Student Achievement in Four Urban School Districts: Impact of Information Technology

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Abstract

The purpose of this study was to explore diffusion of information technology (IT) infrastructure and high school student achievement in four urban school districts. The study sought to address any significant correlations between student achievement and information technology infrastructure funding. The study used the American College Test (ACT) and Scholastic Aptitude Test (SAT) scores from 94 school districts and statistics from the E-Rate program (IT infrastructure funding) to discern any relationships. The ACT and SAT were used because they are standardized tests used by all school districts across the U.S. The E-Rate program is a federal program that allocates billions of dollars each year to urban school districts to alleviate the disparity between poor and affluent school districts related to access to the Internet (Arfstrom & Sechler, 2006). The influx of E-Rate funds is evaluated in terms of IT diffusion in these schools and the resulting impact on student achievement. Other moderating factors such as school size, student to teacher ratio, number of students tested, and dropout rate were analyzed. Research observations revealed there was a positive impact of E-Rate funds on student achievement and on the achievement gap between urban impoverished and affluent school districts.

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Keywords: E-Rate, achievement gap, IT diffusion, school districts

1. INTRODUCTION

The need to link the diffusion of information technology (IT) in secondary education and student achievement is important. Wise (2008) asserts there is a crisis in U.S. high schools concerning student achievement. The federal government through the Federal Communications Commission (FCC) spends billions of dollars each year on IT infrastructure (Internet access, telecommunications, cabling, switches, and routers) primarily for urban impoverished K-12 school districts (Arfstrom & Sechler, 2006). The primary purpose of this massive expenditure is better Internet access or narrowing of the digital divide between poor and affluent school districts. This large source of funds for IT infrastructure for schools and libraries is the E-Rate program (Jaeger, McClure, & Bertot, 2005). This program provides discounts to allow impoverished schools to purchase Internet access and telecommunication services (Universal Services Administrative Company (USAC), 2009). The questions to be addressed are to what extent does the E-Rate program impact student achievement by infusing IT infrastructure in schools and what

has been the effect on the student achievement gap?

2. RESEARCH QUESTION

Kennard (1999) discussed the digital divide and the need for federal support. The digital divide refers to those that have access to technology and those that do not have access primarily because of an economic and social gap. Kennard who was the chairperson of the Federal Communications Commission (FCC) was tasked with implementing the Telecommunications Act of 1996 that directed the FCC to implement a funding mechanism to bring advanced technology to the nation's public schools and libraries. This project became known as the E-Rate or education rate program. The E-Rate program has been responsible for investing $1.7 billion in information technology infrastructure in over 80,000 schools and libraries during the first year of the initiative.

Jayakar (2004) defines the E-Rate or education rate as a set of initiatives targeted at low income applicants, high cost areas, rural health care providers, and libraries mandated by Congress in the 1996 Telecommunications Act. The purpose of the program is to bridge the technology gap between rich and poor communities. Schools receive discounts ranging from 20 % to 90 % based on the number of students enrolled in the national school lunch program. Monies collected can be spent on IT infrastructure such as telecommunication services, the Internet, and internal wiring or cabling.

Research has been mixed concerning the linkage of IT on student achievement and inconclusive on whether the E-Rate program has improved student achievement or narrowed the digital divide. Some researchers question the value of IT on student achievement (Cuban, Kirkpatrick & Peck, 2001) and question the assertion that buying technology such as hardware and software for schools will lead to effective use by teachers and students thus improving the learning environment

Ward (2005) analyzed the E-Rate program in Texas and its impact on public schools from 1994 to 2003. Ward's (2005) study revealed more teachers were allocated to E-Rate subsidy schools than non-E-Rate schools and the overall average college entrance scores (ACT and SAT) of E-Rate schools dropped. Ward theorizes the E-Rate subsidy motivated schools to encourage more marginal students to take the college entrance exams thus triggering a drop in average college entrance scores.

Arfstrom and Sechler (2006) laud the results of ten years of the E-Rate program. The authors point out the E-Rate program has provided almost $19 billion to schools and libraries. They claim that the E-Rate has been responsible for increasing Internet access in public schools from 14 % in 1996 to 94 % in 2005.

There has been little empirical research ascertaining whether the E-Rate program by providing better IT infrastructure improvements in impoverished urban school districts has narrowed the digital divide and has improved student achievement as measured on standardized nation-wide tests. Recently, the Government Accountability Office [GAO] reported the Federal Communications Commission (FCC), which monitors the E-Rate program, lacks adequate performance goals and performance measures (U. S. Government Accountability Office (GAO), 2009).

There are very few current studies that link technology diffusion in secondary schools to student achievement as measured on a nationwide standardized test such as the SAT or ACT. The studies that do exist are dated, very limited in scope, lack generalization, or lack empirical validation (Cuban et al., 2001; Goolsbee & Guryan, 2006; Schacter, 1999; Simpson et al., 2005; Ward, 2005; Wenglinsky, 2005). In addition, results of research on IT diffusion in education have been inconclusive. Chin and Marcolin (2001) argue success measures linked to diffusion should be the focus of future research and there needs to be a tighter relationship between diffusion and its performance impact. Schrum (2005) strongly articulates the need for focused research in this area since there has been no documented systematic increase in student achievement linked to technological innovation. This study purports to discern whether there is an impact, linkage or correlation between IT funding levels and student achievement. The research will also add information to the debate on whether there is a correlation between IT diffusion and student achievement.

The literature is inconclusive on the effect of IT diffusion or adoption in an educational environment. Schacter (1999) found that IT diffusion was sufficient to improve student performance in an educational setting. Early research by Cuban, Kirkpatrick and Peck (2001) disagreed with Schacter's findings and suggested

the infusion of technology (computers and wiring for Internet) into high schools had no effect on student achievement. Similar findings were supported by Simpson, Payne and Condie (2005) in their case study of secondary schools in Scotland and by D'Souza and Wood (2007) in their case study of secondary math students in Australia. Wenglinsky (2005) directly associated the use of technology to student achievement but his results were mixed. Norris, Sullivan, Poirot, and Soloway (2003) in their study of the impact of IT diffusion in kindergarten to 12th grade (K-12) found the lack of IT resources was a detriment to IT diffusion not teacher attitude. This study will add to the body of knowledge on the dynamic nature of IT and student achievement.

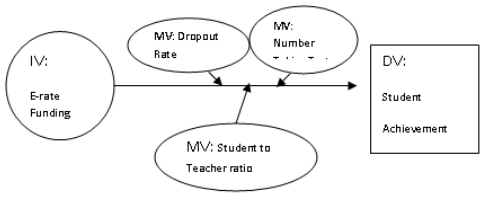
The FCC and other federal agencies that allocate monies to schools, specifically the E-Rate program, should know which programs are effective and which ones are not. The study is significant since massive amounts of federal monies are funneled to poverty stricken urban school districts for IT infrastructure each year with the inferred hope that it would spur student achievement. The GAO reports reveal a lack of accountability in this area. This study would provide an initial baseline for assessing the effectiveness of the E-Rate program.

3. THE STUDY

For this study, information was obtained on IT federal funding to school districts over the last twelve years from the FCC through the E-Rate program. The study centered on school districts primarily in Los Angeles, California, Chicago, Illinois, Philadelphia, Pennsylvania, and Houston, Texas so the study could be generalized to other urban school districts throughout the United States receiving E-Rate funds. Test scores for students were collected from these selected school districts from the California Department of Education, Texas Education Agency, Illinois Department of Education, Pennsylvania Department of Education, and National Center for Education Statistics (NCES) as appropriate. To discern student achievement, the study measured scores in urban impoverished, affluent, non-impoverished schools as well as impoverished school districts to determine if changes that occur in each are similar or different. Since the four largest urban school districts are basically classified as urban impoverished entities based on their high percent of students in the free and reduced lunch (> 75%), four affluent school districts with a low percent (<15%) of students in the free and reduced lunch were selected for comparison. This served as a baseline of comparison.

Other collocated school districts (86) classified as impoverished and non-impoverished were analyzed in the study to determine if they followed similar patterns. School size, teacher to student ratio, and dropout rate were considered since they could have been moderating variables in the study (see Figure 1). Socioeconomic factors were accounted for by identifying the percent of students in each school district eligible for the federal free and reduced lunch program. In the quantitative study, the E-Rate funding was the independent variable, student achievement was the dependent variable, and number of students taking test, dropout rate, and student-to-teacher ratio were the moderating variables (Figure 1).

Figure 1 Research Model



4. RESEARCH DESIGN

The units of analysis for the study are the identified school districts. School districts were selected because E-Rate funding is primarily allocated by school district rather than individual school. School districts were selected because a more detailed analysis of student achievement based on the SAT and ACT is possible. There are several sources of data for the proposal. The first source is the U.S. Department of Education National Center for Education Statistics (NCES). This site contains information on student/teacher ratio and information on school districts (Institute of Education Sciences (IES), 2009). This information is online and free. The second sources of data were the Scholastic Aptitude Test (SAT) and American College Test (ACT). Information on aggregate school district SAT and ACT scores

were obtained from the California Department of Education, Illinois Department of Education, Pennsylvania Department of Education, and Texas Education Agency Web sites. The third source of data is FCC's Schools and Libraries Division (SLD) information site at http://www.e-ratecentral.com/. This site contains information on which libraries, school districts, and schools have qualified and received IT infrastructure funding. The E-Rate discount rate based on a school district's free and reduced lunch program eligibility is available. The site also contains information on how the E-Rate funds are distributed for internal connections (cabling and equipment), Internet access, and telecomm (telephone service and wide area connectivity). A baseline for student achievement was established by assessing scores in urban impoverished, affluent, impoverished, and non-impoverished school districts to form a baseline for comparison. This process was accomplished by comparing school districts with a low percent of students in the national free and reduced lunch program to those with a higher percent in the program. The E-Rate program has traditionally fully funded urban school districts at the 80% or more free and reduced lunch eligibility level but has rarely fully funded those at the 20% or less level (E-Rate Central, 2009). Based on this observation, urban impoverished school districts could be classified as those that have 80% or more students eligible for the free and reduced lunch program. Similarly, affluent school districts could be defined as those that have less than 20% of their student population eligible for the free and reduced lunch program. The primary sources of information for free and reduced lunch data are the state educational web sites (California Department of Education, 2009; Illinois State Board of Education, 2009; Pennsylvania Department of Education, 2009; Texas Education Agency, 2009) and the SLD.

5. SAMPLE/DATA COLLECTION

The sample size for the school districts in the study was the eight primary urban impoverished and affluent school districts and the 86 collocated school districts near or within the same county as the major urban school districts. The 94 school districts in the study represent 801 high schools. The four urban impoverished school districts account for 411 or 51.3% of all high schools. The additional collocated school districts had the potential to refute or support findings from the initial sample. In addition, the collocated school districts can be viewed as a control group to contrast any differences. The major urban impoverished school districts are Los Angeles Unified School District (SD), Chicago Public Schools, School District of Philadelphia, and Houston Independent School District (ISD). The selected affluent school districts are Irvine Unified SD in Irvine, CA, Central Buck School District in Doylestown, PA, Clear Creek ISD in League City, TX, and Glenbard Township School District in Glen Ellyn, IL. Each of the selected affluent school districts have an average free and reduced lunch eligible population of less than 15% while the urban impoverished districts' numbers range from 75% to more than 90% (California Department of Education, 2009; Illinois State Board of Education, 2009; Pennsylvania Department of Education, 2009; Texas Education Agency, 2009). All of the school districts were analyzed to discern changes in achievement gap. In order for the study results to be generalized, geographically dispersed urban school districts were selected from the West (Los Angeles Unified), Midwest (Chicago Public Schools), East (The School District of Philadelphia), and Southwest (Houston ISD). All of the selected impoverished school districts are among the ten largest in the U.S. (Institute of Education Sciences [IES] National Center for Education Statistics, 2009). Each state where these districts are located is also an active participant in the E-Rate program (E-Rate Central, 2009). Some of the information such as the number of students testing was derived from raw data. The timing for collecting data for the appropriate measurements is shown in Table 1.

While the school districts selected were not completely random nevertheless the study should have reliability and validity for other urban school districts meeting the same or similar criteria. The California Department of Education, Chicago Public Schools, Illinois Department of Education, Pennsylvania Department of Education, and Texas Education Agency provide historical ACT and SAT scores for school districts to the public for research and other purposes therefore approval was not required from the College Board nor ACT, Inc. The strength of this strategy is the study employed data already collected by the SLD, educational entities, and National Center for Education Statistics.

6. DATA ANALYSIS

The study employed a pretest-posttest design to discern any changes between the groups based on the E-Rate program. Specifically, the study used the Solomon four-group design which permitted the authors to analyze the magnitude of effects caused by pretesting, history, maturation, and treatment. The pretest groups were the urban impoverished, affluent, impoverished, and non-impoverished groups before the effects of the E-Rate program (1997-2000). The posttest groups were the same groups after the effects of the E-Rate (post 2000). The study employed the analysis of variance (ANOVA) on gain scores. The study used descriptive statistics to analyze school size, school district student to teacher ratio, dropout rate, assessment tests, and E-Rate data. Then correlation and regression analysis was used to test the hypotheses. The results of the study ascertained the level of impact of E-Rate federal funding on student achievement and the achievement gap. It also discerned whether there was any moderating factors based on the variables identified that affected this result.

7. METHODOLOGY

The period for the study was 1997 to 2008. The four groups were urban impoverished, affluent, impoverished, and non- impoverished. The pretest period was 1997 to 2000. Although the Schools and Libraries started dispensing funds in 1998, some major school districts such as the Schools of Philadelphia did not take advantage of the

program until 2000. In addition, according to previous research by Goolsbee and Guryan (2006), there can be a significant lag time before the results of E-Rate funding materialize. Based on this research E-Rate results would be expected two or more years after funding because of implementation of the IT infrastructure and integration into the school district's curriculum.

Pre-E-Rate Analysis

Using SPSS, a bivariate correlation was run on the variables for the pre-E-Rate group (1997-2000). There was a significant negative correlation of -.231, -.248, -.234 and -.250 at the 0.05 level between school size and SAT scores for 1997, 1998, 1999, and 2000. This indicated the larger the school district, the lower the SAT scores. There was a significant negative correlation of -.672, -.699, -.703, and -.700 at the 0.01 significance level for E-Rate discount and SAT scores for 1997, 1998, 1999 and 2000. This suggested socioeconomic factors based on the free and reduced lunch program were negatively correlated with SAT scores. Student to teacher ratio and number of students tested while slightly negative did not exhibit significant correlation with SAT scores. Number of students testing was correlated with the E-Rate discount at the 0.05 significance level at .234, .232, .226 and .212 for 1997, 1998, 1999 and 2000 respectively. These results show a higher E-Rate discount was positively related to the number of students testing. This supported Ward's observation that higher E-Rate funding levels stimulated a higher number of students testing. Number of students testing however was not correlated with SAT scores at a significant level. Dropout rate was significant and negatively correlated with SAT scores. The 1997 dropout rate was correlated with SAT97, SAT98, and SAT99 at the 0.01 significant level at -.605, -.605, and -.585 respectively. The 1998 dropout rate was correlated with SAT98 and SAT99 at the 0.01 significant level at -.520 and -.566 respectively. The 1999 dropout rate was correlated with SAT99 at the 0.01 significant level of -.637 and 2000 dropout rate was correlated with SAT00 at the 0.01 significant level of -.633. These results suggest school districts with higher dropout rate have lower SAT scores. Dropout rate also relate to socioeconomic factors.

The One-Way Analysis of Variance or ANOVA was used to analyze the data since the study involves examining the sample means of SAT scores for different categories of school districts receiving E-Rate funds and drawing conclusions about the resultant SAT means. The ANOVA requires the data to be independent and normal with equal variances (Norusis, 2008). The data for each district is independent since SAT scores are not dependent upon scores in other districts – this was examined with histograms and boxplots available from the 1st author.

The Levene's Test of Homogeneity was employed to determine equal variance. Large significances above .5 show equal variance (Norusis 2008). Table 2 shows equal variance for most of the years of SAT testing. The df1 or degrees of freedom one (3) is the number of categories (4) minus one. The df2 or degrees of freedom two is the total number of districts (94) minus four, one from each category. The

requirements to proceed with ANOVA are fulfilled by SAT scores being independent and normal with equal variance.

Table 2. *Test of Homogeneity of Variances*

	Levene Statistic	df1	df2	Sig.
SAT97	2.959	3	90	.037
SAT98	1.554	3	90	.206
SAT99	1.654	3	90	.183
SAT00	.772	3	90	.513
SAT01	2.490	3	90	.065
SAT02	.550	3	90	.649
SAT03	.987	3	90	.403
SAT04	.424	3	90	.737
SAT05	.192	3	90	.902
SAT06	.338	3	90	.798
SAT07	.197	3	90	.898
SAT08	.802	3	90	.496

The One-Way ANOVA run on the pre-E-Rate (1997-2000) dataset revealed F=25.363 at sig=.000 for SAT97, F=25.127 at sig=000 for SAT98, and F=25.972 at sig=.000 for SAT99, and F=25.001 at sig=000 for SAT00. The sig values demonstrate the mean comparisons were significant for 1997 through 2000. The Post Hoc Test confirms this observation. The Post Hoc Test reveals some noteworthy comparisons. The mean comparison for SAT scores between urban impoverished and affluent districts (primary groups) was -223.25, -229.75, -230.0, and -238.0 significant at the 0.05 level for SAT97, SAT98, SAT99, and SAT00 respectively. The mean comparison between the impoverished and non-impoverished districts was -111.791, -117.047, -127.488 and -120.558 significant at the 0.05 level for SAT97, SAT98, SAT99, and SAT00 respectively. The trend demonstrated a slow but widening gap of SAT scores between urban impoverished and affluent districts between 1997 and 2000 where the gap widened from -223.25 points to -238.0. A similar trend was noted between impoverished and non-impoverished districts where the gap widened from -111.791 in 1997 to -120.558 points in 2000.

Post E-Rate Analysis

Bivariate correlation of variables was run on the post-E-Rate (2001-2008) dataset. This dataset included E-Rate funding. The correlation results revealed similar findings on school size, and E-Rate discount, and SAT scores. Large district size was negatively correlated with SAT scores. The E-Rate discount indicated socioeconomic factors based on the free and reduced lunch program correlated negatively with SAT scores. Student to teacher ratio and number of students tested while slightly negative did not exhibit significant correlation with SAT scores. The number of students tested was positively correlated with E-Rate funding at the 0.01 significance level for 2001 to 2008, varying from .535 to .931. These results show that higher E-Rate funding was positively related to the number of students testing. There was a negative correlation between E-Rate funding and SAT scores from 2001 to 2008. This summary information is highlighted in Table 3.

Table 3. *Correlation of E-Rate Funding and SAT Scores*

	SAT01	SAT02	SAT03	SAT04	SAT05	SAT06	SAT07	SAT08
E-Rate98	-.306**	-.291**	-.173	-.260*	-.243*	-.219*	-.236*	-.229*
E-Rate99	-.306**	-.299**	-.180	-.263*	-.249*	-.227*	-.240*	-.233*
E-Rate00	-.320**	-.324**	-.197*	-.280**	-.276*	-.254*	-.255*	-.247*
E-Rate01	-.288**	-.259*	-.165	-240*	-236*	-.228*	-.226*	-.234*
E-Rate02	-.303**	-.287**	-.179	-.280**	-.282*	-.256*	-.275**	-.255*
E-Rate03	-.245*	-.221*	-.147	-.226*	-.221	-.211*	-.232*	-.217*
E-Rate04	-.277**	-.267**	-.169	-.252**	-.253	-.230*	-.233*	-.224*
E-Rate05	-.269**	-.255*	-.153	-.229*	-.223*	-.213*	-.234*	-.219*
E-Rate06	-.308**	-.297**	-.180	-.266**	-.255*	-.241*	-.259*	-.247*
E-Rate07	-.227*	-.209*	-.126	-.191	-.181	-.177	-.195	-.188
E-Rate08	-.281**	-.258**	-.164	-.245*	-.241*	-.233*	-.258**	-.239*

**. Correlation is significant at the 0.01 level (2-tailed0
*. Correlation is significant at the 0.05 level (2-tailed)

These results can be interpreted several ways. One researcher (Ward, 2005) suggested that E-Rate funding had a negative impact on SAT scores because it motivated more students to test. Another interpretation is that larger E-Rate funding went to school districts that traditionally score lower on the SAT test versus more affluent or non-impoverished school districts with less E-Rate funding.

Table 4 shows the mean SAT scores for each category of school district from 1997 to 2008. There has been little change in each category. Urban impoverished school districts had a period from 2003 to 2008 where there was minor SAT improvement of .69%, .57%, .46%, .58%, .58%, and 1.04% respectively from 1997. This was a change from a steady decline of from 1997 to 2000 of -.115%, -.347%, and -1.042 in 1998, 1999, and 2000 respectively.

Table 4. *Mean SAT Scores 1997-2008*

Year	Urban Improv	Affluent	Impov	NonImpov
1997	864	1087	932	1044
1998	863	1092	935	1052
1999	861	1091	925	1052
2000	856	1094	924	1044
2001	859	1078	920	1063
2002	860	1080	918	1054
2003	870	1089	900	1054
2004	869	1091	926	1057
2005	868	1091	928	1061
2006	869	1098	923	1049
2007	869	1092	928	1053
2008	873	1089	919	1058

Table 5 shows the mean differences or gap for SAT scores between the various school district categories. All of the means were significant at the 0.05 level. The result shows a widening of the SAT gap between urban impoverished and affluent school districts increasing from -223.25 in 1997 to -238 in 2000. The gap narrowed slightly starting in 2001 and maintained a positive trend except for 2005 when it slipped -.335% and 2006 when it fell -2.57%. The overall trend was positive culminating in a +3.47% in 2008 when compared to the 1997 SAT gap. Unlike the urban impoverished and affluent school districts, the gap between impoverished and non-impoverished school districts never improved or exceeded the 1997 SAT gap. The mean average SAT score for the urban impoverished school districts was at a 12-year high in 2008 (+1.041%) and the gap between affluent school districts was at a 12-year low (+3.47) using 1997 as the baseline year. A summary of the significant gains and losses is shown in Table 5.

Table 5. *ANOVA Post Hoc Mean Differences 1997-2008 SAT Scores*

	SAT Gap Urb/Affl	since'97	SAT Gap Imp/ Non-imp	since'97
'97	-223.25	0	-111.791	0
'98	-229.75	-6.5	-117.047	-5.256
'99	-230	-6.75	-127.488	-15.697
'00	-238	-14.75	-120.558	-8.767
'01	-218	+5.25	-143.05	-31.259
'02	-219.75	+3.5	-136.14	-24.349
'03	-218.5	+4.75	-153.79	-41.999
'04	-221.75	+1.5	-131.628	-19.837
'05	-224	-.75	-132.93	-21.139
'06	-228	-5.75	-126.047	-14.256
'07	-222.75	+.5	-124.721	-12.93
'08	-215.5	+7.75	-138.488	-26.697

Note: Mean differences significant at the 0.05 level.

Figure 2 graphically shows the SAT achievement for all of the categories. The changes are hard to discern because they are small. SAT scores in general have remained flat for all school district categories.

Figure 2. SAT achievement gap 1997-2008

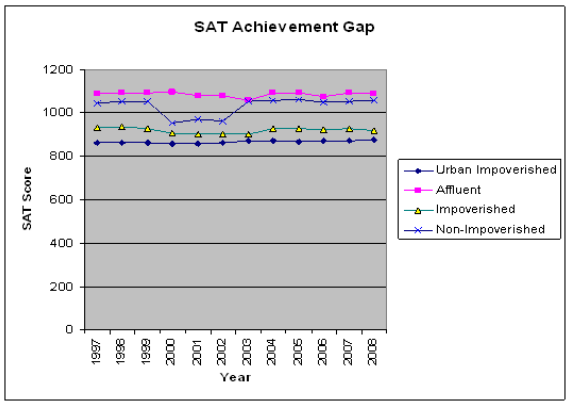
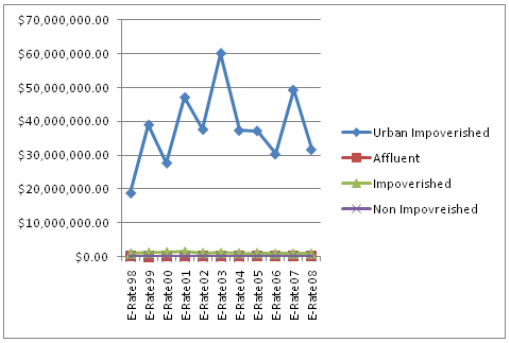


Table 6 summarizes the average funding for the various categories of school districts and Figure 3 graphically illustrates this funding level. E-Rate funding to urban impoverished school districts peaked in 2003. The graph shows the stark differences between the urban impoverished school districts and the other categories which varied from 18 to over 30 times more than the other categories combined. See Table 6.

Figure 3. E-Rate funding by school district category



There were no significant changes in dropout rate for urban impoverished school districts to

merit the increase in SAT scores. An examination of the mean in Table 6 for dropout rate between 1997 and 2008 revealed that dropout rate had worsened from 1997.

Table 6. *E-Rate Funding 1997-2008*

	Urban Impov	Affluent	Impoverished	Non Impov
E-Rate98	$18,910,561.75	$135,756.00	$1,020,603.49	$83,670.21
E-Rate99	$39,001,565.00	$94,840.00	$1,208,115.49	$106,529.88
E-Rate00	$27,773,048.00	$130,202.75	$1,400,259.95	$63,264.44
E-Rate01	$47,077,809.00	$155,204.50	$1,527,777.00	$78,572.35
E-Rate02	$37,633,302.00	$134,926.75	$1,149,118.88	$81,423.60
E-Rate03	$60,055,459.75	$136,970.00	$1,172,323.70	$91,208.98
E-Rate04	$37,342,813.00	$148,587.50	$1,071,467.47	$96,026.72
E-Rate05	$37,230,749.50	$150,369.50	$1,135,617.37	$127,606.30
E-Rate06	$30,365,988.75	$212,318.25	$902,440.93	$139,960.37
E-Rate07	$49,261,999.00	$202,213.50	$978,334.14	$135,579.05
E-Rate08	$31,689,157.25	$193,258.50	$943,463.33	$164,020.51

Since dropout rate was negatively correlated with higher SAT scores, it would be expected there would be a drop rather than an increase in SAT scores. Table 6 conveys this information. The conclusion is dropout rate was not a factor in the SAT increase. The other factors such as student to teacher ratio and number of students testing were insignificant statistically according to the ANOVA analysis.

Table 7. Dropout Rate (%)

	Urban Imp	Aff	Impov	Non-Imp
Drop97	9.83	4.2	8.01	2.90
Drop98	16.72	4.8	10.59	4.04
Drop99	16.65	2.38	9.43	3.04
Drop00	15.1	2.02	8.61	3.08
Drop01	14.35	1.95	9.3	2.46
Drop02	15.77	1.5	8.08	3.88
Drop03	16.82	1.55	8.73	3.24
Drop04	13.22	1.4	8.92	3.58
Drop05	13.56	1.58	10.56	3.32
Drop06	15.12	1.72	14.05	5.96
Drop07	13.7	1.78	15.01	4.35
Drop08	15.8	1.6	15.27	4.82

8. SUMMARY OF FINDINGS

Hypothesis one that increased funding has had no impact on student achievement is not supported by the data because of the increase in SAT scores from 2003 (+.69%) to 2008 (+1.041%) when compared to 1997. Increased funding most likely accounted for SAT improvements from 2003 to 2008 for urban impoverished school districts because similar gains were not evident in the other school district categories except the non-impoverished category. Affluent school district SAT scores climbed +.183% in 2003 and remained steady at +.183% in 2008 when compared to 1997 SAT scores. Impoverished school districts fell by -.3.43% in 2003 and -1.39% in 2008 in comparison to 1997. The non-impoverished school districts showed a rise in 2003 of +.96% and rise of 1.34% in 2008. Non-impoverished school districts without massive E-Rate funding showed a steady decline from 1997 SAT scores. There appears to be an impact from E-Rate funding but it was small and almost imperceptible for urban impoverished school districts. In any case, SAT scores for the urban impoverished school district category were at a 12-year high in 2008.

Hypothesis 2 that the E-Rate program has not narrowed the student achievement gap between poor and affluent schools as measured on nation-wide assessment tests is not supported by the data. The achievement or SAT gap began narrowing in 2001 (+2.35%) and made progress to 2008 (+3.47%) between urban impoverished and affluent school districts. There was no mirrored or similar improvement in impoverished versus non-impoverished school districts when compared to SAT 1997 scores. The gap between these categories fluctuated between -4.4% and -26.6% below the 1997 baseline. E-Rate funding may not have had a great effect on the achievement gap but it may have been enough to slightly improve and prevent further degradation of SAT scores and deterioration of the student achievement gap for urban impoverished school districts. In any case, the gap was at a 12-year low between urban impoverished and affluent school districts in 2008 indicating noteworthy progress.

9. CONCLUSIONS

The results of the study are in contrast to research results by Cuban, Kirkpatrick, and Peck (2001) and Wenglinsky (2005) that showed technology in schools does not improve student achievement. Ward (2005) who studied the impact of the E-Rate in Texas from 1994 to 2003 noted no improvement in SAT scores. Goolsbee and Guryan (2006) also studied effects of the E-Rate program from 1996 to 2001 in California and found no impact. This study contradicts Ward's and Goolsbee and Guryan's findings since improvement albeit small was

observed starting in 2003. The methodology used in this study most likely accounted for this disparity. The school districts in this study were segmented and categorized therefore there was greater focus on the urban impoverished school districts. If school districts are not categorized as in this study then changes in SAT scores could be masked by the total numbers.

E-Rate is an IT specific initiative that had as its goal to narrow the achievement gap and it has achieved this goal in a limited fashion. The pre-E-Rate period (1997-2000) was a time period of slipping SAT scores (-.92%) and widening of the achievement gap (-6.6%) between urban impoverished and affluent school districts. The post E-Rate era (2001-2008) exhibited a reversal of the trends initiated in the pre-E-Rate period. The achievement gap narrowed between urban impoverished and affluent school districts by +3.47% between 1997 and 2008. In contrast, the gap between impoverished and non-impoverished school districts increased by -23.88% between 1997 and 2008. The study results support the contention that there has been some IT diffusion into the aforementioned urban impoverished school districts. Perhaps the gap between urban impoverished and affluent school districts would have been less positive without the impact of the E-Rate program.

Recommendations for Future Research

The study could expand to include the impact of E-Rate on SAT scores for the top 50 urban school districts versus the four in this study. This could bolster or refute the results in this study. This study included 94 school districts so the data gathering task would be manageable. A possible road block would be obtaining permission to use the data since some states treat SAT scores and school district data as confidential data. Another research topic could be an in-depth analysis of the impoverished urban school districts between 2001 and 2007 to pinpoint what had been implemented to improve student achievement. This would involve surveys of the urban impoverished school districts to determine things such as what IT technology was established and how this tech-teaching curriculum to affect SAT scores.

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