MEMORANDUM December 16, 2019

TO: Alyssa Howell
Mathematics Director, Office of Secondary Curriculum and Development

FROM: Carla Stevens
Assistant Superintendent, Research and Accountability

SUBJECT: **RELATIONSHIP BETWEEN IMPLEMENTATION FIDELITY OF IMAGINE MATH® AND HISD SECONDARY STUDENTS' EDUCATIONAL ACHIEVEMENT, 2018–2019**

Imagine Math® is an adaptive, online mathematics program designed to supplement in-class instruction. The program is a districtwide initiative aimed at students from grades six through twelve. This evaluation report examined the fidelity of implementation of Imagine Math® and the associations between its use and student achievement in Houston Independent School District (HISD) secondary schools in the 2018–2019 academic year. Comparisons were made between middle school and high school levels for implementation fidelity and 2019 STAAR mathematics performance levels.

Key findings include:

- Imagine Math® was made available to 110,416 students in 26 middle schools, 62 high schools, and 15 combined K–12 schools for a total of 103 schools for the 2018–2019 academic year.
- Average level of adherence to fidelity components approached expectation at middle schools and high schools.
- Frequency of use of Imagine Math® by teachers and analysis of the Imagine Math® reports for instructional purposes was low.
- Students' use of the program approached expectation, with high-school students completing the highest number of lessons followed by middle-school students.
- The most important predictor of middle school and high school students' 2019 academic achievement was their previous year's STAAR scale scores.
- The number of Imagine Math® lessons attempted with fidelity was a statistically significant predictor of student achievement; the more lessons attempted, the better the STAAR scaled score.

Further distribution of this report is at your discretion. Should you have any further questions, please contact me at 713-556-6700.

Carla J. Stevens CJS

Attachment

cc: Grenita Lathan
Yolanda Rodriguez
Silvia Trinh
Montra L. Rogers

HOUSTON INDEPENDENT SCHOOL DISTRICT

RESEARCH

Educational Program Report

MIGRANT EDUCATION PROGRAM
2018–2019

HISD | Research and Accountability
ANALYZING DATA, MEASURING PERFORMANCE.

2019 BOARD OF EDUCATION

Diana Dávila
President

Holly Maria Flynn Vilaseca
First Vice President

Elizabeth Santos
Second Vice President

Sergio Lira
Secretary

Susan Deigaard
Assistant Secretary

Wanda Adams
Jolanda Jones
Rhonda Skillern-Jones
Anne Sung

Grenita Lathan, Ph.D.
Interim Superintendent of Schools

Carla Stevens
Assistant Superintendent
Department of Research and Accountability

Venita Holmes, Dr. P.H.
Research Manager

Georgia Graham
Research Specialist

Houston Independent School District
Hattie Mae White Educational Support Center
4400 West 18th StreetHouston, Texas 77092-8501

www.HoustonISD.org

HISD | Research and Accountability
ANALYZING DATA, MEASURING PERFORMANCE.

EVALUATION REPORT

BUREAU OF PROGRAM EVALUATION

Relationship Between Implementation Fidelity of Imagine Math® and HISD Secondary Students' Educational Achievement, 2018–2019

Prepared by Georgia Graham

Abstract

Imagine Math® is a standards-aligned, adaptive, interactive online mathematics program designed to supplement in-class instruction for students. This evaluation report examined the fidelity of implementation of Imagine Math® and the associations between its use and student achievement in Houston Independent School District (HISD) secondary schools in the 2018–2019 academic year. Based on teacher results, the research showed that the average levels of adherence to fidelity components were approaching expectations for both middle schools and high schools. At the teacher-level, frequency of use of Imagine Math® by teachers and analysis of the Imagine Math® reports for instructional purposes was low. Nevertheless, student progress and students' use of the program, were approaching expectations. Results of multiple linear regression analyses showed that, at the teacher-level, the Data Analysis component was a consistent statistically significant predictor of student achievement across levels. At the student-level, however, the most important predictor of students' 2019 academic achievement was their previous year's STAAR scale score. The number of Imagine Math® lessons attempted with fidelity was also a statistically significant positive predictor of student achievement; the more lessons attempted the better the STAAR scaled score.

Background

Imagine Math® is an adaptive, online mathematics program designed to supplement in-class instruction. Imagine Math®, the program, formerly known as Think Through Math (TTM), was funded in 2013–2014 through the Texas Education Agency's Texas Success Initiative and was free to students in grades three through eight. Additional services may have been purchased by campuses to serve students enrolled in high school Algebra I courses (HISD, 2014). In 2017, HISD re-launched the program, as "a districtwide initiative aimed at students from grades six through twelve who exhibited below satisfactory performance on state assessments" (HISD, 2018, p.12).

Imagine Math® supports students and teachers with personalized, interactive math instruction through a research-based and standards-aligned curriculum (Imagine Learning, 2019). The program combines virtual and on-site teacher training, live teacher support, unique student motivation and contests, and adaptive instruction in a web-based learning system to help students learn math. Students are immersed in a language-rich curriculum that uses data to scaffold concepts for each learner, ultimately leading to deep understanding and college and career-readiness. Since the system is adaptive, students learn in their zone of proximal development with the right degree of challenge (Imagine Learning, 2019).

Introduction

The Imagine Math® model is guided by five basic tenets and eight classroom practices that provide guidelines for program training and implementation that lead to desired outcomes (Imagine Learning, 2019). The Imagine Math® website outlines the five basic pedogeological tenets of the model as being: (i) personalized learning driven by the Quantile® Framework; (ii) on-demand tutoring by certified math teachers; (iii) productive struggle with proactive intervention; (iv) math tools; and (v) a motivation system that develops confident thinkers. Research has supported these tenets as being key elements to improve student learning (An, 2004; Wang et al., 2015). The interrelationship between the program features is built on the Quantile® Framework for Mathematics. This framework is a universal scale for both assessment and instruction that is used for interpreting student performance (Lennon & Burdick, 2004; Williamson, 2006).

The classroom best practices for successful implementation can be summed up in eight student-focused and teacher-focused strategies (Imagine Learning, 2019). The three student-focused strategies

cover student usage: (i) students need to have dedicated computer time (lab schedule or computer cart schedule); (ii) 60–90 minutes of use (cumulative) per week; (iii) and, complete and pass 2–3 lessons per week or roughly 30 lessons a year to increase their scores (Imagine Learning, 2019). Each of Imagine Math® default grade level pathways consist of roughly 30+ lessons; hence, *Think 30*. This standard is largely grounded in research done between 1991 and 1999 with 632 junior high and high school students learning 9th grade algebra using a similar product like TTM for an average of 15–20 contact hours during the academic year (Meyer, Steuck, Miller, & Kretschmer, 2000).

The remaining best practices are teacher-focused, three of which are based on teacher strategies: (iv) a motivation plan, extra incentives and rewards for the class, is outlined and explained to students (i.e. pizza party); (v) students are encouraged to use Imagine Math® Notebook/Journal; and (vi) teachers should be reviewing these regularly. There are two best practices related to data usage: (vii) teachers are expected to review student data regularly; and (viii) conduct regular consultation with students regarding individual progress in Imagine Math®. Finally, teachers are expected to encourage students to use Math Help where available in the program (Imagine Learning, 2019).

Literature Review

The induction of technology in the classroom is premised on the belief that increased access and use of computers and digital tools will enhance teaching and learning outcomes, increase efficacy, and improve development of critical skills amongst students (Brown, & Warschauer, 2006; Fried, 2008; Keengwe, Onchwari, & Wachira, 2008; Sandholtz, Ringstaff, & Dwyer,1999). The use of innovative web-based technology, especially in the assessment phase, enhances students' learning in mathematics when the web-based assessment system is well designed and used correctly and in a timely manner (Nguyen, Hsieh, & Allen, 2006).

The focus here is not on the design of the system, but rather on the implementation of the intervention according to the program developers' design. "Fidelity of implementation is traditionally defined as the determination of how well an intervention is implemented in comparison with the original program design during an efficacy and/or effectiveness study" (O'Donell, 2008, p. 33). This is the extent to which the intervention corresponds to the originally intended program (i.e. adherence, compliance, integrity).

Factors that affect implementation fidelity

The literature highlights several factors that impede or facilitate implementation fidelity: teacher characteristics, classroom characteristics, and school characteristics. A cursory scan of literature on implementation of technology-based programs in schools identified a variation in technology usage across and between campuses, which was attributed to differences in implementation related to teacher roles, administration, professional development opportunities, and availability of supplementary program supports (Bebell & O'Dwyer, 2010; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010; Turnbull, 2002). The responsibility of implementing any school-based intervention falls squarely on the shoulders of the teachers; therefore, teacher characteristics are an important factor in implementation fidelity. According to Bebell & Kay (2010), it is impossible to exaggerate the influence of individual teachers in the success or failure of technology-based learning models because "teachers nearly always control how and when students access and use technology during the school day" (p. 47). Therefore, teacher buy-in for technology immersion is key to successful implementation (Shapley et al., 2010).

Research on teacher buy-in has identified that teachers are more likely to support school improvement projects when adequate training and resources are available, and support is provided by program developers and staff (Turnbull, 2002; Shapley et al., 2010). In looking at the implementation of a comprehensive school reform in relation to teacher buy-in, Turnbull (2002) found that teacher participation in the selection of a program was not a significant indicator for successful implementation. Rather, predictors of immediate and long-term buy-in included training and support, administration buy-in, and control over classroom implementation. Administrator buy-in was also identified by Bebell & Kay (2010) as an indicator of successful implementation. In looking at the implementation of educational technology in middle school environments, it was found that it was important to ensure that school administrators were on-board and believed that the program would be beneficial for the school. The variation in usage between schools of educational technology impacted the outcomes (Bebell & Kay, 2010).

In addition to teacher factors, research has also focused on classroom factors that increased implementation fidelity and the sustainability of quality program implementation by teachers (Hamre, Downer, Jamil, & Pianta, 2012). In a study of methods of implementation fidelity, McKenna, Flower, & Ciullo (2014) found that giving teachers control over how programs were being implemented in classrooms, allowed them to decide what changes were needed and how those changes are made without compromising fidelity of implementation. When fidelity is adequate, but student performance is lagging, teachers can reconceive and adjust the interventions to more adequately meet student needs (McKenna, Flower, & Ciullo, 2014). To ensure fidelity, teachers should be provided with additional coaching and feedback on intervention

delivery, comprehensive training and support (Darling-Hammond & Richardson, 2009).

Finally, it is important to take into consideration school characteristics when exploring implementation fidelity (McNamara & Hollinger, 2000). In a study that looked at school characteristics and student performance, Heck & Mayor (1993) defined school characteristics as more than administration buy-in. It included socio-economic profile of schools, campus leadership, teacher practices and behavior, extracurricular activities, and resources, both human and material, available at schools. What they found was that differences among schools were attributed to background characteristics of students and the demographic variables of the schools that they attended (Heck & Mayor, 1993). Another study concluded that the relationship between school environmental characteristics (e.g., student background, school size, school level) and school academic indicators (e.g., attitudes toward knowledge and achievement, staff professional development) were useful in explaining the types of outcomes that were produced (Berg & Cornell, 2016).

Conceptualizing implementation fidelity

Drawing on existing literature and the program logic model, linkages are built between activities and outcomes (Emshoff, 2008). Implementation fidelity is conceptualized as the extent that the intervention has been implemented as designed based on the components of the intervention (Caroll et al., 2007; Dane & Schneider, 1998; Dusenbury, Brannigan, Falco, & Hansen, 2003; Mihalic, 2004). Imagine Math® has identified five implementation components (Formative Assessment, Data Analysis, Leadership, Teacher Usage, and Student Progress). The literature has highlighted Teacher Buy-in and Training and Support as additional components of fidelity **(Table 1)**. These six components are then divided into the subcategories of *adherence* or *moderators* (Caroll et al., 2007). Adherence deals specifically with implementation fidelity, whether the intervention is being implemented as intended, while moderators refer to the examination of factors that impact the degree of fidelity (Caroll et al., 2007).

Research Questions

Based on HISD's prior exposure to TTM (now Imagine Math®), the Secondary Curriculum and Development Department at HISD made the Imagine Math® program available to all students in the district beginning in the 2017–2018 academic year. With this investment, it is essential to determine the impact of this web-based program on student performance, how these outcomes vary based on demographic characteristics, and elements of the implementation process that has helped to improve these outcomes. As such, the research questions are as follows:

1. To what extent was Imagine Math® implemented in HISD secondary schools?

2. What hindered or facilitated the level of fidelity of Imagine Math® in HISD secondary schools?

3. What were key factors that predicted Imagine Math® student performance on the 2019 STAAR Math 3–8 and Algebra 1 EOC exams?

Districts have access to a variety of web-based assessment and practice resources to improve students' academic achievement. However, poor implementation can adversely affect effectiveness. That is not to say that an inadequate response to an intervention could not also be a mismatch between the practice and the students' needs. It, then, becomes essential for districts to determine the degree to which they implement evidence-based practices as intended to determine if an inadequate student response is due to poor implementation or inappropriate selection of intervention. With increased investment in web-based resources, this study was designed to investigate the impact of the Imagine Math® program on secondary student performance on state-level assessments.

Table 1. Components of Implementation Fidelity

	Components	**Measures**
Adherence–*The degree that variables are implemented is the degree of implementation fidelity*	Data Analysis	Use of program reports to inform teaching
	Data Management	Ability to access and retrieve reports
	Frequency of Use	Time on site
	Leadership (MLE)	Leadership support of program
	Student Progress	Number of lessons attempted
Moderator –*Variables that affect level of achieved implementation*	Training and Support	Teacher received training and support
	Teacher Buy-in	Teacher perception of program

Identification of essential components

Method

For the 2018–2019 academic year, Imagine Math® was made available to 110,416 students in 26 middle schools, 62 high schools, and 15 combined K–12 schools; for a total of 103 schools, including charter schools.

Sample

The sample consisted of teachers who completed the online survey and their associated students which were linked through the Teacher Appraisal and Development System (TADS). A total of 247 teacher surveys were received, only 196 were completed and included in this analysis. The sample of survey respondents consisted of 55 teachers from middle schools, 128 from high schools, and 13 from schools with combined grades ranging from K-12. Survey respondents had an average of 9.2 years of teaching experience for middle schools (SD=8.9), 7.4 years of teaching experience for high schools (SD=7.1), and 9.1 years of teaching experience for combined schools (SD=6.5). The mean length of time using Imagine Math® for middle school teachers was 2.9 years (SD=1.3), 2.6 years for high school teachers (SD=1.3), and 2.7 years for teachers at combined schools (SD=.95).

The student sample was derived from the classroom of teacher survey respondents. The sample excludes students who were absent from the previous year's State of Texas Assessments of Academic Readiness (STAAR) 3–8 or STAAR End-of-Course (EOC) exams, given that previous year's mathematics performance constituted a baseline control. Only first-time test takers were included. Middle school students who took Algebra I were not included in the sample as the initiative was aimed at low performing students. Student demographic data were drawn from the Public Education Information Management System (PEIMS) Fall Resubmission files. The final analytic sample consisted of 44,592 students, of these 24,587 students (55.1%) had greater than zero lessons completed, while 8,907 (31.7%) of these students used the math software with fidelity. Most of the students, 53.0 percent (n=23,626) were enrolled in a high school, 38.2 percent (n=17,025) were enrolled in a middle school, and 8.8 percent (n=3,941) attended a combined K–12 school (**Appendix–A**, p. 12).

The ethnic composition of the sample was mainly Hispanic, with 57.0 percent at middle schools, 64.4 percent at high schools, and 51.5 percent at combined schools. Students identified as economically disadvantaged comprised 81.5 percent of the overall sample, 84.1 percent at middle schools, 81.0 percent at high schools, and 73.7 percent at combined schools. More than half of the students were at risk of dropping out of school. Specifically, 60.5 percent of middle school students, 62.8 percent of high school students, and 54.8 percent of students at a combined school were at-risk. Gifted and talented students made up 17.3 percent of the overall sample, with 17.3 percent at middle schools, 18.4 percent at high schools, and 10.5 percent at combined schools.

Data Collection

Teacher Survey. The teachers completed an online survey based on the Imagine Math® Implementation Rubric (2018). The rubric included benchmarks relating to teacher data usage, professional development, and report usage. The survey included measures of adherence, with teachers rating their level of agreement with statements on a 5-point Likert scale ranging from *strongly agree* (4) to *strongly disagree* (0) for two indicators: data usage (4 items) and leadership (3 items). Teachers used a 4–point Likert scale to rate their frequency of use of Imagine Math® reports to guide student intervention: 0 (*never review*) to 4 (*more than once a week*).

The survey also included measures related to teacher buy-in and training and support. The survey was disseminated from March 5–April 15, 2019, through several online platforms. Imagine Math® posted a link to the survey on the dashboard of district teachers, the survey was posted on the HISD HUB, and distributed via SurveyMonkey. Weekly email reminders were sent out to teachers, all secondary school principals, and campus math chairs. An academic memo was posted on HISD website announcing the survey. Each of the teacher-level components were coded as '1' for teachers who used Imagine Math® and '0' for those who did not.

Academic Achievement. The academic outcome measures were the 2019 spring administration of the STAAR mathematics for grades 6 to 8 and the Algebra 1 EOC exam results for grades 9 to12. The STAAR is a state-mandated criterion-referenced assessment that annually measures students' academic performance and achievement. Student scale scores on the 2019 STAAR spring administration was included in the study. Re-testers were not included in the study due to over exposure to both the program and outcome measures. Students' STAAR data used in this study were retrieved from Cognos, a data querying software. Outcomes were measured by comparing 2019 HISD student STAAR scores with those who met the vendor recommended usage level (fidelity) versus those who did not. Imagine Math® identifies fidelity of usage as the completion of two or more lessons per week, which would mean an average of 30+ lessons in the 2018–2019 academic year, Think 30. Based on the degree of fidelity, students who used the program with fidelity were coded as '1', without fidelity coded as '2' and those who did not use coded as '0'.

Measures

Student progress is measured using the number of lessons attempted variable, according to Imagine Math number of lessons attempted is the number of lessons

completed. Implementation fidelity was measured as the level in which *adherence* to Imagine Math® *components* and related *moderators* achieved the expected ideal level based on the implementation rubric (Appendix–B, p. 13). This involved gathering data on Imagine Math® components for each of the treatment groups and comparing school-to-school variations with the expectation of 'full' fidelity.

Adapting a process developed by Shapley, Sheehan, Maloney, & Caranikas-Walker (2010), the value for each component was computed relative to the maximum value of 4, which denotes full fidelity. The scales were standardized to allow comparisons across different components. A mean fidelity standard score was computed on the 0 to 4 scale for each indicator. *Z* scores were calculated to facilitate the grouping of several Likert-type items into a 'survey scale' using the factor analysis technique, Cronbach's alpha (α), to provide evidence that the components of the scale were sufficiently intercorrelated and that the grouped items measured the underlying variable (Sullivan & Artino, 2013). The Likert scales were normally distributed, and Cronbach's alpha showed reliability level for all fidelity components. The results of Cronbach's alpha ranged from .707 to .917, denoting a rating ranging from acceptable to excellent (**Appendix–C,** pp.14–15).

Data Analyses

Two approaches to data analyses were used. First, campus-level analyses used descriptive statistics (counts, mean, standard deviation, percentages) to describe how the Imagine Math® model and its components were implemented. This was followed by using mean standard scores to examine the relationship between implementation levels and student academic achievement. The second approach of analyses involved predictors that measured adherence to fidelity components (Data Analysis, Data Management, Frequency of Use, Leadership, and Student Progress) and moderators (Training and Support, and Teacher Buy-in) that supported fidelity. The dependent variable was students' performance on 2019 STAAR mathematics or Algebra 1 EOC exams. Students included in the analyses had a prior year STAAR mathematics score. Analyses were conducted separately for students in middle school and high school. The histogram and scatter plots of the residual indicated the assumption of normality, linearity, and homoscedasticity were all satisfied.

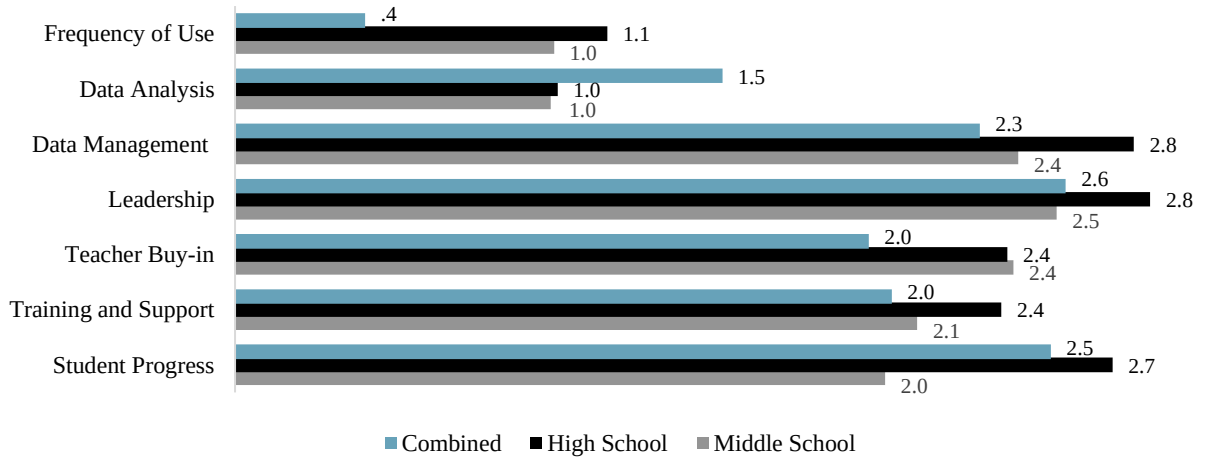
Students' 2019 STAAR scores were regressed on their previous years' STAAR scores, demographic characteristics, and Student Progress. Stage two investigated the association between treatment fidelity indicators and students' academic outcomes, which were regressed on students' previous years' STAAR scores, demographic characteristics, Student Progress, Frequency of Use, Data Analysis, and Data Management scores.

RESULTS

To what extent was Imagine Math® implemented in HISD secondary schools?

Figure 1 displays the mean fidelity scores by component and school level. Mean standard scores for fidelity components generally showed to be *approaching expectation* at the middle and high school levels. The two moderators, Teacher Buy-in and Training and Support, were also *approaching expectation*. Fidelity scores for Teacher Buy-in at middle school (2.4), high school (2.4), and combined school (2.0) levels showed that respondents found Imagine Math® useful to them and their students. Results showed that the mean standard score for Training and Support was highest for high schools (2.4), followed by middle schools (2.1), and combined schools (2.0). Training and Support was provided by the vendor and HISD staff designated as the

Figure 1. Mean Level of Implementation Expectation by School Level



Note: Progress towards fidelity was measured at three levels *below*, 0–1.99; *approaching*, 2.00–2.99; and *met*, 3.00–4.99.

Imagine Math® lead who assisted with implementation and offered support for product usage.

Leadership had the highest mean standard score across campus levels, reflecting *approaching expectation* at the high school level (2.8), middle school level (2.5), and at the combined school level (2.6). Respondents agreed that there was support for the use of Imagine Math® in the classroom by leadership, teachers were able to determine how to use the program in the classroom, and students had access to computers. Data Management was also *approaching expectation* with a mean standard score that ranged from 2.3 at the combined school level to 2.8 at the high school level. Based on the mean standard scores across campus levels, teachers agree**d** they had the ability to use the Imagine Math® program to retrieve reports and manipulate the program.

Adherence for Data Analysis and Frequency of Use was *below expectation*. The mean standards score for Data Analysis was the lowest at the high school level (1.0) and middle school level (1.0), compared to the combined school level (1.5). This showed that generally, survey respondents did not analyze data from Imagine Math® to identify needs of low standards and struggling students, apply an intervention or lesson according to the results, or adjust the program according to student needs.

The Frequency of Use was also *below expectation* at all three campus levels, high school (1.1), middle school (1.0), and combined school (.4), which showed limited use of the Imagine Math® program and reports. This was also evident by the number of times teachers logged onto the Imagine Math® website. Having the highest mean standard score for Frequency of Use, high school teachers had the highest number of logins in the school year on the Imagine Math® website (m=38.1) and spent on average 4.7 hours on the website. Middle school teachers who had a mean log in of 33.4 times in the school year spent an average of 3.3 hours on the website. While combined schools had a mean log in of 14.7 times in the school year and spent an average of 1.2 hours on the website.

Student Progress measured the strength of adherence to the use of Imagine Math® at the student level. The mean standard score for the number of lessons students attempted was *approaching expectation* at the high school level (2.7), combined school level (2.5), and middle school level (2.0). During the 2018–2019 academic year, Imagine Math® student usage data showed that students at middle schools had the lowest number of lessons attempted but, on average, attempted 486 problems, earned 6,714 points and used the software for 4.0 hours. High school students attempted, on average, 467 mathematics problems, earned 6,672 points, and used the software for 3.6 hours. Students who attended combined schools had the second highest score for Student Progress and only attempted, on average, 336 problems, earned 5,323 points, and used the software for 2.0 hours.

Table 2 displays the correlations among the seven components of fidelity, with statistically significant coefficients marked with an asterisk. Overall, there was a statistically significant association for six of the seven components. The association between Data Management and Data Analysis was statistically significant (*r=.50).* There was also a statistically significant association between Leadership support of teachers' use of Imagine Math® with Data Analysis (*r*=.38) and Data Management (r=.73). Teacher Buy-in to the use of Imagine Math® was associated at a statistically significant level with Data Use to inform instruction (*r*=.39), the ability to manage the software to assess student learning (*r*=.70), leadership encouragement and support for the use of Imagine Math® in the schools (*r*=.70), use of the software by teachers (*r*=.47). Training and Support showed the strongest possible agreement across all associations (r=.75). Student Progress was only positively associated with how frequently teachers used the software (*r*=.29).

What hindered or facilitated the level of fidelity of Imagine Math in HISD secondary schools?

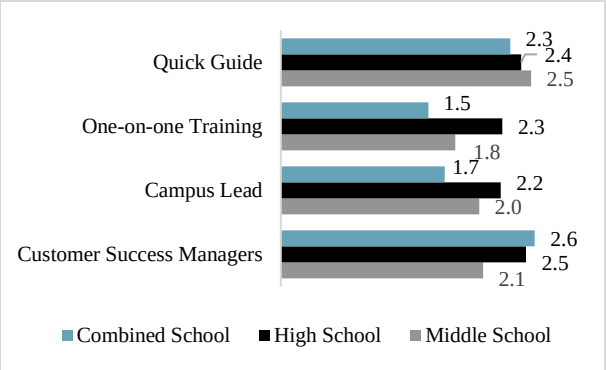
Training and support for Imagine Math® was provided by the vendor as well as district staff designated to guide product usage. The vendor provided support through one-on-one training, printed material (Quick Guide), professional learning events, and planning sessions. **Figure 2** shows the level of fidelity relative to the four elements of Training and Support Quick Guide, One-on-one Training, Campus Lead, and Customer Success Mangers.

Table 2. Correlations of Imagine Math® Fidelity Components

	Data Analysis	Data Management	Leadership	Frequency of Usage	Training and Support	Teacher Buy-in	Student Progress
Data Analysis	1.00 **						
Data Management	.50 **	1.00					
Leadership	.38**	.73 **	1.00				
Frequency of Usage	.63**	.59 **	.67 **	1.00			
Training and Support	.47 **	.71 **	.72 **	.54 **	1.00		
Teacher Buy-in	.39 **	.70 **	.70 **	.47 **	.75 **	1.00	
Student Progress	.15	.14	.03	.29 **	.01	.08	1.00

Note: * p<.05 **p<.01 ***p<.000

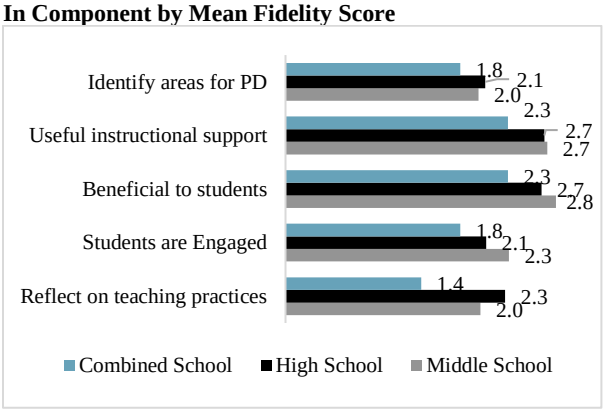
Figure 2. Level of Fidelity for Elements of the Training and Support Component by Mean Fidelity Score



On average, teachers reported a level of agreement with the benefits of the training and support for effective implementation as approaching a level of fidelity across all elements for each campus level. Teachers agreed that the Quick Guide was a helpful resource for setting up and using Imagine Math at the middle school level (m=2.5), high school level (m=2.4), and combined school level (m=2.3). Teachers also reported that the Customer Success Managers provided ongoing training and support for middle schools (m=2.1), high schools (m=2.5), and combined schools (m=2.6).

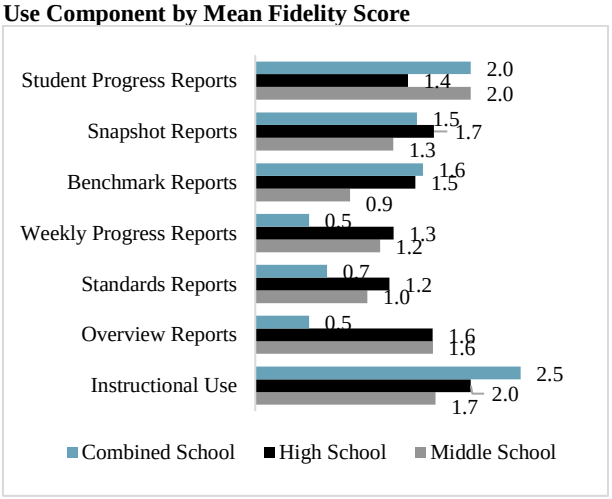
Imagine Math® was designed as a support not only for students, but teachers as well. Teachers were asked about their perception of Imagine Math® as being a useful tool for themselves and their students. This was measured using five elements that comprised the Teacher Buy-in component (**Figure 3**). Comparisons across campus levels indicated that teachers, on average, found Imagine Math® to be beneficial to their students and a useful instructional support (scores ranged from 2.3 to 2.8).

Figure 3. Level of Fidelity for Elements of the Teacher Buy-In Component by Mean Fidelity Score



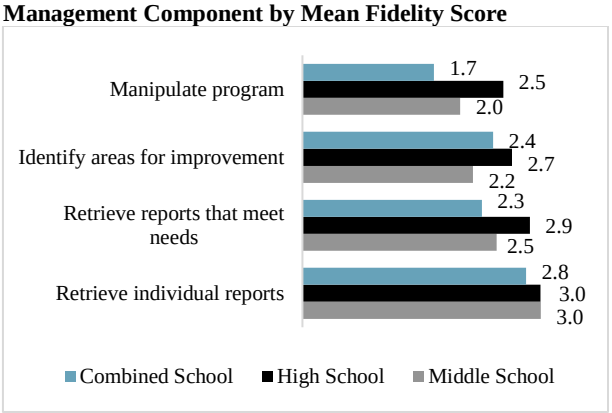
On average, teachers approached fidelity relative to frequency of use, with teachers at combined schools having the highest mean standard score (2.5), followed by high schools (2.0), and middle schools (1.7) (**Figure 4**). For fidelity of use, Imagine Math recommends that reports are accessed weekly. Results show that teachers, on average, used Imagine Math reports monthly. Frequency of use of Student Progress reports, on average, was *approaching expectation* at the middle school and combined school levels (2.0), and *below expectation* at the high school level (1.4). Teachers also reported that they used Imagine Math® to inform instruction on an as needed basis, for the most part. With teachers at the high school and combined school levels *approaching expectation* for instructional use and *below expectation* at the middle school level.

Figure 4. Level of Fidelity for Elements of the Frequency of Use Component by Mean Fidelity Score



The Imagine Math reports are designed to give teachers the information they need to help with student learning and ensure program success. To do so, teachers need to be able to access and retrieve the reports. Teachers' level of agreement with Data Management components assessed their ability to retrieve individual or group reports, identify areas where they need to adjust their instruction based on the reports, retrieve reports that best meet their needs, and manipulate the program to meet the math needs of individual learners (**Figure 5**).

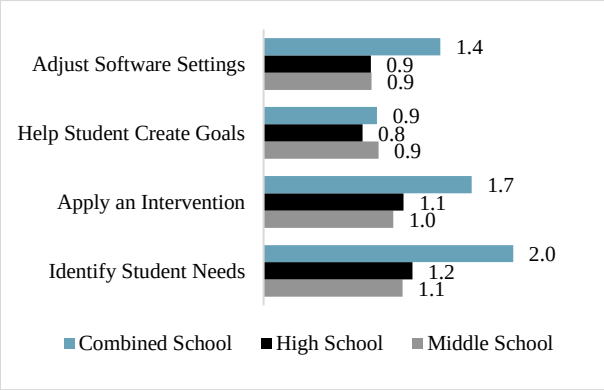
Figure 5. Level of Fidelity for Elements of the Data Management Component by Mean Fidelity Score



While teachers *approached expectation* on most of the elements of the Data Management component, manipulating the Imagine Math® program had the lowest mean fidelity score. However, teachers at the high school level showed the highest fidelity level related to manipulating the Imagine Math program (2.5), followed by middle schools (2.0). Teachers at the combined school level tended to fall *below expectation* (1.7).

The Imagine Math® reports provide information that supported teachers in identifying and addressing the needs of low standards and struggling students. Based on the data, teachers should be adjusting the software (groupings, settings, usage frequency, instructional pathway, or journaling), applying intervention and extension lesson(s), and helping students create goal(s) (**Figure 6**). The level of fidelity for all four elements of the Data Analysis component were *below expectation*, with one exception. Teachers were below fidelity in using Imagine Math to identify and address the needs of low standards and struggling students, with the lowest level of fidelity achieved by teachers at the middle school level (m=1.1), followed by high schools (m=1.2), and combined schools, which *approached expectation* (m=2.0). Additionally, teachers' responses were *below expectation* relative to applying intervention and extension lessons based on the data retrieved. Again, the lowest level of fidelity was at middle schools (m=1.0), followed by high schools (m=1.1), and then combined schools (m=1.7).

Figure 6. Level of Fidelity for Elements of the Data Analysis Component by Mean Fidelity Score



What were key factors that predicted Imagine Math® student performance on the 2019 STAAR Math 3–8 and Algebra 1 EOC exams?

The research examined key factors to predict the performance of HISD students, who were exposed to Imagine Math® on the 2019 STAAR Math 3–8 and Algebra 1 EOC exams. Correlations between the Imagine Math® components were reported in Table 2 (p. 6) and the regression statistics in **Appendix D**, **Table D1** to **D2** (pp 16–17). A two-stage hierarchical multiple linear regression was conducted to determine the extent to which students' 2018 STAAR math scale scores and demographic characteristics predicted the 2019 STAAR math scale scores for middle school and high school students (Model 1). The second model investigated whether teacher-level components (Data Analysis, Data Management, Frequency of Use, and Student Progress) predicted higher 2019 STAAR 3–8 math scale scores, after controlling for prior score, demographic characteristics, and number of Imagine Math® lessons completed.

The hierarchal multiple regression for middle school students, model 1, revealed that prior performance, being GT, at risk for school dropout, or Black contributed significantly to the regression model (*p<.000)* and accounted for 71.1 percent of the variation in 2019 STAAR 3–8 scale scores. Introducing the teacher level variables explained an additional .7 percent of the variation in 2019 STAAR 3–8 scale scores. The change in R^2 was significant *(p<.000).* Combined, the increase in student level and teacher level variables accounted for 71.8 percent of the variance in 2019 STAAR 3–8 scale score. The most important predictor of the 2019 STAAR 3–8 scale score was the previous years' scale score, which uniquely explained 70 percent of the variance in 2019 STAAR 3–8 scale score.

In terms of demographic characteristics, being Black was a significant predictor of the 2019 STAAR 3–8 math scale score (p<.01). The score of Black students decreased by 25.67 scale score points compared to White students. For students at risk of dropping out of school, the performance was 22.91 scale score points lower than for students not at-risk of dropping out (p<.000). As expected, the value on the 2019 STAAR 3–8 scale scores for GT students was 39.24 scale score points higher than for non-GT students (p<.000).

At the teacher level, Data Analysis and Frequency of Use were significant negative predictors of student performance. The predicted value of the scale score for students whose teacher analyzed the data from Imagine Math® was 20.42 scale score points lower than for students whose teacher received lower ratings on the Data Analysis component (p<.05). Similarly, students whose teacher frequently used the program resulted in 26.16 scale score points lower on 2019 STAAR 3–8 compared to those whose teachers did not use the program (p<.000).

Model 1 of the regression for high school students predicted 41.5 percent of the variance in the model *(p<.000).* The inclusion of teacher level variables, model 2, explained an additional 4.1 percent of the variation in students' 2019 STAAR Algebra I EOC scale scores. The change in R^2 was significant *(p<.000).* Combined, the student level and teacher level variables accounted for 45.6 percent of the variance in students' 2019 STAAR

Algebra I EOC exam scores. For model 1 and model 2, the previous years scale scores were the strongest predictor of 2019 STAAR Algebra I EOC exam scale score.

At the student-level, gender, at-risk status, GT, and home language accounted for a statistically significant amount of the variance in both models. Female students showed an average increase of 139.96 scale score points more than male students ($p<.000$). For students at risk of dropping out of school, the performance was 130.67 scale score points lower than for students not at-risk of dropping out ($p<.000$). The score of GT students increased by 140.12 scale score points compared to non-GT students ($p<.01$).

Students who identified their home language as Spanish showed an average decrease of 182.5 scale score points compared to those who spoke other languages ($p<.05$). This held true as well for students whose home language was English, the predicted value of their performance was 221.47 scale score points lower than for students who spoke other languages ($p<.000$).

With the addition of teacher-level variables, high school students who attempted thirty or more Imagine Math® lessons obtained, on average, an increase of 270.93 scale score points compared to those students who did not complete any lessons ($p<.000$). High school students whose teachers' fidelity component scores met expectations for managing the Imagine Math® website saw an increase of 133.33 scale score points compared to students whose teachers were below expectation for Data Management ($p<.000$).

Teacher usage had an inverse effect on student scale scores. Teachers who used Imagine Math® at least once a month showed a decrease of 49.87 scale score points compared to students whose teacher did not use Imagine Math® ($p<.000$). Similarly, the predicted value of scale score for students whose teacher analyzed the data from Imagine Math® was 91.16 scale score points lower than for students whose teacher received lower ratings on the Data Analysis component ($p<.01$).

Discussion

The overarching goal of immersing Imagine Math® into HISD secondary schools was to increase students' academic achievement as measured by the state assessment, STAAR. Therefore, it became important to understand whether Imagine Math® was associated with higher test scores. The evaluation used the Imagine Math® rubric and existing literature to develop a model of fidelity based on teacher- and student-level components. The evaluation examined how fidelity components used in the model linked to student outcomes.

The intention of the evaluation was to assess the predictive strength of variables that measured the extent to which Imagine Math® was used at the student and teacher levels. A two-level multiple linear regression model was used to determine if there was an association between student academic achievement and the number of lessons attempted. Moreover, the analysis sought to test the relationship between academic achievement by teacher-level components (Data Analysis, Data Management, Frequency of Use, and Student Progress).

It was found that across middle and high school levels, schools were *approaching expectation* on four of the seven fidelity components (Data Management, Leadership, Training and Support, and Student Progress). The strength of the association between these components was assessed. At the teacher-level, there was a statistically significant association among the six components of fidelity. However, at the student-level, the only significant positive association was between Frequency of Use by teachers and Student Progress; unfortunately, this was the component that had the lowest level of implementation fidelity.

Though there was a bivariate correlation only between Frequency of Use by teachers and Student Progress, the regression showed an association between Data Management and Data Analysis at the high school level and Data Analysis and Frequency of Use at the middle school level once other variables were controlled for. Of the three indicators that showed an association in the regression model, only Data Management had a positive association. This indicator had one of the highest mean level of implementation fidelity for high schools. The predicted value of scale score for students whose teacher managed the data from Imagine Math® to meet student needs was higher than for students whose teacher received lower ratings on the Data Management component.

With Data Analysis, at the middle school and high school levels, the predicted value of scale score for students whose teacher analyzed the data from Imagine Math® was lower than for students whose teacher received lower ratings on the Data Analysis component. Once again, the level of adherence to the Data Analysis component was *below expectation* across campuses. Based on the results for the adherence to fidelity components, many HISD teachers reported they did not use the software with fidelity or conduct the required data analysis to adjust the program to meet their students' needs. Imagine Math® recommends that teachers review reports on a weekly basis in order to adjust instruction to student learning (Imagine Learning, 2019).

While Frequency of Use showed a significant correlation to student performance it had the lowest level of fidelity component score across campuses. Though low, high school teachers had the highest usage and high school students achieved the highest Student Progress

(Figure 1, p. 5). When included in the regression model, Frequency of Use was a statistically significant negative predictor of student performance at the middle school level. The scale scores that a student would most likely achieve if his or her teacher would have used Imagine Math® were lower than for students whose teacher received lower ratings on the Frequency of Use component. Student Progress, the number of Imagine Math® lessons attempted, therefore, appears to be dependent on how frequently teachers use Imagine Math®.

At the student-level, the student's prior score predicted more of the variance at the middle school (70%) than at the high school level (51%). As a result, the Imagine Math® program predictors accounted for a larger percentage of the variation in student performance for high schools compared to middle schools. Being GT was also a statistically significant positive predictor of student performance at both campus levels. GT students who used Imagine Math® had a higher scale score than those who were not GT. Students who were at-risk of dropping out who used Imagine Math® tended to perform lower than their counterparts who were not at risk.

The number of Imagine Math® lessons attempted with fidelity was a consistently positive predictor of students' STAAR mathematics scores. Imagine Math® recommends that students attempt at least 30 lessons an academic year, Think 30 (Imagine Learning, 2019). The predicted value of scale score for students who attempted 30 or more lessons was higher than for students who completed fewer than 30 lessons. While the fidelity component for Student Progress, number of lessons attempted, was *approaching expectation* across campus levels, this did not align with the amount of time spent on the software or problems attempted. The number of problems attempted, hours spent on the software, or incentives may be key elements; however, students need to be encouraged to complete the lessons.

Teachers become critical to the success or failure of any technology-based learning model as they create opportunities for students to use technology, either in the classroom, at home, or through incentives. The influence that teachers may have on effective implementation of technology-based learning models could be attributed to teachers who use the program frequently as they appear to be more likely to create opportunities for students to do the same (Bebell & Kay, 2010).

The findings from this evaluation are consistent with previous research that found that the classroom best practices of Imagine Math®, when done with fidelity, are key elements that appear to contribute to the improvement in student learning (Meyer, Steuck, Miller, & Kretschmer, 2000). Teacher usage, data analysis, and data management, as well as student usage, are essential elements of the model. The District should provide continued support to increase students' and teachers' use of the Imagine Math® program and related reports to achieve the level of fidelity that would lead to improved student academic performance in mathematics.

References

An, S. (2004). *The Middle Path in Math Instruction: Solutions for Improving Math Education*. Rowman & Littlefield Publishing Group.

Bebell, D., & Kay, R. (2010). One to One Computing: A Summary of the Quantitative Results from the Berkshire Wireless Learning Initiative. *Journal of Technology, Learning, and Assessment*, 9(2).

Bebell, D., & O'Dwyer, L. (2010). Educational outcomes and research from 1: 1 computing settings. *Journal of Technology, Learning, and Assessment*, *9*(1).

Berg, J. K., & Cornell, D. (2016). Authoritative school climate, aggression toward teachers, and teacher distress in middle school. *School Psychology Quarterly*, *31*(1), 122.

Brown, D., & Warschauer, M. (2006). From the university to the elementary classroom: Students' experiences in learning to integrate technology in instruction. *Journal of Technology and Teacher Education*, *14*(3), 599–621.

Carroll, C., Patterson, M., Wood, S., Booth, A., Rick, J., & Balain, S. (2007). A conceptual framework for implementation fidelity. *Implementation Science*, *2*(1), 40.

Dane, A. V., & Schneider, B. H. (1998). Program integrity in primary and early secondary prevention: are implementation effects out of control? *Clinical Psychology Review*, *18*(1), 23-45.

Darling–Hammond, L., & Richardson, N. (2009). Research review/teacher learning: What matters. *Educational Leadership*, *66*(5), 46–53.

Dusenbury, L., Brannigan, R., Falco, M., & Hansen, W. B. (2003). A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. *Health Education Research*, *18*(2), 237–256.

Emshoff, J. G. (2008). Researchers, practitioners, and funders: Using the framework to get us on the same page. *American Journal of Community Psychology*, 41, 393–403. doi:10.1007/s10464-008-9168-x.

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education*, *50*(3), 906–914.

Hamre, B. K., Downer, J. T., Jamil, F. M., & Pianta, R. C. (2012). Enhancing teachers intentional use of effective interactions with children: Designing and testing professional development interventions. In R.C. Pianta (Ed.), Handbook of Early Childhood Education (pp. 507–532). New York, NY: The Guilford Press.

Heck, R. H., & Mayor, R. A. (1993). School characteristics, school academic indicators and student outcomes: Implications for policies to improve schools. *Journal of Education Policy*, *8*(2), 143–154.

Houston Independent School District [HISD]. (2018). District Improvement Plan 2-18-2019. Retrieved from https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7908/2018-2019%20District%20Improvement%20Plan.pdf.

Houston Independent School District [HISD]. (2014). Think Through Math in HISD, 2014–2015. Retrieved from https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/8269/pe_federalstateprograms/TTM%2014-15%20Report-Lissa.pdf.

Imagine Learning. (2019). *Imagine Math*. Retrieved from https://www.imaginelearning.com/programs/math.

Keengwe, J., Onchwari, G., & Wachira, P. (2008). Computer technology integration and student learning: Barriers and promise. *Journal of Science Education and Technology*, *17*(6), 560–565.

Lennon, C., & Burdick, H. (2004). The lexile framework as an approach for reading measurement and success. *electronic publication on www. lexile. com*.

McKenna, J. W., Flower, A., & Ciullo, S. (2014). Measuring fidelity to improve intervention effectiveness. *Intervention in School and Clinic*, *50*(1), 15–21.

McNamara, K., & Hollinger, C. L. (2000). Fidelity of problem–solving implementation and relationship to student performance. *School Psychology Review*, *29*(3), 443–461.

Meyer, T. N., Steuck, K, Miller, T. M., & Kretschmer, M. (April 2000). *Multi–year large–scale field studies of the fundamental skills training project's intelligent tutoring systems*. Paper presented at the annual meeting of the American Research Association, New Orleans. Retrieved from http://media.thinkthroughmath.com/images/Research/MultiYearFieldStudy.pdf.

Mihalic, S. (2004). The importance of implementation fidelity. *Emotional and Behavioral Disorders in Youth*, *4*(4), 83-105.

Nguyen, D. M., Hsieh, Y. C., & Allen, G. D. (2006). The impact of web-based assessment and practice on students' mathematics learning attitudes. *Journal of Computers in Mathematics and Science Teaching*, *25*(3), 251-279.

O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K–12 curriculum intervention research. *Review of Educational Research*, *78*(1), 33–84.

Sandholtz, J., Ringstaff, C., & Dwyer, D. (1999). Creating an Alternative Context for Teacher Learning. *Teaching with Technology: Creating Student-Centered Classrooms, Teachers College Press, NY*, 137-152.

Shapley, K. S., Sheehan, D., Maloney, C., & Caranikas–Walker, F. (2010). Evaluating the Implementation Fidelity of Technology Immersion and its Relationship with Student Achievement. *Journal of Technology, Learning, and Assessment*, 9(4).

Schneider, B. (1998). Program integrity in primary and early secondary prevention: Are implementation effects out of control. *Clinical Psychology Review*, 18:23–45.

Sullivan, G. M., & Artino Jr, A. R. (2013). Analyzing and interpreting data from Likert-type scales. *Journal of Graduate Medical Education*, *5*(4), 541-542.

Turnbull, B. (2002). Teachers' participation and buy–in: Implications for school reform initiatives. *Learning Environments Research*, 5, 235–252.

Wang, Z., Lukowski, S. L., Hart, S. A., Lyons, I. M., Thompson, L. A., Kovas, Y., … & Petrill, S. A. (2015). Is math anxiety always bad for math learning? The role of math motivation. *Psychological Science*, *26*(12), 1863–1876.

Williamson, G. L. (2006). *What is Expected Growth?* [White Paper]. Retrieved from Meta Metrics®, Inc.: https://www.friends.edu/wp–content/uploads/2015/08/ElectronicReference.pdf.

APPENDIX–A

Demographic Characteristics of 2018–2019 HISD Secondary Students by School Level

		Overall Sample		Middle School		High School		Combined	
		N	%	n	%	n	%	n	%
Gender	Female	20,832	46.7	7,838	46.0	11,066	53.2	1,928	48.9
	Male	23,757	53.3	9,185	54.0	12,560	46.8	2,012	51.1
Ethnicity	Black	10,464	23.5	4,667	27.4	5,076	21.5	721	18.3
	Hispanic	26,958	60.5	9,707	57.0	15,222	64.4	2,029	51.5
	White	3,119	7.0	1,653	9.7	1,897	8.0	501	12.7
	Other	4,051	9.1	998	5.9	1,431	6.1	690	17.5
Home Language	Spanish	21,315	47.8	7,818	45.9	11,331	48.0	2,166	55.0
	English	19,291	43.3	7,399	43.5	10,557	44.7	1,335	33.9
	Other	3,986	8.9	1,808	10.6	1,738	7.4	440	11.2
Economically Disadvantaged	No	8,245	18.5	2,713	15.9	4,494	19.0	1,038	26.3
	Yes	36,347	81.5	14,312	84.1	19,132	81.0	2,903	73.7
Immigrant	No	42,543	95.2	16,125	94.7	22,541	95.4	3,787	96.1
	Yes	2,136	4.8	898	5.3	1,085	4.6	153	3.9
Homeless	No	40,906	91.7	15,594	91.6	21,667	91.7	3,645	92.5
	Yes	3,686	8.3	1,431	8.4	1,959	8.3	296	7.5
At-Risk	No	17,282	38.8	6,717	39.5	8,785	37.2	1,780	45.2
	Yes	27,307	61.2	10,306	60.5	14,841	62.8	2,160	54.8
Gifted/ Talented	No	36,874	82.7	14,074	82.7	19,275	81.6	3,525	89.5
	Yes	7,715	17.3	2,949	17.3	4,351	18.4	415	10.5
SPED	No	41,031	92.0	15,724	92.4	21,627	91.5	3,680	93.4
	Yes	3,558	8.0	1,299	7.6	1,999	8.5	260	6.6

Source: 2018–2019 PEIMS student databases. Percentages may not total 100 due to rounding.

APPENDIX–B

Scoring Rubric for Measuring Fidelity of Implementation of Imagine Math® in HISD Schools

	Below Expectation	**Approaching Expectation**	**Met Expectation**
	0–1.99	2.00–2.99	3.00–4.00
Element			
Data Analysis	Teachers *disagree* or *strongly disagree* that they use data to inform instruction.	Teachers *agree* or *neutral* that they use data to inform instruction.	Teachers *strongly agree* that they use data to inform instruction.
Data Management	Teachers *disagree* or *strongly disagree* that they are able to manage IM site to meet their needs.	Teachers *agree* or *neutral* that they are able to manage IM site to meet their needs.	Teachers *strongly agree* that they are able to manage IM site to meet their needs..
Frequency of Usage	Teachers on average never review overview or standards reports pages in an academic year.	Teachers on average review overview or standards reports monthly in an academic year.	Teachers on average review overview or standards reports weekly in an academic year.
Leadership (MLE)	Teachers *disagree* or *strongly disagree* that administrator's encourage integration, provide supports, and work with staff frequently.	Teachers *agree* or *neutral* that administrator's encourage integration, provide supports, and work with staff frequently.	Teachers *strongly agree* that administrator's encourage integration, provide supports, , and work with staff frequently.
Student Progress	Students attempted 0 lessons in an academic year.	Students attempted 1 to 29 lessons in an academic year.	Students attempted 30 or more lessons in an academic year (*Think 30*).
Training and Support	Teachers *disagree* or *strongly disagree* that the vendor and trained Lead Staff provide training and support.	Teachers are *neutral* or *agree* that the vendor and trained Lead Staff provide training and support.	Teachers *strongly agree* that the vendor and trained Lead Staff provide training and support.
Teacher Buy-in	Teachers *disagree* or *strongly disagree* that Imagine Math is beneficial to them and their students.	Teachers *agree* or *neutral* that Imagine Math is beneficial to them and their students.	Teachers *strongly agree* that Imagine Math is beneficial to them and their students.

APPENDIX–C

Data Sources for Imagine Math Implementation Indicators

Indicator	Source	Item Description	Index Score	Standards-Based Score
Data Analysis Cronbach's alpha=.899	Teacher Survey	*Please indicate how each of the following statements apply to you regarding the use of Imagine Math® Reports* (Q17)I am able to identify and address the needs of low standards and struggling students. (Q18) I apply intervention and extension lessons based on the data. (Q19) I help the students to create goal(s) based on the report data. (Q20) I adjust the groupings / settings, usage frequency, instructional pathway, or journaling.	4-point scale Z score	0=Do not review standards 1=Monthly 2=Once per week 3=More than once per week
Data Usage Cronbach's alpha=.830	Teacher Survey	*Please indicate to what extent you agree or disagree with the following statements regarding your ability to use Imagine Math® to do the following:* (Q21) Retrieve individual or group reports. (Q22) Identify areas where I need to adjust my instruction based on the reports retrieved. (Q23) Retrieve reports that best meet my needs. (Q24) Manipulate the program to meet the math needs of individual learners.	5-point scale Z score	0=Strongly Disagree 1=Disagree 2=Neutral 3=Agree 4=Strongly Agree
Frequency of Usage Cronbach's alpha=.889	Teacher Survey	Q6. How often in the 2018 –2019 academic year have you used Imagine Math to inform your instruction?	6-point scale Z score	0=Never 1=As Needed 2=3-4 times a month 3=2 times a month 4=3 to 4 times a week 5=1 to 2 times a week
	Teacher Survey	Q9. How frequently do you review each data source? a) Overview Reports b) Standards Reports c) Weekly Progress Reports d) Benchmark Reports e) Snapshot Reports	4-point scale Z score	0=Never 1=Monthly 2=Weekly 3=Daily
	IM Database	Number of logins	Continuous variable -.77 to 3.49 *Z* score	
	IM Database	Time on IM website	Continuous variable -.76 to 3.53 *Z* score	
Leadership Cronbach's alpha=.707	Teacher Survey	*Please indicate to what extent you agree or disagree with the following statements:* (Q27) School administrators have supported the use of Imagine Math® in the classroom. (Q31) I can determine how best to use Imagine Math® in my classroom. (Q33) My students have access to computers to use Imagine Math® in my school.	5-point scale Z score	0=Strongly Disagree 1=Disagree 2=Neutral 3=Agree 4=Strongly Agree
	Teacher Survey	(Q4) How frequently in the 2018 – 2019 academic year has leadership worked with you to discuss student data (PLC) from Imagine Math®?	5-point scale Z score	0=Never 1=As Needed 2=Weekly 3=Every 6-weeks 4=Monthly

APPENDIX–C, *continued*

Indicator	Source	Item Description	Index Score	Standards-Based Score
Student Usage / Progress	IM Database	Total Lessons Attempted	Continuous variable -.61 to 19.73 *Z* score	
	IM Database	Earned Points	Continuous variable -.56 to 31.91 *Z* score	
	IM Database	Usage (Hours)	Continuous variable -.53 to 23.81 *Z* score	
Training and Support Cronbach's alpha=.858		*Please indicate to what extent you agree or disagree with the following statements relating to training and support for Imagine Math®.* (Q25) Imagine Learning Customer Success Managers have provided ongoing training and support. (Q26) The designated Imagine Math® Lead at my school is helpful (teachers or administrator that are trained to support other teachers). (Q28) The one–on–one training received from Imagine Math® staff helped me improve my math instruction to students. (Q29) The Imagine Math® Quick Guide is a helpful resource for setting–up and using the software.	5-point scale Z score	0=Strongly Disagree 1=Disagree 2=Neutral 3=Agree 4=Strongly Agree
Teacher Buy-In Cronbach's alpha=.917		Please indicate to what extent you agree or disagree with following statements relating to the usefulness of Imagine Math®. (Q30) Imagine Math® helps me to identify different areas of professional development that I need. (Q32) Imagine Math® helps me to reflect on my own teaching practices. (Q34) My students have access to computers to use Imagine Math® in my school. (Q35) Students are engaged and interested in the Imagine Math® Program. (Q36) Imagine Math® is beneficial to students to increase their math performance.	5-point scale *Z* score	0=Strongly Disagree 1=Disagree 2=Neutral 3=Agree 4=Strongly Agree
Outcome				
	Chancery Ad hoc	Performance on 3–8 STAAR or Algebra I EOC		

Note: Cronbach's Alpha: >.9 (Excellent), >.8 (Good), .7 (Acceptable), .6 (Questionable), > .5 (Poor), and < .5(Unacceptable)

APPENDIX–D

Table D1. Hierarchal Regression Models Predicting the Effects of Imagine Math® on HISD Middle School Students' Academic Achievement

	Model 1				Model 2			
	B	SE	*β*	*t*	**B**	SE	*β*	*t*
(Constant)	486.79	43.44		11.21	502.21	44.95		11.17
Scale Score STAAR 2017-2018	0.74	0.02	0.71***	31.20	0.73	0.03	0.70***	29.68
Gender	7.33	5.27	0.03	1.39	8.61	5.22	0.03	1.65
[Male]								
Economically Disadvantaged	1.77	7.85	0.00	0.23	-0.80	7.93	0.00	-0.10
At-Risk	-22.91	6.55	-0.08***	-3.50	-25.28	6.52	-0.08***	-3.88
GT	39.24	6.91	0.12***	5.68	38.54	6.85	0.11***	5.63
[0 is reference group]								
Home Language								
English	-21.88	11.85	-0.07	-1.85	-21.18	11.73	-0.07	-1.80
Spanish	-24.28	13.68	-0.08	-1.78	-20.37	13.59	-0.07	-1.50
[Other]								
Ethnicity								
Black	-25.67	10.53	-0.07**	-2.44	-30.62	10.58	-0.84*	-2.89
Hispanic	-10.58	10.83	-0.04	-0.98	-17.78	10.80	-0.06	-1.65
[White]								
Lessons Attempted (>30)					29.82	12.32	0.07**	2.42
Lessons Attempted (<30)					10.30	9.67	0.03	1.07
[Lessons Attempted =0]								
Points Earned					25.40	13.50	0.04	1.88
[PointsEarned =0]								
Data Management					3.60	9.89	0.01	0.36
Data Analysis					-20.42	7.00	-0.06*	-2.92
Frequency of Use					-26.16	6.46	-0.07***	-4.05
[0 is reference group]								
R^2				0.711				0.718
F				275.64				5.24

* p<.05 **p<.01 ***p<.000

DV 2019 STAAR 3-8 Mathematics. Students who took Algebra I in middle school not included.

Table D2. Hierarchal Regression Models Predicting the Effects of Imagine Math® on HISD High School Students' Academic Achievement

	Model 1				Model 2			
	B	SE	*β*	*t*	*B*	SE	*β*	*t*
(Constant)	391.32	222.15		1.76	361.76	239.17		1.51
Scale Score STAAR 2017-2018	2.31	0.12	.53***	19.05	2.21	0.12	0.51***	18.75
Gender	139.96	26.00	.14***	5.38	110.92	25.34	0.10***	4.38
[Male]								
Economically Disadvantaged	-41.82	41.35	-.03	-1.01	-86.86	40.48	-0.06	-2.15
At-Risk	-130.67	35.39	-1.07***	-3.69	-110.97	34.14	-0.91**	-4.17
GT	140.12	55.18	.07**	2.54	158.61	53.47	0.08***	2.46
[0 is reference group]								
Home Language								
English	-221.47	72.16	-.22***	-3.07	-153.92	70.54	-0.15**	-2.18
Spanish	-182.50	79.04	-.18*	-2.31	-126.21	77.11	-0.12*	-1.64
[Other]								
Ethnicity								
Black	19.57	67.13	-.02	-0.30	-55.76	65.42	-0.05	-0.85
Hispanic	-71.01	69.77	-.07	-1.02	-135.87	68.53	-0.13	-1.01
[White]								
Lessons Attempted (>30)					270.93	51.11	0.19***	5.30
Lessons Attempted (<30)					71.40	39.45	0.06	1.81
[Lessons Attempted =0]								
Points Earned					151.08	119.55	0.03	1.26
[Points Earned =0]								
Data Management					133.33	31.05	0.12***	4.30
Data Analysis					-91.16	30.79	-0.08*	-2.96
Frequency of Use					-49.87	32.22	-0.05	-1.55
[0 is reference group]								
R^2				0.415				0.456
F				73.97				14.26

* p<.05 **p<.01 ***p<.000