POLICY BRIEF

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Enhancing Math Education in Texas Through Blended Learning: A District Case Study Highlighting Its Transformative Impact

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In 2018, the Texas Education Agency (TEA) introduced a competitive grant program designed to assist Local Education Agencies (LEA) in attaining Math Innovation Zone (MIZ) designation through a four-year process which ensures program fidelity. The primary objective of this initiative is to enhance math proficiency levels for PreK – 8th grade students through the implementation of a blended learning model in math classrooms. Blended learning (BL), recognized for its data-driven pedagogical approach, integrates specialized adaptive software with traditional in-person teaching. This combination equips teachers with the capability to promptly assess student comprehension in real-time during the learning progress, enabling them to deliver tailored interventions and extensions as needed to each student. The incorporation of direct teacher instruction and peer collaboration of traditional in-person teaching along with adaptive software providing a formative and self-assessment component for students in the blended learning approach empowers students, fostering active engagement and increased agency in their learning journey.

This policy brief presents a case study of a BL district in Texas. We analyze data from both before the implementation of the blended learning model through four years thereafter. Additionally, we assess whether more students are adequately prepared for enrolling in Algebra I in 8th grade, a key objective of the blended learning program. The focus on a single school district allowed for a nuanced examination, enabling a clearer understanding of the impacts when comparing BL campuses to non-BL campuses within the same district.

Key Findings

- Blended learning implementation in elementary campuses led to significant improvements in both average STAAR scores and the percentage of students achieving proficiency in math.
- The positive impacts of blended learning extend beyond specific grade levels to positively influence entire campuses.

Blended learning has a positive effect on student achievement.

- More students are scoring proficient in 8th grade Algebra I in blended learning campuses than before implementation.

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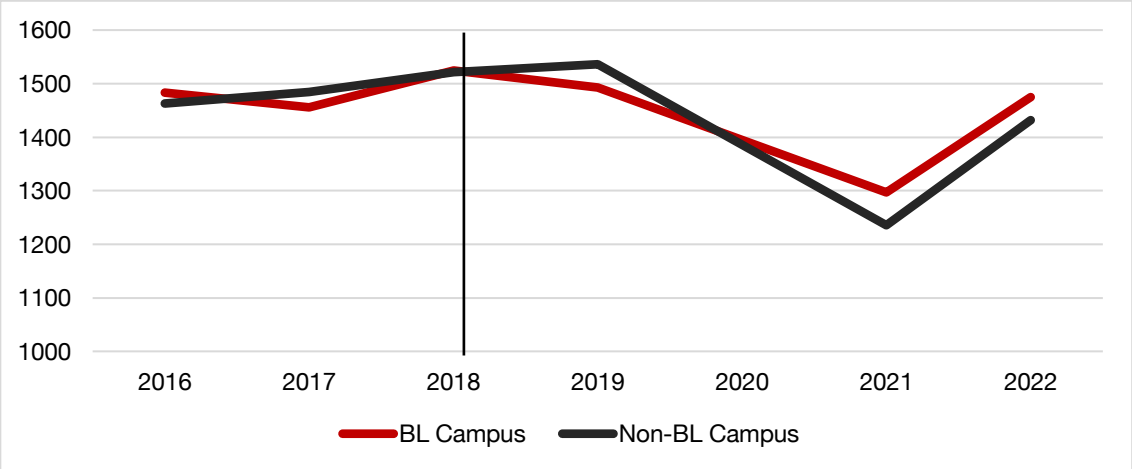
The district highlighted in this case study presents a commitment to academic success and student engagement, even though its demographic profile may suggest potential academic challenges. With a predominantly Hispanic or Latino student body and a significant portion classified as English Language Learners, coupled with a substantial number of students qualifying for free and reduced lunch, the district faces unique educational dynamics. While past academic achievements vary across grade levels, the district demonstrates graduation rates approaching 100%. This district was chosen for this case study since it continues to be innovative in its educational approach. We analyze the role that the blended learning model played across blended learning campuses and the rest of the district. Since we can compare schools within the same district with only a portion of campuses implementing the Blended Learning model, we are able to have a more similar research sample than if we compared districts from around the state.

Elementary School

Blended learning campuses had a 12-point greater gain in STAAR math scale scores.

Our initial analysis focused on 3rd – 5th grades. Identified BL campuses were examined, considering both the percentage of students proficient on the STAAR math test and mean STAAR scale scores, with a specific emphasis on the treatment effect of BL implementation. These were compared to our control campuses in the district that did not implement blended learning through the BL initiative. First, mean STAAR scale scores for each campus were assessed. As anticipated, mean STAAR scale scores increased for both the treated and control campuses during the sample period. BL campuses exhibited a 12-point greater gain than if blended learning had not been implemented, a statistically significant result.

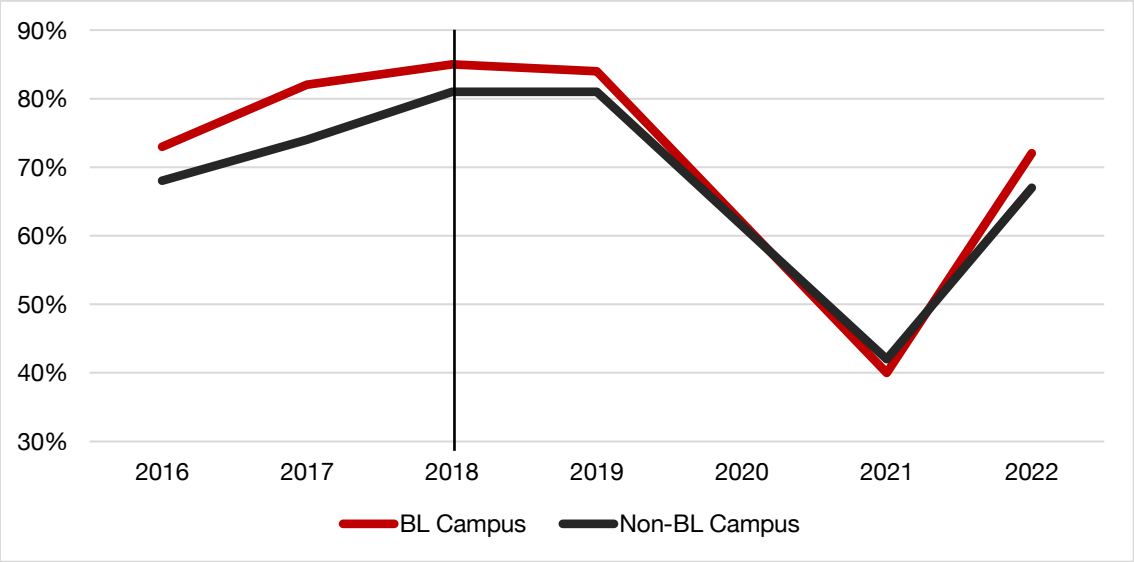
Figure 1. Elementary Mean Math STAAR Score Comparison



Note. This figure shows average yearly change in STAAR math scores for BL and non-BL campuses with the case study district. The vertical line in 2018 marks the beginning of the planning phase for BL implementation, whereas 2019 is the first STAAR test post-implementation. Results only include grades 3-5 data. There is no 2020 STAAR data because of the cancellation of STAAR in spring 2020.

Aligning with the goals of the blended learning grant, we further analyzed math proficiency levels, meaning the percentage of students that met grade level or above target scores. BL campuses demonstrated a 2% increase in students achieving a proficient STAAR score post-blended learning implementation, another statistically significant result. These findings suggest a positive effect of blended learning implementation on BL campuses, irrespective of grade-level implementation, possibly due to the campus-wide nature of professional development for teachers.

Figure 2. Elementary Proficiency Percentage in Math STAAR Comparison



Note. This figure shows average yearly change in the percentage of students who met grade level targets scores for BL and non-BL campuses with the case study district. The vertical line in 2018 marks the beginning of the planning phase for BL implementation, whereas 2019 is the first STAAR test post-implementation. Results only include grades 3-5 data. There is no 2020 STAAR data because of the cancellation of STAAR in spring 2020.

The decline in mean STAAR math scale scores and the percentage of proficient students after the onset of COVID can be attributed to various disruptions to education caused by the pandemic, namely school closures, remote learning challenges, and interruptions in regular academic routines. These unprecedented circumstances likely impacted students' learning experiences and contributed to the observed decline in math performance. However, despite these setbacks, BL campuses exhibited a more robust recovery in 2022 compared to non-BL campuses. This outcome suggests that the adaptable nature of blended learning to personalize student learning based on need may have better equipped schools to address academic challenges posed by the pandemic and facilitate student progress in math education during the recovery period.

It was expected that positive findings would be more apparent at the campus level rather than at specific grade levels based on prior research. Upon further examination at the individual grade level, no statistically significant findings were identified, aligning with expectations. However, noteworthy positive trends were observed in 3rd and 4th grade mean STAAR scores, with 3rd grade exhibiting a particularly significant increase. Blended learning implementation seemed to elevate mean STAAR scale scores by 42

points in 3rd grade, suggesting a potential beneficial impact of blended learning on academic performance at this grade level especially.

8th graders at Blended Learning campuses scored 297 points higher on the math STAAR test than expected after BL implementation.

Middle School

In our middle school analysis, focusing on grades 6th - 8th, we identified campuses within the district as either BL or non-BL as well. Like our elementary school analysis, we considered mean STAAR math scale scores and the percentage of students achieving a proficient level, including students taking Algebra I in 8th grade and those in traditional math courses. We disentangled 8th grade Algebra I rates and proficiency rates to assess one of the BL initiative's goals - increasing readiness for Algebra I in 8th grade.

The initial middle school analysis examined mean STAAR math scale scores for middle school students. While findings suggest a positive effect for BL campuses after treatment, with an increase in the expected mean by 93.8 points, this result is not statistically significant. Similarly, though BL campuses appear to increase by 5% for students scoring proficient, at grade level or above, on the math STAAR test, this, too, is not a significant result.

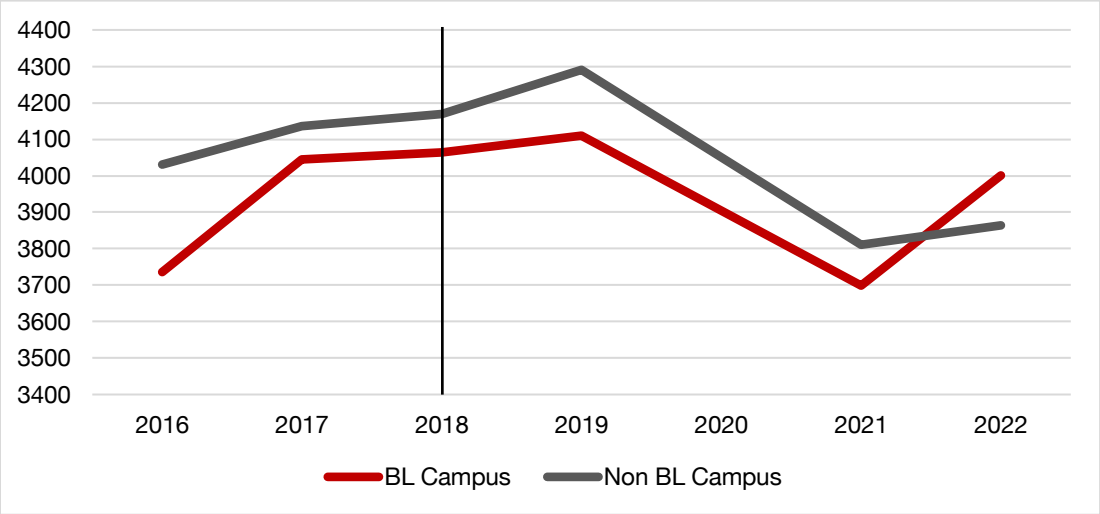
Like the elementary campus study, we disaggregated results based on grade level. Neither 6th nor 7th grade student scores exhibited statistically significant results, although positive effects were observed in 6th grade. An analysis of 8th grade scores, including both 8th grade math and Algebra I, in BL campuses was statistically significant. This suggests that students enrolled at a BL campus score 297 points higher on their 8th grade STAAR test relative to their predicted 8th grade score based on prior achievement before implementation. This aligns with the anticipated impact of the blended learning initiative which aims to increase math STAAR scores, particularly in 8th grade.

Similarly, to the elementary school outcomes, middle school math STAAR scale scores, and the percentage of students achieving proficiency experienced a decline immediately following COVID. BL middle school campuses appear to decline to lower levels than non-BL campuses but demonstrated a more robust recovery compared to non-BL campuses. Recall that this comparison is within the same district.

Finally, we assessed impacts on Algebra I readiness separately, given that this was a policy goal of blended learning implementation. Although the difference-in-differences estimation for Algebra I alone was not significant, it is crucial to highlight trends for BL campus both in the case study district and around the state. As the case study district

has a high poverty level (more than 75% of students receiving free and reduced lunch) according to NCES designation, similar comparisons were made to other districts in the state. The figure below describes all BL campuses in the state compared to non-BL campuses in the state who are categorized as high poverty campuses.

Figure 3. Mean Algebra I Scores – High Poverty Campuses in Texas

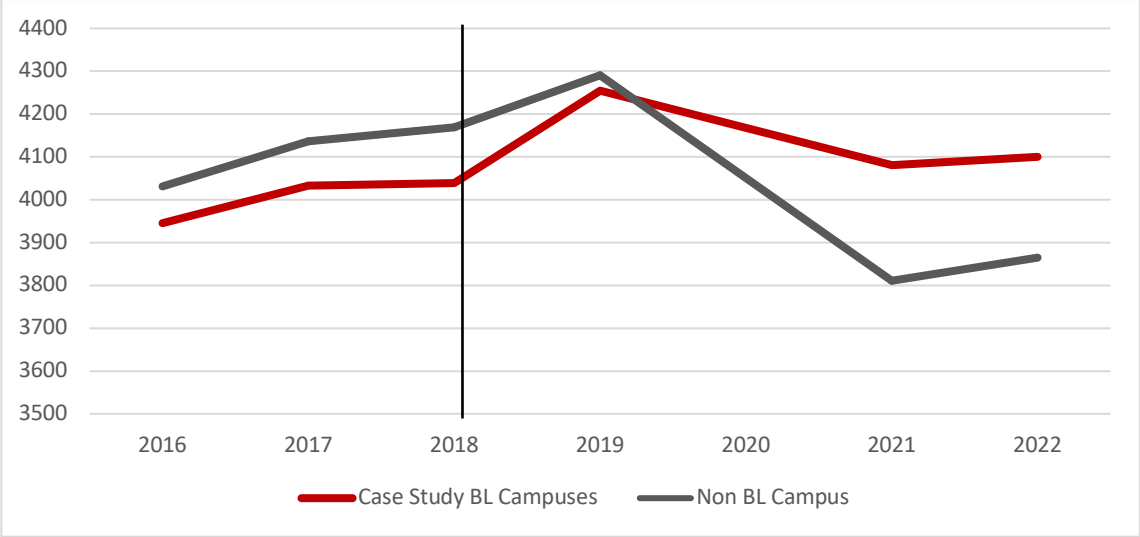


Note. This figure shows average yearly change in STAAR Algebra I scores for BL and non-BL campuses classified as high poverty in the state of Texas. The vertical line in 2018 marks the beginning of the planning phase for BL implementation, whereas 2019 is the first STAAR test post-implementation. Results only include grade 8 data for Algebra I students. There is no 2020 STAAR data because of the cancellation of STAAR in spring 2020.

This comparison is important since campuses with high percentages of economically disadvantaged students are anticipated to have greater academic challenges than other schools. In the context of this comparison, blended learning campuses across the state initially scored lower on the Algebra I STAAR assessment than non-BL campuses with comparable socioeconomic status. Although this comparison includes all campuses around the state, these campuses are in the same implementation cohort as the case study district. The introduction of the blended learning model occurred during the 2019 testing cycle which highlights the positive impact of blended learning on 8th grade Algebra I scores. While BL campuses experienced a more negative trend following the COVID-19 pandemic, their subsequent upward trajectory exhibits a steeper slope which indicates a more resilient and accelerated learning recovery post pandemic.

When looking at the performance of the case study BL campuses against non-BL campuses within the same district, Algebra I Scale Scores appear to have similar trends prior to BL implementation; however, BL campuses scored lower than compared to non-BL campuses. Yet like other findings, these scores exhibit a positive trajectory, particularly post-COVID, with case study BL campuses surpassing non-BL campuses.

Figure 4. Mean Algebra I Scale Scores – Case Study Campuses (Same District)



Note. This figure shows average yearly change in mean STAAR Algebra I scale score for BL and non-BL campuses within the case study district. The vertical line in 2018 marks the beginning of the planning phase for BL implementation, whereas 2019 is the first STAAR test post-implementation. Results only include grade 8 data for Algebra I students. There is no 2020 STAAR data because of the cancellation of STAAR in spring 2020.

Conclusion

Conducting a quantitative case study analysis on a specific blended learning district, spanning 2016-2022, allows us to discern the impact of the initiative by comparing campuses chosen for blended learning implementation by their LEA to those that were not. In addition, we compare similar socioeconomic campuses statewide to the case study district to better understand nuances within high poverty campuses. Using descriptive statistics and a difference-in-differences methodology, we focus on quantifiable data to assess the causal relationships associated with blended learning implementation. Our findings reveal improvements in mean STAAR scale scores and the percentage of students achieving proficient levels within the district with statistically significant results for elementary BL campuses. Recall that proficient means that a student is meeting grade level or higher expectations on the Texas state assessment in math. This suggests a positive correlation between the implementation of blended learning and the observed increase in mean STAAR scale scores and the percentage of students achieving proficiency on the STAAR test, relative to the assumed growth if BL campuses had not implemented blended learning.

Given that professional development often takes place at both the district and campus levels, rather than focusing on specific grade levels, our data indicates a broad positive impact of blended learning implementation across entire campuses, particularly in elementary schools. Notably, a statistically significant impact is observed in in 8th grade math for BL campuses. This is particularly noteworthy as it aligns with one of the major policy goals – promoting 8th grade math proficiency, specifically readiness for Algebra I. Furthermore, our findings suggest an increase in STAAR scores of students taking

Algebra I in 8th grade in addition to a higher percentage of students achieving proficiency in Algebra I for BL campuses. Future research involves large scale analysis at the state level to better understand correlations between blended learning implementation and student achievement, as well as the impact of blended learning implementation as a driver for increasing teacher retention.

Methodology

We use data obtained from the University of Houston's Education Research Center (UH-ERC) which contains all student demographic and achievement data for students attending Texas public schools. This study spans 2016-2022 to provide data for pre- and post-implementation and is limited to one district identified by publicly available data on the TEA website focusing on data for grades 3 – 8 STAAR math assessment data.

Using a Difference-in-Differences (DiD) approach, our study compares BL campuses within the district to those that were not BL campuses controlling for unobserved group and time effects. This methodology allows us to isolate the impact of the blended learning initiative by considering the differences in outcomes between the two groups over time. To ensure a robust analysis, we accounted for various factors, including student demographics and school characteristics. Additionally, we incorporated prior student achievement levels, using previous STAAR scores, to control for any initial disparities in student performance. Multiple assumption checks for DiD were used including visually observed parallel trends for the control and treatment groups prior to blended learning implementation which was further checked with a parallel trends test (estat ptrends) and evaluated by the Granger causality test (estat granger). Though our sample size was restricted to one district, there were ample student samples to ensure robustness and our error was clustered at the campus level. This approach enhances the validity of our findings by isolating the casual effect of BL designation on academic outcomes, providing a more accurate assessment of the programs impact within the district.

Research Team Bio

Kristin E. Mansell, Ph.D., is an Assistant Professor of Practice in Curriculum and Instruction at Texas Tech University. Her research is broadly focused on STEM education policy, the teacher workforce, increasing teacher efficacy through targeted professional learning communities, and the impact of blended learning and personalized learning on both student outcomes and teacher retention.

Heather Greenhalgh-Spencer, Ph.D., is an Associate Dean in the TTU Graduate School and an Associate Professor in Curriculum and Instruction. Her research emerges at the intersection of Educational Technology, Pedagogical Innovation, Personalized Learning, Engagement, and Global uses of Technology in STEM. Greenhalgh-Spencer explores practices of using technology and pedagogical innovation to create engaged learning in both formal and informal learning spaces, and in both national and global contexts. She explores issues in the STEM pipeline, and research embodied and transdisciplinary learning practices that increase engagement for all populations in STEM courses. Greenhalgh-Spencer also researches blended / personalized learning (BL/PL) and the ways that BL/PL can create diverse pathways and increased opportunities for all students. This has, most recently, translated into an increased focus on teacher retention and student support in areas where teacher turnover is an issue.