A Comparisons of State Test Performances of Public Schools and A Charter School System in Old and New Testing in Texas

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Abstract

This study examined the high schools' state tests performances in mathematics, reading, and science of an open-enrollment STEM-focused charter school system,Harmony Public Schools(HPS), between 2010 and 2013, and compared them with the performance of matched traditional public schools (TPS) in Texas. After propensity score matching, 12 HPS schools were compared with 32 matched public schools. Independent sample t-tests were performed to compare the schools' TAKS and STAAR scores in each year. One-way ANOVA was conducted to examine differences across years for each school type and Univariate General Linear Model was used to investigate if school type by year interaction had an effect on scores for each subject over the years. T-test results revealed that HPS scores were significantly higher than TPS scores in most of the categories. One-way ANOVA results showed that both TPS and HPS scores dropped significantly in most of the categories during the transition from TAKS to STAAR and univariate GLM analyses indicated significant interaction effects between school type and year variables for all but 10th grade mathematics.

Keywords: Performance, Charter, Public Schools, Propensity score-matching, Harmony Public Charters.

Introduction

Over the last decade, school choice for parents has grown immensely. Families can send their children to traditional public schools (TPS), charter schools, magnet schools, religious schools, or nonsectarian private schools (Butler, Carr, Toma, & Zimmer, 2013). Among those, charter schools have received the most attention and argument in the U.S. Charter schools are similar to public schools in terms of how they receive public money but have fewer rules, regulations, and laws including staffing, curriculum, and budget decisions compared to traditional public schools. Yet, it is expected them to produce higher student achievements.

In the past two decades, charter schools have become increasingly prevalent and popular in the U.S. and are now the fastest growing school choice option in the U.S. public school education system. More than 6,800 charter schools have opened, serving more than 2.9 million children in 42 states and the District of Columbia in the 2015-2016 school year (National Alliance for Public Charter Schools, 2016). In 2013, charter school students comprised more than four percent of the total public school population in the United States (National Charter School Study, 2013). Unsurprisingly, this number continues to grow every year: "Enrollment in public charter schools has grown six-fold in the past 15 years" (National Alliance for Public Charter Schools, 2016, p.1).

Despite the increase in demand for charter schools as an alternative to traditional public schools, few topics in education inspire as much debate as these schools. Some of the debates concern whether charter schools "skim the cream,"enrolling high-ability students at the expense of lower achievers left in traditional public schools (TPS) (see Zimmer, Gill, Booker, Lavertu, &Witte, 2009), or what educational impacts charter schools have in terms of student achievement (Zimmer, Gill, Booker, Lavertu, & Witte, 2009; Abdulkadiroglu et al., 2009, Booker, Gilpatric, Gronberg, & Jansen, 2007; Hanushek et al., 2007; Hoxby & Murarka, 2007; Sass, 2006; Bifulco & Ladd, 2006). Indeed, one of the main questions about charter schools is whether they are successful at increasing student achievement in line with the mission with which they were founded (Nathan, 1996). Therefore, studies that compare charter school performance with traditional public schools continue to be an area for researchers to examine.

The state of Texas adopted a new testing system in 2012. The State of Texas Assessments of Academic Readiness (STAAR®) replaced the Texas Assessment of Knowledge and Skills (TAKS). To the Texas Education Agency(2015),the new test is more rigorous and more comprehensivethan the previous one. This study aims to investigate Harmony Public Schools high school students' performance between the years of 2010 and 2013 by comparing the two different assessment types with matched TPS students' performance in the areas of reading,science, and mathematics. The rationale for choosing the HPS for this study is that it is the largest charter school network in Texas and second largest in the nation (Mead, Mitchel, & Rotherham, 2015), with 48 schools and more than 30,000 students, and has campuses across the state, including all metropolitan areas. Again, because the HPS has a campus in almost every major city in Texas and has been in service for more than 15 years, it offers a substantial basis to examine how both school types performed in the new testing system, which may also increase the chance of generalizability of the results to a larger population

Conceptual Framework and Review of Currently Relevant Literature

Tyack and Cuban (1995) argued that one of the most viable ways to improve education and society is to reform the public schools. The idea of reforming public schools was first ignited by *A Nation at Risk*, published in 1983 (Texas Education Agency, 2006). The National Commission on Excellence in Education, who prepared the report, suggested that the mediocre educational performance of American students would jeopardize the economic and innovative leadership of America. Accordingly, most states paid attention to school reform movements that aimed to provide well-rounded education to compete with the world. Consequently, charter schools and other choice programs joined the educational arena alongside public schools.

It was hypothesized that establishing a new school type with less regulation and greater autonomy would lead to increased innovation in running schools (TEA, 2007). In addition, those schools were given flexibility to use alternative curricula and non-standardized approaches. With this goal in mind, myriad charter schools with different focuses and styles were opened. The idea and hope behind this movement was to reap better outcomes for all students, regardless of ethnic and socioeconomic status. While the charter school movement and the performance of those schools have received a lot of criticism, it is especially necessary to examine and compare charter schools that have been in service long enough and are still growing to see if the school reform movement is reaping any benefits. In this study, our purpose was twofold: (1) We wanted to see how Harmony Public Schools' high school students' performances in mathematics, science, and reading compared between 2010 and 2013 with matched traditional public schools in Texas (2) We wanted to compare reactions of the two types of schools to the new testing system introduced in Texas.

Relevant literature focusing on both charter and traditional charter schools "was used to develop the skeletal structure of justification" (Eisenhart, 1991, p. 209) and serve as a guide for analysis and interpretation of the results.

Charter School Phenomenon

Many reasons for the emergence of charter schools have been suggested (Mehan & Chang, 2011). One of the claims is that public schools are failing to provide the equal opportunity each and every kid needs including students of color (Godsey, 2015). Therefore, voucher option might be an alternative solution to this problem(Chubb & Moe, 1990). The option of charter schools has been seen as a more viable and less radical alternative than the public funding of private schools with voucher plans (Hart & Burr, 1996). It is also believed that the idea of competition will bring success to failing traditional public schools, which is also a rationale for charter school initiatives (Mehan & Chang, 2011). What's more, it is believed that opening alternative schools like charter schools will bring competition and quality to the public education system. For instance, liberating teachers and administrators from many of the regulations and union contracts intrinsic to public school systems might help educators develop innovative teaching approaches with the goal of increasing students' academic performances (Bierlin, 1996; Mehan & Chang, 2011).

Despite the increased policy emphasis on charter schools and the growth in their numbers, studies comparing the performance of charter schools to public schools have revealed mixed results. In a meta-analysis of 26 studies ofstudent performance reports, Hassel and Terrell (2006) revealed that, in 12 studies, students in charter schools had larger gains than their peers in public schools. Four of 26 research showed charter schools had higher gains in elementary, high, and schools serving at-risk students. Authors also indicated that in four study, charter and public schools had comparable gains. Remaining four studies' findings revealed higher gains of public schools over charter schools. However, Carnoy et al. (2005) found different results based on 19 research studies conducted in 11 states and the District of Columbia where they suggested that there is no evidence in favor of charter schools showing charter schools outperform regular public schools. Zimmerman et al. (2009) also came up with similar results indicating that charter and public schools perform on par, except that charter schools seemed to have positive relationships between high school graduation and college enrollment. There is further research showing that public schools outperformed charter schools, either in general or in specific grades (e.g.,Betts & Tang, 2008; Loveless, 2002; Sass, 2006).

Recently, Stanford University's Center for Research on Education Outcomes (CREDO) (2013) presented an analysis of charter school effectiveness in 27 of the 43 states (including the District of Columbia) that permit charters to operate. They used student academic growth over the course of a school year as the outcome of interest. CREDO's comparison ofthe learning gains of students at charter schools to virtual peers in surrounding TPSs also found contrasting results, wherein students at elementary and middle charter schools had higher learning gains than TPS counterparts whereas charter and TPS high school students had similar growth in reading and math.

In other research, a group of researchers from the University of Arkansas examined the productivityof public charter schools. Wolf et al. (2014) studied the cost effectiveness, or return on investment (ROI), of different school types. They drew their conclusions based on how much money was invested in public charter schools and in TPSs and how much student achievement these school types generated. They found that, overall, the average charter in the study outperformed TPSs on both cost effectiveness and the ROI measures.

Thus, the available research on the comparison between charter schools and traditional public schools is mixed (e.g., Zimmer & Buddin, 2006). It is as easy to find research that indicates charter schools outperform TPSs as it is to find the opposite (Mehan & Chang, 2011). Although researchers may find the methodologies (i.e., single point in time) used in the studies problematic as to why we have different findings about charter schools (Betts & Hills, 2006, 2008; Mehan & Chang, 2011), the reason might have more to do with the varied quality of charter schools, i.e., some of them are run well and others not so well, just as in traditional public schools.

Review of the Literature on Texas Charter Schools and HPS

The State Board of Education (SBOE) was authorized to open a new type of public school with the 74th Texas legislature in 1995 (Texas Education Agency [TEA], 2011). Charter schools are publicly funded public schools that are nonsectarian and operate under a written contract, or charter, from an authorizing agency (Texas Education Agency, 2005). Like TPS districts, charter schools are monitored and accredited under the statewide testing (STAAR) and accountability system. TEA holds the school district accountable for the academic and financial performance of charter campuses. Duringthe 2013-2014 school year, Texas was among the states having the most charter schools(Deis,2011), with more than 689 open-enrollment charter schools serving around 238,000 students (National Alliance for Public Charter Schools, 2015).

There are two types of charter schools in Texas – district or campus charters, and open-enrollment (OE) charter schools. District charter schools, which are locally controlled with an elected school board from members of that district, can authorize the establishment of a campus school that will operate as a charter school. The SBOE grants eligible entities (e.g., public universities, non-profit organizations, and governmental institutions) charters to operate an open-enrollment (OE) charter school. Open enrollment charter schools may accept students from any school district, cannot charge tuition, and Charter schools do not have to provide transportation as traditional public schools do. OE charters may open campuses in more than one metropolitan area, serve only certain grades, and limit student enrollment.

School achievement in Texas charter schools.

In 2011, the Education Research Center (ERC) at Texas A&M University completed an evaluation of Texas charter schools from 2009-2010 and found mixed results – in some measures, charter schools did better than matched traditional public schools, charters underperformed at other measures, and there was no statistically significant difference between charter and matched public schools for some other measures.

Another study (Zimmer et al., 2012) examined charter school achievement at the student level. Charter stayers and switchers were compared, and charter stayers had significantly larger improvements in both math and reading in Texas, by 0.16 and 0.10 standard deviations respectively. Sahin et al. (2013) also studied the difference between the achievement of students enrolled in charter schools and non-charter public schools by grade level. They found that while charter schools performed slightly better at most upper grades, public schools generally performed better at lower grades.

The purpose of this study is to evaluate the success of HPS high schools that were opened prior to 2009, during the 2010-2013 school years. This study extends a prior study in which the Sahin et al. (2013) examined how charter schools in general and HPS specifically performed compared to matched public schools using two years of school level Texas Assessment of Knowledge and Skills(TAKS) math and reading scores. That study found that HPS schools performed better than all other matched schools for grades 4-11 in all subjects, with grades 6-11 statistically significant. We wanted to determine if this result would be confirmed in a longitudinal multilevel study with students in schools across years.

In another study, Sahin, Willson, Top, and Capraro (2014) studied the differences between HPS and traditional public schools (TPS) in high school mathematics, science, and reading achievements. HPS did better than the comparison group about "half of the time in mathematics, all the time in science, and with no statistically significant differences in reading" (p. 17).

Changes in Assessment System in Texas.

Texas adopted a new state assessment for the 2011-12 school year. The State of Texas Assessments of Academic Readiness (STAAR) replaced the Texas Assessment of Knowledge and Skills (TAKS). The new test was designed to bemore rigorous than the previous one. The rigor was increased by "assessing skills at a greater depth and level of cognitive complexity" in order to better measure the growth of higher-achieving students(Texas Education Agency, 2015). Assessments were increased in length as well. In addition,the number of open-ended items in science and mathematics, and writing tasks in writing and English were increased for the sake of more comprehensive assessment. Performance standards in STAAR were set in a way that it requires a higher level of student performance and the standards align across the grade levels: performance standards in TAKS were set separately and not aligned across the grade levels for all the subjects (Texas Education Agency, 2015). A new accountability system was also designed as a performance index framework and this is based on the STAAR tests. Performance indicators were grouped into four indexes that align with the goals of the accountability system. These indexes are student achievement, student progress, closing performance gaps, and postsecondary readiness (Texas Education Agency, 2013).

In the current study, we aimed to examine one particular charter school system and matched traditional public schools to see how their student achievement scores changed for mathematics, reading, and science from 2010 through 2013 in both testing types. The rationale for choosing the HPS for this study is that it is the largest charter school network in Texas and second largest in the nation (Mead, Mitchel, & Rotherham, 2015), with 48 schools and more than 30,000 students, and it has campuses across the state, including all metropolitan areas. Again, because the HPS has a campus in almost every major city in Texas, similar demographics with the matched traditional public schools (see Table 1), and has been in service for more than 15 years, it provides a broad base for comparison of the way both school types performed in the new testing, which may increase the chance of generalizability of results to a larger population.

This study may also help us replicate the best practices, if there are any, of the HPS and the findings may contribute to the ongoing debate on the effectiveness of charter schools. In addition, since the Texas assessment system went through major changes, it is pivotal to study how these two school systems reacted to these changes. The performance comparison of HPS and TPS on TAKS versus STAAR would yield productive results, especially when considering the latter assessment is claimed to be more rigorous and comprehensive in all areas, including mathematics and science.

This study sought answers to the following research questions:

1. How did HPS and matched traditional public high school students' mathematics, reading, and science performance change between 2010 and 2013 in TAKS and STAAR testing?
2. How did HPS and matched traditional public high school students react to the new testing of STAAR assessment in Texas?

Methods

Sample

The purpose of the study is to investigate how TPS and HPS high school students' TAKS mathematics, reading, and science and STAAR End of Course Exam (EOC) scores changed during the years 2010 and 2011, when TAKS was implemented, and 2012 and 2013, when STAAR was implemented. The data were obtained from the Texas Education Agency (TEA). The sample consisted of 8,322 TPS schools and 12 HPS high schools. After we eliminated schools with missing data, the final list of TPS schools was 7,185. We also removed all the schools that did not have high schools, after which the final high school list numbered 1,404.

Because there were some selective schools in the data set, including early college, magnet, and health career high schools, we removed them to make better comparisons. We also removed other charter schools because the goal was to compare HPS schools with traditional public schools. The final list to be matched included 1,292 public high schools. Since the HPS and TPS sample varied greatly in size and demographically by grade, we employed Propensity Score Matching.

Setting

HPS is a Texas-based charter management organization that operates 54 schools serving a diverse student population of more than 33,000 students. Sixty-one percent of these students receive free or reduced price lunch and 68% are from under-represented minorities. It has schools throughout Texas, including all metropolitan areas, focusing on science, computer technologies, engineering, and math education (STEM) to traditionally underserved students. In addition, all HPS high schools are designated as T(exas)-STEM schools, follow the STEM blueprint of Educate Texas, which grants its designation, and use the project-based learning (PBL) approach to teach STEM related courses in the belief that PBL prepares students better for college courses and helps them develop better workforce skills (Fortus, Krajicik, Dershimer, Marx, & Mamlok-Naaman, 2005). HPS has developed its own STEM teaching approach that incorporates project-based and inquiry-based learning with the federal grant, with the goal of increasing students' STEM knowledge and interest, and to produce self-motivated and self-regulated learners (HarmonyPublic Schools, 2013). Students in the HPS STEM approach have to complete multiple projects for each STEM course they take during their school year (Sahin & Top, 2015). Most of these projects are completed outside of classrooms and students have to produce multiple products, including a website, brochure, YouTube page, and digital presentation. According to Sahin and Top (2015), students who complete STEM projects develop important 21st-century skills, with a positive attitude towards STEM subjects and their schools. In summary, it might be of interest for educators to see how a charter school system with STEM focus and a unique PBL approach performed with the new testing system.

Matching procedure.

Propensity matching (Guo & Fraser, 2012) was employed, including the following variables: 9th grade percent mathematics and reading passing (MPP2010 and RPP2010 respectively), current school total enrollment (Enrol2010), percent African-American (AAP2010), percent Hispanic (HP2010), percent special education (SED2010), and percent economically disadvantaged students (ECOP2010) as indicated by free and reduced lunch status in the school. We assumed no other available variables would contribute meaningfully to the procedure. The Nagelkerke R-square predicting school type was .548. The HPS schools all fell in the bottom 10 percent of the propensity score distribution. Since it was not possible from the distribution to evenly match two public schools to each HPS school, we used the nearest neighbor procedure, resulting in 44 high schools; 32 public and 12 HPS. HPS schools have been in operation since 2000, so the oldest HPS high school among the 12 was 8 years old.

Variables

Independent variable.

The primary independent variable was school status (charter versus non-charter), which was coded to compare the 12 HPS schools' students with the public schools' students.

Dependent variables.

For the analyses, students' mathematics, reading, and science testing raw scores for TAKS and STAAR were the primary dependent variables examined. High school mathematics testing in the TAKS focused on Algebra I, Geometry, and Algebra II, which were assessed in grades 9th to 11th, respectively. The STAAR EOC testing was done separately in Algebra I, Geometry, and Algebra II in 9th, 10th, and 11th grades, respectively. Reading was also assessed in English I, English II, and English III in 9th, 10th, and 11th grade until 2014, respectively. STAAR testing started for the first time in the 2011-2012 school year and only 9th graders were tested on Algebra I, English I, and Biology. Grades 9th to11th testing by subjects and test types are given in Table 2 below.

Campus	Enrol2010	AAP2010	ECOP2010	HP2010	SEDP2010	MPP2010	RPP2010
Charter-1	735.0	7.8	18.5	20.8	1.9	99	99
Charter-2	274.0	12.8	57.3	35.4	3.3	80	90
Charter-3	689.0	2.8	68.1	89.3	2.2	84	90
Charter-4	620.0	13.9	34.4	28.1	4.7	93	97
Charter-5	379.0	18.7	78.6	58.0	5.8	81	87
Charter-6	768.0	7.6	53.4	65.8	5.7	81	94
Charter-7	433.0	8.8	70.0	53.8	2.5	93	97
Charter-8	395.0	29.4	80.8	43.3	1.8	86	94
Charter-9	310.0	5.8	73.5	75.5	4.2	91	93
Charter-10	633.0	24.0	35.5	22.7	3.0	96	96
Charter-11	776.0	12.4	79.9	71.9	2.8	93	94
Charter-12	502.0	27.7	42.8	17.1	4.8	82	89
TPS-1	159.0	0.0	92.5	91.2	6.9	88	88
TPS-2	159.0	0.6	44.0	1.3	6.9	86	91
TPS-3	220.0	0.5	30.9	18.6	4.5	90	96
TPS-4	1076.0	0.5	94.6	99.2	5.4	83	85
TPS-5	923.0	21.1	51.8	25.7	7.8	92	96
TPS-6	2346.0	5.1	10.8	11.8	5.5	91	99
TPS-7	103.0	0.0	75.7	20.4	6.8	79	86
TPS-8	206.0	0.5	35.0	39.3	5.8	96	94
TPS-9	515.0	0.2	27.0	30.5	6.0	83	94
TPS-10	119.0	0.8	74.8	94.1	4.2	66	83
TPS-11	156.0	0.0	66.7	33.3	3.8	68	74
TPS-12	233.0	1.3	55.4	30.5	8.2	93	96
TPS-13	252.0	0.0	4.0	2.8	4.4	96	99
TPS-14	223.0	1.3	61.9	48.9	3.6	82	88
TPS-15	118.0	3.4	43.2	10.2	5.9	95	99
TPS-16	377.0	0.0	89.9	96.3	4.2	77	85
TPS-17	220.0	1.4	60.9	11.8	6.4	94	96
TPS-18	280.0	0.4	71.4	66.8	5.0	77	89
TPS-19	176.0	1.1	26.7	9.7	5.1	96	97
TPS-20	187.0	0.0	74.3	28.3	8.6	80	91
TPS-21	170.0	14.7	61.2	47.1	5.3	82	93
TPS-22	1441.0	2.6	82.2	95.2	5.6	65	84
TPS-23	171.0	2.3	69.6	25.1	9.4	84	87
TPS-24	316.0	23.7	6.0	14.6	3.5	87	99
TPS-25	303.0	20.8	48.8	19.1	3.3	94	98
TPS-26	57.0	1.8	43.9	57.9	1.8	84	95
TPS-27	158.0	6.3	75.9	61.4	6.3	80	88
TPS-28	315.0	0.0	96.5	98.1	5.1	85	92
TPS-29	206.0	2.9	59.7	40.3	5.8	88	90
TPS-30	556.0	3.4	10.1	10.6	6.1	93	99
TPS-31	397.0	0.5	54.9	57.2	6.0	86	90
TPS-32	412.0	2.4	25.0	4.1	7.0	88	97

Table 1. Matched Schools' 2010 Demographics

Grades	2010 TAKS	2011 TAKS	2012 STAAR[6]	2013 STAAR
9	Math[1], ELA	Math, ELA	Algebra I, English I Reading, English I Writing, Biology	Algebra I/Geometry, English I Reading, English I Writing, Biology
10	Math[2], ELA, Science[3]	Math, ELA, Science	N/A	Geometry/Algebra II, English II Reading, English II Writing, Chemistry
11	Math[4], ELA, Science[5]	Math, ELA, Science	N/A	N/A

[1] Math was comprised of questions from middle school mathematics and Alg I content.
[2] Math was comprised of questions from Alg 1 and Geometry contents.
[3] Science was comprised of questions from Biology and Chemistry contents.
[4] Math was comprised of questions from Alg1, Geometry, and Alg2 contents.
[5] Science was comprised of questions from Biology, Chemistry, and Physics
[6] For STAAR EOC tests, they are not grade specific but subject specific and the tests are taken right after the course is taken. So, for example, an 8th grade student taking algebra takes the test in 8th grade.

Table 2. TAKS and STAAR Tests by Grade and Subject

Analyses

After we matched the 12 HPS high schools with traditional public high schools, we used SPSS 22.0.0 to conduct independent t-tests on binary outcomes for grades 9th and 10th to compare TPS and HPS TAKS and STAAR scores in given years. We did not compare 11th grade scores because STAAR testing was administered to 11th grade students for the first time in the 2013-2014 school year. Also, there was no testing for 10th grade reading, mathematics, and science during 2012, so there were no data for those. Because TAKS mathematics and science testing were a mixture of related subjects (e.g., science testing included questions from biology, chemistry, and physics), we calculated 2013 science scores by taking the average of EOC biology, chemistry, and physics scores. Likewise, we calculated 2013 10th grade mathematics scores by taking the average of 10th grade geometry and algebra II scores. Line graphs illustrate how schools' performance changed by years and testing system. Because students were tested in science only in 10th grade, we compared TAKS with STAAR scores only for 10th grade.

For the second research question, we first standardized all scores in order to make comparisons across the years. This process included first transforming all the row scores into Z-scores and then converting Z-scores into T-scores having a mean of 50 and a standard deviation of 10. Then, one-way ANOVA was conducted to examine differences across years for each school type and the univariate General Linear Model was used to discover if group variable, or year variable, or group by year interaction has an effect on scores for each subject over the years.

	School Types	N (# of Students)	Mean	t	Sig. (2-tailed)
M_2010_9th	TPS	2525	.6623	-1.730	.035
	HPS	316	.7387		
M_2011_9th	TPS	2254	.6439	-6.341	.000
	HPS	401	.7388		
AlgI_2012_9th	TPS	1842	.5569	-.7223	.000
	HPS	550	.6200		
AlgI_2013_9th	TPS	2010	.5376	-12.743	.000
	HPS	633	.6472		

Table 3. 2010-2013 9th Grade Mathematics Performances by Test Type, TPS versus HPS

Results

Grade 9 Mathematics

For the first question, independent t-tests were run to see how 9th grade students' mathematics scores differed by school types. HPS schools had statistically significantly higher scores than their counterpart schools, traditional public schools, in each year regardless of testing type.

Grade 9 Reading

For 9th grade reading, HPS schools statistically significantly outperformed TPS in all years regardless of test type (see Table 4).

	School Types	N (# of Students)	Mean	t	Sig. (2-tailed)
	TPS	2530	.7249	-4.981	.000
R_2010R_9th	HPS	315	.7943		
	TPS	2257	.7436	-5.634	.000
R_2011_9th	HPS	403	.8201		
	TPS	2083	.6292	-3.636	.000
R_2012_9th	HPS	653	.6585		
	TPS	2247	63.74	-4.246	.000
R_2013_9th	HPS	871	67.40		

Table 4 . 2010-2013 9th Grade Reading Performance by Test Type, TPS versus HPS

	School Types	N (# of Students)	Mean	t	Sig. (2-tailed)
	TPS	1416	.7345	-.256	.798
M_2010_10th	HPS	125	.7396		
	TPS	1607	.7333	-2.373	.018
M_2011_10th	HPS	271	.7667		
	TPS	N/A	N/A	N/A	N/A
AlgII_2012_10th	HPS				
	TPS	1302	.6113	-4.995	.000
Mer_AlgII_Geo_2013_10th	HPS	541	.6619		

Table 5. 2010-2013 10th Grade Mathematics Performances by Test Type, TPS versus HPS

	School Types	N (# of Students)	Mean	t	Sig. (2-tailed)
	TPS	1428	.6342	-.123	.902
R_2010_10th	HPS	126	.6357		
	TPS	1602	.6206	-4.033	.000
R_2011_10th	HPS	272	.6596		
	TPS	N/A	N/A	N/A	N/A
R_2012_10th	HPS	N/A	N/A		
	TPS	395	.5045	-18.504	.000
R_2013_10th	HPS	624	.7328		

Table 6. 2010-2013 10th Grade Reading Performances by Test Type, TPS versus HPS

	School Types	N (# of Students)	Mean	t	Sig. (2-tailed)
	TPS	1421	.7274	.238	.902
S_2010_10th	HPS	121	.7226		
	TPS	1608	.7379	-3.201	.001
S_2011_10th	HPS	271	.78.32		
	TPS	N/A	N/A	N/A	N/A
S_2012_10th	HPS	N/A	N/A		
	TPS	3433	.61.34	-2.453	.014
Mer_B_C_P_2013_10th	HPS	1363	.62.89		

Table 7. 2010-2013 10th Grade Science Performances by Test Type, TPS versus HPS

		Sum of Squares	df	Mean Square	F	Sig.
HPS[1] 2010-13_9th_Math	Between Groups	4232.10	3	1410.70	21.56	.000
	Within Groups	124074.41	1896	65.44		
	Total	128306.52	1899			
TPS[2] 2010-13_9th_Math	Between Groups	61159.11	3	20386.37	304.42	.000
	Within Groups	577734.70	8627			
	Total	638893.81	8630	66.97		
Year*Group[3]	Between Groups	3630.997	3	1210.33	18.15	.000
	Within Groups	701809.12	10523	66.69		

Note: [1] One-Way Analysis of Variance of HPS *9th Grade TAKS and STAAR Math T-Scores between 2010 and 2013.* [2] One-Way Analysis of Variance of TPS *9th Grade TAKS and STAAR Math T-Scores between 2010 and 2013.* [3] *Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*

Table 8. 9th Grade TAKS and STAAR Math T-Scores between 2010 and 2013, HPS versus TPS

		Sum of Squares	Df	Mean Square	F	Sig.
HPS 2010-13_9th_Reading	Between Groups	205946.36	3	68648.79	1551.23	.000
	Within Groups	98952.84	2236	44.25		
	Total	304899.21	2239			
TPS 2010-13_9th_Reading	Between Groups	690634.06	3	230211.36	2615.12	.000
	Within Groups	802049.0649	9111	88.03		
	Total	2683.11	9114			
Year * Group	Between Groups	637.75	3	212.58	2.68	.045
	Within Groups	901001.90	11347	79.40		

Note: [1] One-Way Analysis of Variance of HPS *9th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013.* [2] One-Way Analysis of Variance of TPS *9th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013.* [3] *Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*

Table 9. 9th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013, HPS versus TPS

Grade 10 Mathematics

In 10th grade mathematics, HPS schools statistically did better than traditional public schools on the TAKS 2011 and STAAR 2013 and better on the TAKS 2010, but data were not available for both school types in 2012 because there was no STAAR testing for 10th graders (see Table 5).

Grade 10 Reading

For 10th grade reading performance, again, HPS students had statistically significant higher scores than their counterparts on the TAKS 2011 and 2013 and scored higher on the TAKS 2010 reading assessment (see Table 6).

Grade 10 Science

In 10th grade science scores, HPS school students performed better than traditional public school students on the TAKS 2011 and STAAR 2013, and the difference was statistically significant. Traditional public school students performed slightly better on the TAKS 2010 (see Table 7).

For the second question, we used one-way ANOVA to examine how each school type's scores changed by year and univariate General Linear Model (GLM) analyses to see if there was an interaction effect between the group variable and the year variable. One-way ANOVA results showed that each group's 9th grade math scores (HPS and TPS) significantly changed over the years studied ($F(3,1896) = 21.557$, $p = .000$ and $F(3, 8627) = 304.419$, $p = .000$, respectively). Tukey HSD Post Hoc procedure was conducted for each group, which proved significant in the one-way ANOVA test on all possible pairwise contrasts.

The following pairs of groups were found to be significantly different ($p < .05$) for HPS 9th grade; 2010 Math (M=54.673, SD=7.676) and 2011 Math (M=57.388, SD=2.135); 2011 Math and 2012 STAAR EOC Alg 1 (M=53.128, SD=9.778); 2012 STAAR EOC Alg1 and 2013 STAAR EOC Alg1 (M=55.004, SD=9.000); and 2011 Math and 2013 STAAR EOC Alg1. For TPS, Tukey HSD Post Hoc analyses yielded significant differences ($p < .05$) between the following groups: 2010 Math (M=51.908, SD=10.131) and 2011 Math (M=56.438, SD=2.860); 2011 Math and 2012 STAAR EOC (M=49.956, SD=8.803); and 2011 Math and 2013 STAAR EOC Alg1 (M=49.841, SD=8.854).

Univariate General Linear Model (GLM) analysis showed that there was also a significant interaction effect ($F(3,10523) = 18.148$, $p = .000$)) between the group variable and the year variable, indicating that differences among the year factor depend on the levels on the school group factor (see Table 8).

For 9th grade reading testing, one-way ANOVA analyses showed that both HPS and TPS scores significantly changed over the years studied for TAKS and STAAR tests (F (3, 2236) =1551.23, *p*=. 000 and F (3,9111) =2615.12, *p*=.000 respectively) (see Table 9). Tukey HSD post-hoc test for significant year variables revealed that HPS had significant differences (p<. 05) in 9th grade reading scores between year 2010 TAKS Reading (M=53.40, SD=6.46) and 2011 TAKS Reading (M=57.39, SD=2.14); 2011 TAKS Reading and 2012 STAAR EOC Reading (M=53.27, SD=7.60); 2012 STAAR EOC Reading and 2013 STAAR EOC Reading (M=73.95, SD=7.30); and 2011 TAKS Reading and 2013 STAAR EOC Reading. For TPS, Tukey HSD yielded similar significant differences between 9th grade Reading scores: 2010 TAKS Reading (M=50.43, SD=10.32) and 2011 TAKS Reading (M=56.44, SD=2.86); 2011 TAKS Reading and 2012 STAAR EOC Reading (M=51.60, SD=10.97); 2012 STAAR EOC Reading and 2013 STAAR EOC Reading (M=72.25, SD=10.83); and 2011 TAKS Reading and 2013 STAAR EOC Reading. Univariate General Linear Model (GLM) analysis yielded a significant interaction effect between the group and year variables (F (3, 11,347) =2.68, *p*=.045), indicating that differences among the year factor depend on the levels of the school group factor.

For 10th grade mathematics testing, we compared the scores of 2010 and 2011 TAKS mathematics, and the 2013 average of EOC Algebra 2 and EOC Geometry because there was no state test for 10th grade mathematics in the 2011-2012 school year. One-way ANOVA analysis was run separately to examine the differences over the years for both school systems. While TPS's 10th grade math scores changed significantly (F (2, 4322) =20.51 *p*=.000), HPS's scores did not change significantly over the years studied (F(2,934)=1.290, p=.276). (see Table 10). Tukey HSD post-hoc analysis for TPS revealed that there is only a difference between 2011 TAKS mathematics (M=52.65, SD=9.27) and 2013 STAAR EOC average Algebra 2 and Geometry scores (M=50.68, SD=9.83). In addition, univaritate GLM analysis did not yield any interaction effect between the group variable and the year variable (F (2, 5256)=2.873, *p*=.057).

*Math T-Scores between 2010 and 2013. 3 Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*For 10th grade reading scores, one-way ANOVA results showed that, while HPS schools' reading scores changed significantly (F (2,1019) =254.77, *p*=. 000) over the years studied, TPS's reading scores did not change significantly (F(2,3422)=1.10, p=.332) (see Table 11). Tukey HSD post-hoc analysis revealed the following significant differences at p<.05: 2010 TAKS Reading (M=41.95, SD=7.47) and 2011 TAKS Reading (M=44.03, SD=4.75); and 2011 TAKS Reading and 2013 STAAR EOC Reading

		Sum of Squares	Df	Mean Square	F	Sig.
HPS 2010-13_10th_Math	Between Groups	188.99	2	94.50	1.290	.276
	Within Groups	68426.99	934	73.26		
	Total	68615.98	936			
TPS 2010-13_10th_Math	Between Groups	3555.80	2	1777.90	20.51	.000
	Within Groups	374627.78	4322	86.68		
	Total	378183.59	4324			
Year * Group	Between Groups	484.41	2	242.20	2.873	.057
	Within Groups	443054.77	5256	84.30		

Note: [1] One-Way Analysis of Variance of HPS *10th Grade TAKS and STAAR Math T-Scores between 2010 and 2013.* [2] One-Way Analysis of Variance of TPS *10th Grade TAKS and STAAR Math T-Scores between 2010 and 2013.* [3] *Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*

Table 10. 10th Grade TAKS and STAAR Math T-Scores between 2010 and 2013, HPS versus TPS

		Sum of Squares	Df	Mean Square	F	Sig.
HPS2010-13_10th_Reading	Between Groups	25476.30	2	12738.15	254.774	.000
	Within Groups	50947.82	1019	50.00		
	Total	76424.11	1021			
TPS2010-13_10th_Reading	Between Groups	134.90	2	67.45	1.102	. 332
	Within Groups	209468.70	3422	61.21		
	Total	209603.61	3424			
Year*Group	Between Groups	16065.37	2	8032.68	136.99	.000
	Within Groups	260416.53	4441	58.64		

Note: [1] One-Way Analysis of Variance of HPS *10th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013.* [2] One-Way Analysis of Variance of TPS *10th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013.* [3] *Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*

Table 11. 10th Grade TAKS and STAAR Reading T-Scores between 2010 and 2013, HPS versus TPS

		Sum of Squares	Df	Mean Square	F	Sig.
HPS2010-13_10th_Science	Between Groups	1594.93	2	797.47	10.22	.000
	Within Groups	136664.98	1752	78.00		
	Total	138259.91	1754			
TPS2010-13_10th_Science	Between Groups	3165.61	2	1582.80	15.06	. 000
	Within Groups	678814.29	6459	105.09		
	Total	681979.90	6461			
Year*Group	Between Groups	398.28	2	199.14	2.01	.000
	Within Groups	815479.27	8211	99.32		

Note: [1] One-Way Analysis of Variance of HPS *10th Grade TAKS and STAAR Science T-Scores between 2010 and 2013.* [2] One-Way Analysis of Variance of TPS *10th Grade TAKS and STAAR Science T-Scores between 2010 and 2013.* [3] *Univariate General Linear Model Analysis for years (2010 and 2013) by group (HPS vs TPS)*

Table 12. 10th Grade TAKS and STAAR Science T-Scores between 2010 and 2013, HPS versus TPS

(M=53.54, SD=7.79). Univariate GLM yielded a significant interaction effect between the group variable and the year variable (F (2, 4441)=136.99, *p*=.000).

For 10th grade science scores, one-way ANOVA analyses showed that science scores of both school types (HPS vs TPS) significantly changed over the years studied (F (2, 1752) =10.22, *p*=. 000 and F (2,6459) =15.06, *p*=.000) (see Table 12). Tukey HSD post-hoc analyses revealed significant differences for each group at p<.05. For HPS, there were differences between 2010 TAKS Science (M=49.89, SD=9.97) and 2011 TAKS Science (M=54.08, SD=7.10), and 2011 TAKS Science and 2013 STAAR average score of EOC Biology, Chemistry, and Physics (M=52.16, SD=9.03). For TPS, there were differences between 2010 TAKS Science (M=50.11, SD=10.01) and 2011 TAKS Science (M=52.15, SD=9.48), and 2011 TAKS Science and 2013 STAAR average of EOC Biology, Chemistry, and Physics (M=51.35, SD=10.70). Also, univariate GLM showed a significant interaction effect between the group and year variables (F (2, 8211)=2.01, *p*=.000).

Discussion and Conclusion

The purpose of this study is to examine changes in the high school state test performance in mathematics, reading, and science of a particular charterschool system (HPS) and matched traditional public schools (TPS) in Texas between 2010 and 2013. The state adopted a new testing system in 2012 and the study also investigated the ways this change in testing affected test performance in both types of schools.

Independent t-tests were conducted to compare the charter school system and the matched public schools. T-test results revealed that 9th grade students' mathematics scores in the charter school system were higher than the matched public school students' scores in each year between 2010 and 2013 for both the TAKS and the STAAR, and these results were statistically significant. Similarly, HPS outperformed TPS in 9th grade reading in all years, regardless of testing types.

The same pattern was observed for 10th grade students. In mathematics and reading tests, the charter school system did statistically better than traditional public schools on the TAKS in 2011 and on the STAAR in 2013. HPS's 2010 results were better in both areas but not at a statistically significant level. The data were not available for either type of school in 2012 because there was no STAAR testing in these areas for 10th graders in that year. For 10th grade science scores, HPS students outperformed traditional public school students on the TAKS in 2011 and the STAAR in 2013, and these results were statistically significant. However, traditional public school students performed slightly better on the TAKS in 2010. Overall, HPS's scores are significantly higher in most of the categories examined in this study.

These results are aligned with research showing that the performance of charter schools is better than public schools (Hassel & Terrell, 2006). These findings are also consistent with the findings of the Sahin et al.'s (2013) previous study, in which HPS consistently produced better achievement scores than matched public schools at grades 6-11. Since the HPS is a STEM-focused school system, superior performance on mathematics and science could be predicted. However, the HPS's better performance on reading is unexpected. Further research examining the HPS's STEM teaching approach may shed more light on the reasons for this difference: it is possible that the achievement due to the STEM focus may have created a culture of success throughout the system, regardless of study subjects.

If we take the HPS, that has a campus in almost every major city in Texas, as our evidence of charter school success, then the question of whether charter schools are more efficient suppliers of educational services than are traditional public schools becomes a very critical question to answer. To Gronberg, Jason, and Taylor (2011), "charter schools are able to produce educational outcomes at lower cost than traditional public schools—probably because they face fewer regulations—but are not systematically more efficient relative to their frontier than are traditional public schools" (p. 28). Thus, we need more and newer research to have sound evidence to say that charter schools provide similar or better educational opportunities for students at a cheaper rate than do traditional public schools.

How the schools' performance changed from the TAKS testing to the new STAAR testing was also investigated. One-way ANOVA was conducted to examine differences across years for each school type and the univariate General Linear Model was used to discover if group by year interaction has an effect on scores for each subject over the years. For 9th grade mathematics and reading, both TPS and HPS scores dropped from year 2011 to year 2012, the first year of implementation of STAAR. The differences were statistically significant. There are two possible explanations: first, this is likely an indication that the STAAR assessment is more rigorous than the previous TAKS assessment. It was claimed that the STAAR test was designed in such a way that the assessments were increased in length; overall test difficulty wasincreased by including more rigorous items; and the rigor of items was increased by assessing skills at a greater depth and level of cognitive complexity in order to be able to measure the growth of higher-achieving students better (Texas Education Agency, 2015). Thus, decreases in scores between year 2011 and 2012 for both school types could originate from the increase in test rigor.

Second, it is also important to note that no state accountability ratings were assigned in 2012 since it was the first year of implementation of the new test (Texas Education Agency, 2015). All schools and students were aware of this and they might not have taken the tests seriously since the test results had no effect on their school's accountability rating, potentially explaining the drop in scores observed from 2011 to 2012.

Tenth grade score changes from TAKS to STAAR revealed a different pattern and might shed light on the above discussion. There was no STAAR testing for 10th grade in all subjects in year 2012, but the comparison between 2011 TAKS and 2013 STAAR results showed that mathematics and science scores dropped significantly for both school types from year 2011 to 2013, whereas reading scores increased dramatically for HPS with no significant change observed for TPS reading scores. Considering the fact that the state resumed assignment of accountability ratings in 2013 by using STAAR results (Texas Education Agency, 2015), these results suggest that accountability ratings were not an issue, and support the claim that the STAAR assessment is more rigorous than the previous TAKS assessment for 10th grade science and mathematics.

The comparison of schools' performance from the first (2012) and second year (2013) of STAAR implementation for 9th grade revealed that reading scores increased significantly from 2012 to 2013 for both types of schools. While TPS mathematics scores dropped, HPS scores increased significantly from 2012 to 2013. Overall, HPS's STAAR scores improved in all three areas from 2012 to 2013, while TPS scores improved in two of these areas. In addition to the resumption of accountability ratings in 2013, adjustment to the new test in the second year of implementation could be one reason for the increase in scores. In addition, the comparison of 9th grade mathematics and science scores of year 2011 and 2013 showed that 2013 scores for both school types are significantly lower than 2011 scores. These results also support the claim that the STAAR assessment is more rigorous than the previous TAKS assessment for this grade level. Interestingly, reading results for both school types did not follow the same pattern.

In conclusion, the overall results of this study suggest that HPS performed better than the matched public schools in most of the categories examined in this study regardless of test type. In addition to independent t-tests comparing the charter school system and the matched public schools, univariate General Linear Model (GLM) analyses yielded significant interaction effects between the group and year variables for all subjects except 10th grade mathematics. These results indicate that differences among the year factor depend on the levels on the school group factor and support the results of independent t-tests showing the superior performance of HPS over the matched public schools.

These results may be consistent with some of the recent research wherein charter schools performed better than traditional public schools (Bett & Tang, 2008; CREDO, 2013, 2017). Therefore, as charter schools are seen as a viable alternative to the traditional public school system and are the fastest growing school choice option in the U.S. public school education system (National Alliance for Public Charter Schools, 2014), researchers, policymakers, and educators should invest more effort, time, and energy to study the effects of charter schools on student achievement.

Limitations and Future Research

This study had several limitations. First, not all scores in mathematics, reading, and science between years 2010 and 2013 were available. Eleventh grade scores were not included because STAAR testing was not administered to 11th grade students until the 2013-2014 school year. Also, there was no testing for 10th grade reading, mathematics, and science during 2012, the first year of STAAR testing. The study could have been stronger with the presence of test data for these years.

Second, the STAAR and the TAKS tests were not an exact match for high school grade levels. On the TAKS, mathematics and science testing were a mixture of other related subjects (e.g., science testing included questions from biology, chemistry, and physics), whereas the STAAR introduced EOC (End of Course) tests for each of these subjects separately. Therefore, researchers calculated 2013 STAAR science scores by taking an average of the EOC biology, chemistry, and physics scores. Likewise, the 2013 10th grade mathematics scores were calculated by taking an average of 10th grade Geometry and Algebra II scores.

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