					
	STAAR	BOY	CBA1	CBA2	CBA3
Mean	38.38834951	33.19417476	66.87378641	60.49514563	53.12621359
StD	20.71489767	20.99944634	63.08541320	28.34314948	30.34699474

Covariance Matrix					
	STAAR	BOY	CBA1	CBA2	CBA3
STAAR	429.106986	197.314468	303.146815	187.684821	228.038551
BOY	197.314468	440.976746	542.722188	410.444850	377.253422
CBA1	303.146815	542.722188	3979.769358	661.340848	623.611130
CBA2	187.684821	410.444850	661.340848	803.334123	505.400616
CBA3	228.038551	377.253422	623.611130	505.400616	920.940090

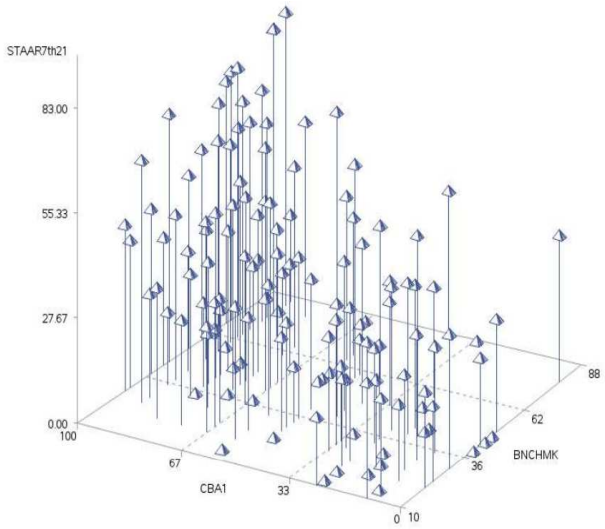
Total Variance	6574.1273029

Eigenvalues of the Covariance Matrix				
	Eigenvalue	Difference	Proportion	Cumulative
1	4426.85310	3143.82038	0.6734	0.6734
2	1283.03272	917.96950	0.1952	0.8685
3	365.06322	16.13176	0.0555	0.9241
4	348.93146	198.68467	0.0531	0.9771
5	150.24679		0.0229	1.0000

Eigenvectors					
	Prin1	Prin2	Prin3	Prin4	Prin5
STAAR	0.102204	0.234226	0.238031	0.897020	-.270905

Figure 13. Virtual vs. In-Person

Figure 13 is the result from the eigenvalues procedure available in SAS. A 95% prediction ellipse has been drown at the top to help the detection of deviation from normality. This is a graphical indication that the data are not bivariate normal. The center of Figure 17 is the sample mean and the ellipse gives a visual indication of skewness and outliers in the data, thus displaying a linear correlation. The ellipse is nearly circular to indicate that there is little correlation. There is clear evidence that students are learning less during lockdown than in a typical year. The tables for the five different numbers in the eigenvalues tell how much variance there is in the data for STAAR, BOY, CBA1, CBA2, and CBA3. The five numbers are positive meaning a high variance, and also to predict the future direction with a proportion and cumulative points for each variable. The eigenvectors allow to compute the predictions and confidence ellipses as shown at the end of Figure 13.



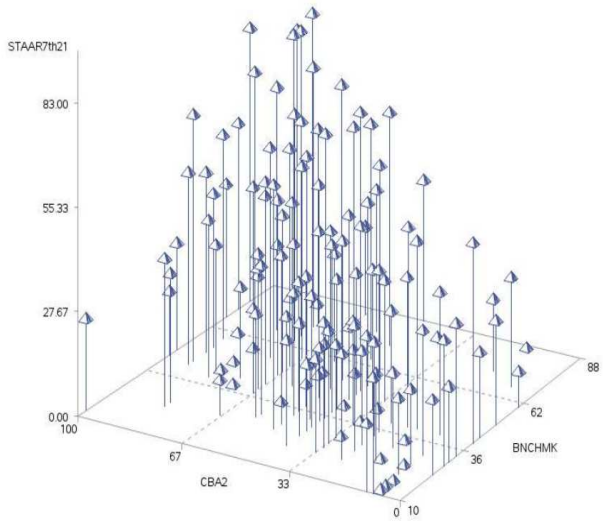


Figure 14. 3D Descriptive Statistics for CBA1 2020-2021 - Figure 15. 3D Descriptive Statistics for CBA2 2020-2021

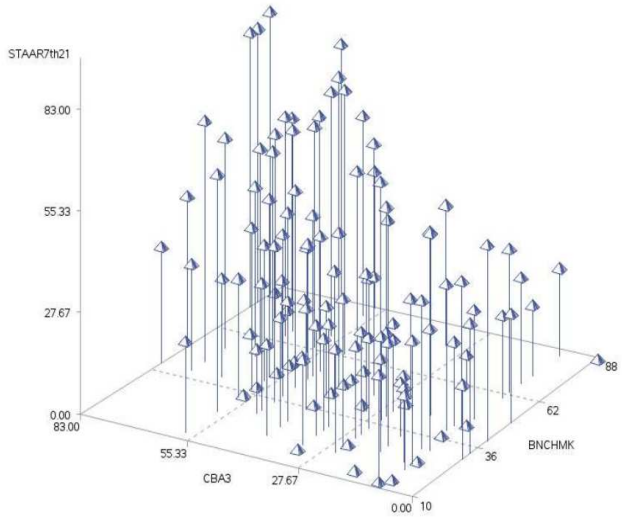
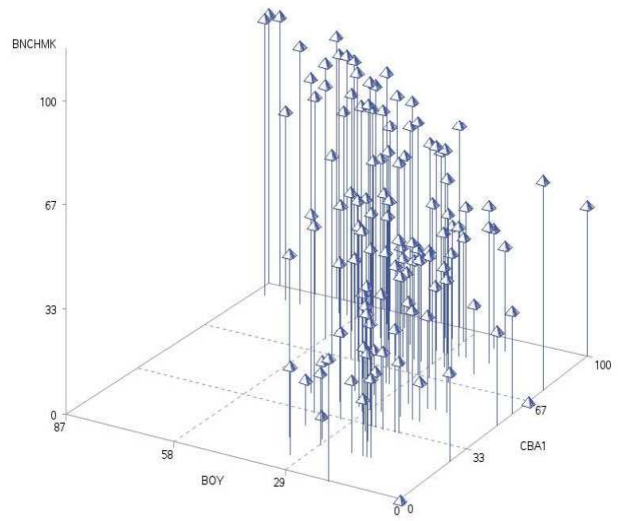


Figure 16. 3D Descriptive Statistics for CBA3 2020-2021

Figures 14, 15, and 16 are the 3D descriptive statistics obtained using STAAR, benchmark, and a respective CBA's scores maintaining the significance difference or relation of variables. The criteria for STAAR Mathematics exam requires at least 41% for passing, below 40% is non-passing, while approaching from 63% to 80%, and masters scores equal or above 80%. For the virtual period of 2020-2021, only a 63.4% of students passes with score above 40% with an average score of 45% meaning that the 2021-2022 school year have been improved by a 6%. The benchmark for 2021 was a good predictor for the improvement for the current 2022 year. These 3D descriptive statistics shows more about the distribution of observations in variables used for the analysis, giving the interaction plots and behaviours becoming narrower in the relations to the variables and being more spread for the 2020-2021 virtual year period for Antonio Gonzalez middle school.



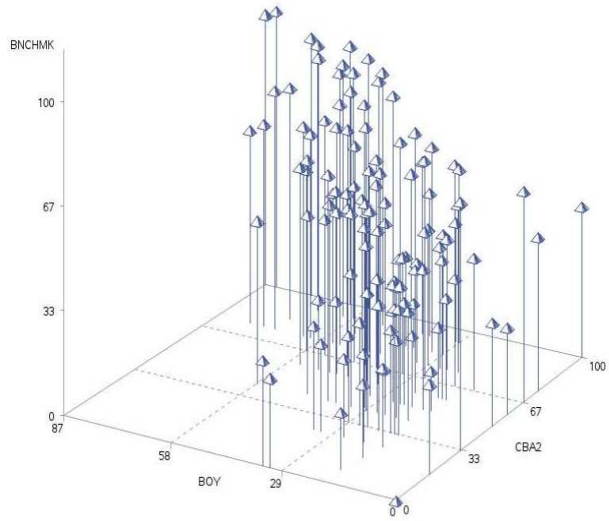


Figure 17. 3D Descriptive Statistics for CBA1 2021-2022 - Figure 18. 3D Descriptive Statistics for CBA2 2021-2022

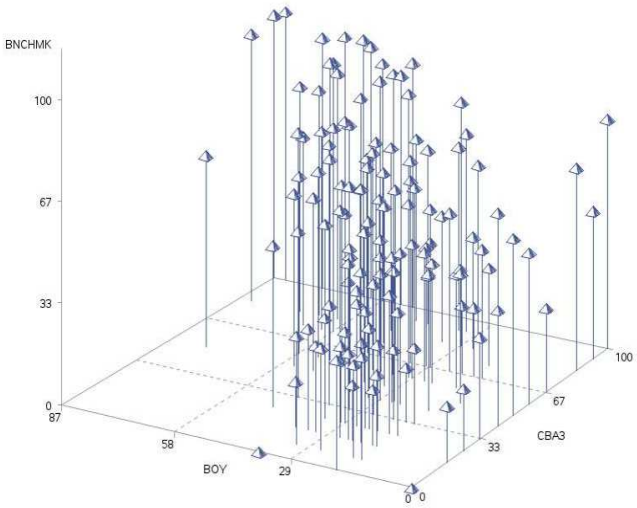


Figure 19. 3D Descriptive Statistics for CBA3 2021-2022

The students in Webb county have not taken the STAAR exam for the school period 2021-2022. The prediction for future scores in the STAAR exam was required the descriptive statistics to use BOY, benchmark, and a respective CBA's scores using the significance difference or relation of variables are in Figure 17, 18, and 19. Results show that for the in-person education in the year period 2021-2022, a 71.9% of students passed with a score above 40% with an average score of 51% and the raw score is 24 questions out of 46 included in the exam. This 3D descriptive statistics gives the distribution of observations in variables with the interaction plots and behaviour of the narrows in the relations to the variables showing less spread for the 2021-2022 virtual year period than the previous school years of 2020-2021.

Moments			
N	200	Sum Weights	200
Mean	32.28	Sum Observations	6456
Std Deviation	20.6886855	Variance	428.021709
Skewness	0.07359288	Kurtosis	-0.4127576
Uncorrected SS	293576	Corrected SS	85176.32
Coeff Variation	64.091343	Std Error Mean	1.46291098

Basic Statistical Measures			
Location		Variability	
Mean	32.28000	Std Deviation	20.68869
Median	33.00000	Variance	428.02171
Mode	0.00000	Range	83.00000
		Interquartile Range	25.00000

Tests for Location: Mu0=0				
Test	Statistic		p Value	
Student's t	t	22.06559	Pr > |t|	<.0001
Sign	M	82	Pr >= |M|	<.0001
Signed Rank	S	6765	Pr >= |S|	<.0001

The UNIVARIATE Procedure
Variable: BNCHMK

Moments			
N	200	Sum Weights	200
Mean	45.775	Sum Observations	9155
Std Deviation	18.3482332	Variance	336.657663
Skewness	0.35200337	Kurtosis	-0.5247214
Uncorrected SS	486065	Corrected SS	66994.875
Coeff Variation	40.0835243	Std Error Mean	1.29741602

Basic Statistical Measures			
Location		Variability	
Mean	45.77500	Std Deviation	18.34823
Median	43.00000	Variance	336.65766
Mode	43.00000	Range	78.00000
		Interquartile Range	28.00000

Tests for Location: Mu0=0				
Test	Statistic		p Value	
Student's t	t	35.28167	Pr > |t|	<.0001
Sign	M	100	Pr >= |M|	<.0001
Signed Rank	S	10050	Pr >= |S|	<.0001

Figure 20. STAAR 2020-2021 - Figure 21. Benchmark 2020-2021

Figures 20 and 21 are results for the univariate procedure for virtual classes. The idea for the benchmark is to predict future student scores for the STAAR exam. The results show a decline of 13.525 points in the mean, a decline of 10.000 points in the median and an increment of 2.341 points in the standard deviation.

The UNIVARIATE Procedure
Variable: BNCHMK

Moments			
N	200	Sum Weights	200
Mean	49.83	Sum Observations	9966
Std Deviation	20.970453	Variance	439.759899
Skewness	0.03638018	Kurtosis	-0.3156368
Uncorrected SS	584118	Corrected SS	87512.22
Coeff Variation	42.0839916	Std Error Mean	1.48283495

Basic Statistical Measures			
Location		Variability	
Mean	49.83000	Std Deviation	20.97045
Median	50.00000	Variance	439.75990
Mode	33.00000	Range	100.00000
		Interquartile Range	30.00000

Note: The mode displayed is the smallest of 3 modes with a count of 12.

Tests for Location: Mu0=0				
Test	Statistic		p Value	
Student's t	t	33.60455	Pr > |t|	<.0001
Sign	M	97.5	Pr >= |M|	<.0001
Signed Rank	S	9555	Pr >= |S|	<.0001

Figure 22. Benchmark 2021-2022

Figure 22 is the univariate result for in-person classes for 2021-2022 year period. Despite absences due to COVID-19 cases, students showed improvement of 4.055 in the mean, an improvement of 7.000 in the median and a increment of 2.633 in the standard deviation from previous benchmark. The latter means that the scores are more spread out than it was before.

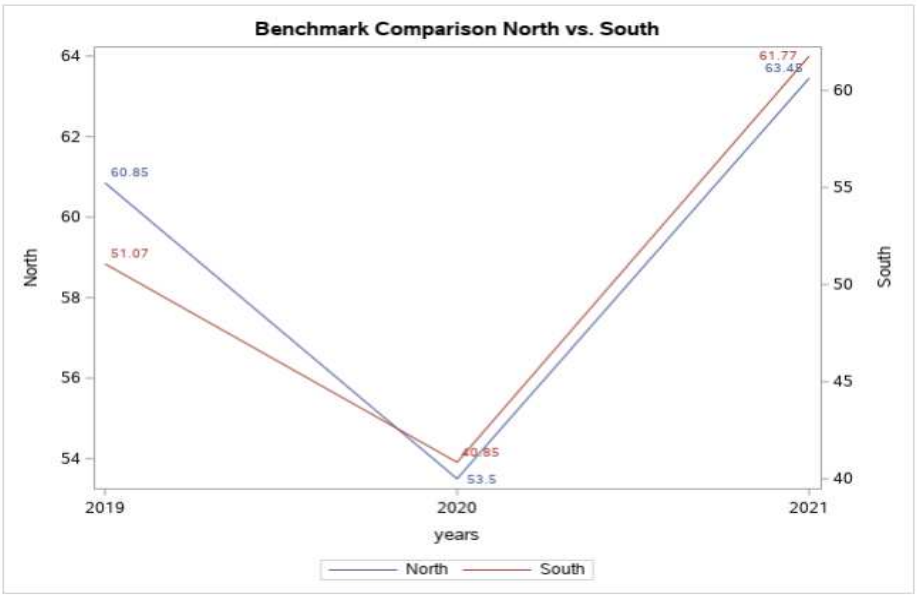


Figure 23. Benchmark Scores from 2019 to 2021

Figure 23 compares the mean benchmark scores for years 2019, 2020, and 2021 for school districts located in the south vs. north of Laredo. Six different data were matched to 200 students to make comparison more exact for the study. The significant difference between south and north are distinguishable. An approximate 3% more of students located at the south presented more absences during the benchmarks due to positive COVID-19 diseases than that of north.

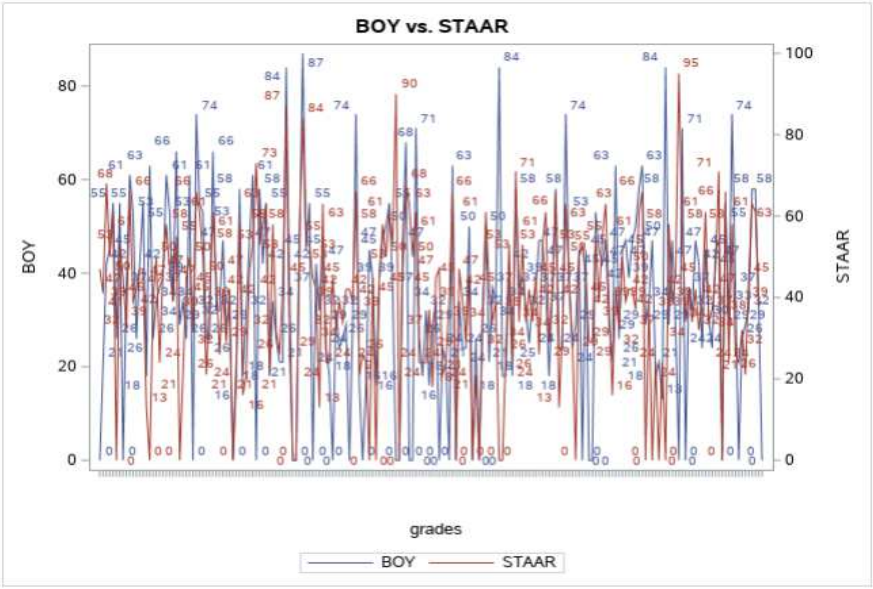


Figure 24. BOY Exam vs. STAAR Exam

Figure 24 is the scarlett point procedure, where 200 grades of BOY exams are compared to other 200 grades of the STAAR exams. The improvement and learning of students during 2020-2021 period have been decreased, but there still is an improvement for BOY vs. STAAR. During three years the final score (STAAR) is still highest than the first exam score (BOY). An average mean of 33.50 is presented for BOY exam, and an average mean of 38.21 is presented for the STAAR exam. The required score to pass the STAAR exam is 41 points out of 100. This implies that although students show learning loss over the years, more than 50% of students passed the final exam for the 7th grade students in Mathematics.

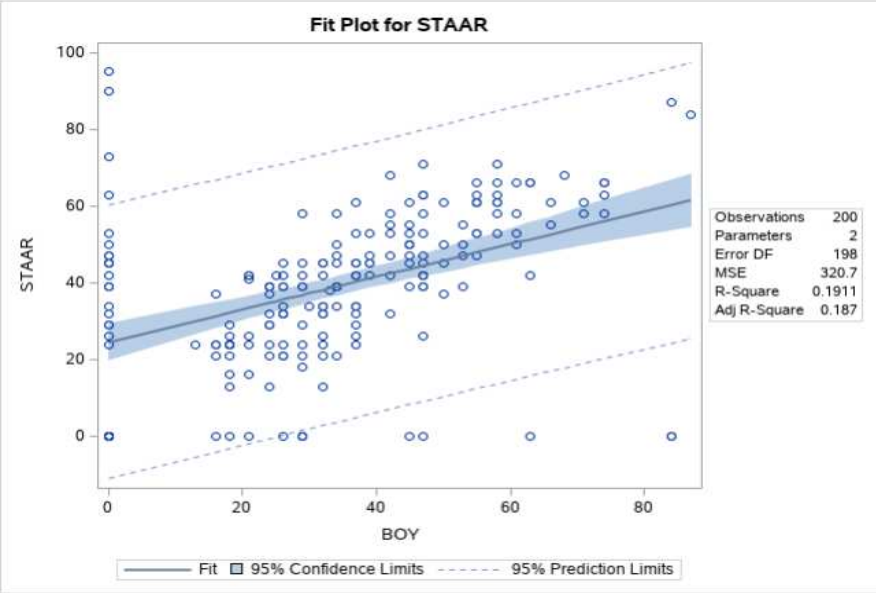


Figure 25. Regression for STAAR vs. BOY

For among 200 scores reported for STAAR and BOY exams as shown in Figure 25, the estimated measures of the mean square error shows the average of 320.700 for the two parameters, R-Square of 0.191 and adjunct R-Square of 0.187. This enables investors to measure the performance of mutual funds against that of a benchmark. This indicates a very low correlation with the index due to most of the students who were present very different scores between BOY and STAAR exams but giving a positive linear regression for STAAR vs. BOY meaning that a positively benefit from the beginning of the year period to the end.

6 Conclusions

During the pandemic that induced lockdown in 2019, schools in many countries were forced to close for extended period. It is of great policy interest to know whether students can have their educational needs met under these circumstances and to identify groups at special risk. This study addresses this question with uniquely rich data available on primary school students in UISD, Laredo, TX. ”There is clear evidence that students are less learning during lockdown than in a typical year [26].” These losses are evident from the 7th grade students taking Mathematics for STAAR with only one student at the master’s level with an 83% grade. The size of these effects is on the order of 3 percentile points or 0.08 of standard deviation for the year period, but students from disadvantaged homes are disproportionately affected by 6 percentile. The regression analysis shows a significant difference between the north and south sides of Laredo, where the north side has significantly benefited from benchmark scores for 2019, 2020, and 2021 years. The impact of the in-person education has been improved with this study it is also observed that the improvement of students by observing a total of 19 students may have been at the master’s level by the STAAR exam in 2022.

7 Conflicts of Interest Statement

The authors certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers’ bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Acknowledgement

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research project during the coursework of STAT 5390 Case Seminar in Applied Statistics in Spring 2022 at TAMIU. The authors would like to thank three reviewers for their valuable comments and efforts towards improving the manuscript.

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