The Effectiveness of Blended Learning

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Abstract

District of Columbia Public Schools, a school district aiming to improve proficiency rates by 2017, is experimenting with a new teaching technique called blended learning. Proficiency rates from 2008-2012 of 3rd and 5th grade students, grouped by race, gender, and high and low users of blended learning, will be analyzed in order to determine if blended learning should be used to accomplish the goals of the school district.

1 Introduction

We hear it in the news nearly every day: Inner-city school districts are not achieving optimal test scores. Schools are closing, teachers, both effective and ineffective, are losing their jobs, and students are losing opportunities to succeed in and out of the classroom every day. As some school districts are slowly falling apart, it is important to recognize a school district which is reforming its educational philosophy while attempting to overcome the typical "inner-city school" stereotype: The District of Columbia Public School District.

The District of Columbia Public Schools has transformed into a center of education reform throughout the last decade. In 2012, the District of Columbia Public Schools (DCPS) implemented a strategic plan, called *A Capital Commitment*. This plan aims to accomplish five main goals, all with the overarching goal of improving the quality of education in the district within the next five years. The first goal of the Capital Commitment plan, and the focus of this study, is to improve achievement rates. Specifically, the district wants 70% of its students to be proficient in reading and mathematics by 2017 [3]. In order to accomplish this goal, the district plans to invest in high quality instructors and instructional strategies. To find high quality instructors, DCPS started to utilize a new teacher evaluation system. In order to gain high quality instruction, DCPS is experimenting with a new teaching technique called "blended learning".

Classrooms experimenting with blended learning strategies do not look like the typical classroom. A normal day does not consist of students spending the day sitting at their desks while frantically trying to write down every word that the teacher is writing on the board. According to an article by the Greater Education, the classrooms in Hart Middle School, a school utilizing blended learning strategies, look a lot different [1]. A mathematics classroom at Hart Middle School is a basement with 200 students. The basement is split into smaller sections with a different activity to complete in each one. One activity may be a teacher-led discussion about counting while another activity may be completing a worksheet online that the computer has determined is skill-appropriate for the student. Other models of blended learning are a lot more basic. Teachers may teach a traditional lesson for half the class and then let the students complete suitable activities on the computer. Some teachers may focus on using an interactive whiteboard more frequently. As one can observe, the term "blended learning" can be interpreted

in a variety of ways, and while these are all great examples of what blended learning is, it is important to also recognize what blended learning is not. Blended learning is not turning the students loose to complete worksheets or activities online that are not helpful or appropriately challenging. Blended learning is a technique of teaching that allows students to use technology to learn at their own pace. The thought is that this blend of computerized and traditional lessons that are significantly more personalized should give students a better educational experience and increase proficiency rates.

If blended learning strategies are effective, one should observe an increase in proficiency rates throughout the past few years. These proficiency rates are a result of the D.C. standardized test called the D.C. Comprehensive Assessment System, or DC CAS. The test is distributed every spring to students in grades 3-8 and the scores label students as either below basic, basic, proficient, or advanced [2]. This study will investigate DC CAS scores from the years 2008, 2010, and 2012 among 20 different schools within DCPS. Ten of these schools are considered high-users of blended learning and the other ten schools are considered low users of blended learning. Proficiency rates from two main racial groups will be compared in this study: African American and an "other" racial group. This "other" group is a combination of White, Asian, and Hispanic students and is a result of the fact that data was only available for subgroups containing more than ten students, meaning adequate data was not provided. Additionally, proficiency rates from both genders will be compared. The statistical comparison between these groups will answer the following questions.

1. Is blended learning more effective in reading in 3rd or 5th grade when comparing the two racial groups?
2. Is blended learning effective in mathematics in 3rd or 5th grade when comparing the two racial groups?
3. Is blended learning effective in reading in 3rd or 5th grade when comparing genders?
4. Is blended learning effective in mathematics in 3rd or 5th grade when comparing genders?
5. Overall, has blended learning made a positive difference in proficiency rates from 2008 to 2012?

This study will help determine what strategies D.C. Public Schools should or should not use in order to accomplish the goal of getting 70% of students to be proficient in reading and mathematics by 2017 [3]. This study will also make it possible to target which groups, if any, benefit from blended learning the most.

2 Definitions and Development

A **proficiency rate** is the percentage of students that meet or exceed expectations in a given subject. A sample of various hypotheses is given in Figure 2.1. The remaining hypotheses are given in Figure A.1**.**

Hypotheses
H_0: There is no difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2010. H_1: There is a difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2010.
H_0: There is no difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2010. H_1: There is a difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2010.
H_0: There is no difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2010. H_1: There is a difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2010.
H_0: There is no difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2012. H_1: There is a difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2012.
H_0: There is no difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2012. H_1: There is a difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2012.

Figure 2.1

3 Results

The study began with a series of ANOVA, single factor tests to determine if there was a difference in proficiency rates between high users of blended learning and low users of blended learning. The ANOVA test, which compares two or more groups, compared proficiency rates from high users of blended learning and low users of blended learning. The ANOVA also compared either gender or race, depending on what hypothesis the study was analyzing. Each test was further broken down based on grade level and subject area. Proficiency rates from various combinations of these groups were compared in 2008, 2010, and 2012. Due to the small size of some of the groups, a 10% level of significance was used, rejecting the null hypothesis in favor of the research hypothesis if the *p-value* is less than .10. Figure 3.1 shows an example of how one would input data into a typical ANOVA, single factor test.

2008 Reading 3rd Grade by Race			
BAA	BO	NBAA	NBO
50	92.2	78	88.1
38.1	48.3	40	
83.3	23.1	7	
70		53.3	
57.1		48	
12.2		78.3	
71.9		45	

Key:
BAA = Blended African American
BO= Blended "Other"
NBAA = Non-Blended African American
NBO = Non-Blended Other

Figure 3.1

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Race: 2010				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	1.78	.19	2.46	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	2.89	.06	2.49	Reject null, accept research
H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	3.15	.05	2.41	Reject null, accept research
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	2.74	.07	2.41	Reject null, accept research

Figure 3.2

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Race: 2012				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	2.15	.13	2.44	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	1.5	.24	2.44	Do not reject null
H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	3.71	.03	2.38	Reject null, accept research
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	6.83	.002	2.38	Reject null, accept research

Figure 3.3

Figures 3.2 and Figure 3.3, above, are both tables that reveal significant results from the ANOVA tests. (The other tables, which did not reveal significant data, are located in the appendices in Figure A.2- Figure A.5) Figures 3.2 and 3.3 communicate that there is a difference when comparing races in proficiency rates for mathematics and reading tests in 2010 and 2012 among 3rd graders. Additionally, there is a difference when comparing races in proficiency rates in mathematics among 5th graders in 2012. Due to the fact that 69% of DCPS is African American and the other racial groups provided limited data, it was not possible to accurately determine which specific racial group performed best and had higher proficiency rates [2]. Therefore, the study further mined the data by using a t-Test with a .10 significance level to determine if blended or non-blended strategies worked best for solely African American students. The data in Figure A.6 reveals that there was no difference in proficiency rates between African American students from high users of blended learning and low users of blended learning. This means that the difference seen in Figure 3.2 and Figure 3.3 was a result of proficiency rates from students in other racial groups.

Figures A.2-A.4, located in the appendices, reveal that blended learning strategies do not make a difference in 3rd and 5th grade mathematics and reading proficiency rates upon comparing genders in 2008, 2010 and 2012. Similarly, Figure A.5 reveals that blended learning strategies do not make a difference in 3rd and 5th grade mathematics and reading proficiency rates between races in 2008.

Next, in order to determine whether or not proficiency rates in general improved from 2008 to 2012, a t-Test using a 5% level of significance was used. Once again, the null hypothesis is rejected in favor of the research hypothesis if the *p-value* is less than .05. This time, all the proficiency rates from all samples, including male, female, African American, "other" racial groups, high users of blended learning, and low users of blended learning in 2008 was selected and compared to proficiency rates from those same samples from 2012. As seen in Figure 3.4, below, there is a difference in proficiency rates for reading. However, upon further analysis, what the data actually reveals is that proficiency rates got worse between 2008 and 2012. There was no difference in math proficiency rates between 2008 and 2012.

Comparing 2008 to 2012 Proficiency Rates				
Hypothesis	t	*p-value*	t Critical	Decision Rule
H_0: There is no difference in reading proficiency rates from 2008-2012 H_1: There is a difference in reading proficiency rates from 2008-2012	3.35	.0009	1.96	Reject null, accept research
H_0: There is no difference in math proficiency rates from 2008-2012 H_1: There is a difference in math proficiency rates from 2008-2012	1.04	.29	1.96	Do not reject null

Figure 3.4

For the amount of hype over blended learning in the district and in school districts around the nation, it did not seem probable that blended learning could make such a minimal difference. Knowing that, of the 20 schools that provided data, 8 of those schools are categorized as some of the lowest performing schools in the district, the results from this study

led to another question: If the lowest performing schools were excluded, have proficiency rates in reading and mathematics improved from 2008 to 2012? To answer this, we performed another t-Test with a 5% significance level. Figure A.7 communicates that no significant results were revealed, meaning that blended learning made no difference even among the higher performing schools included in this study.

4 Conclusion and Directions for Further Research

Recall the five main questions that this study was leading us to answer. Through the use of an ANOVA single factor test and a t-Test, we can say that blended learning is not effective for reading or mathematics between the two racial groups in 2008. The effects of blended learning between the two racial groups are not seen until 2010 for 5th grade mathematics, 3rd grade mathematics, and 3rd grade reading. These effects continue into 2012 for 3rd grade mathematics and reading. However, due to the small population sizes, we were unable to see which racial group saw the benefits of blended learning. Blended learning is not effective between genders for reading or mathematics in 3rd or 5th grade. Because proficiency rates failed to show a significant difference from 2008 to 2012, we can say that blended learning is not a successful teaching strategy and despite all the hype, the school district should not depend on it to help accomplish the *Capital Commitment* goals.

Despite the fact that there is little evidence that shows the benefits of blended learning right now, there is evidence to support trends towards an increase in proficiency rates due to blended learning in the future. Figure 4.1- Figure 4.4 reveal the trends in proficiency rates from 2008 to 2012. The proficiency rates that are graphed were found by finding the average of proficiency rates in mathematics and reading for each year. Figures 4.1 and 4.2, consisting of data organized by race, show a slight increase in proficiency rates of high users of blended learning and a slight decrease of proficiency rates from low users of blended learning from 2010 to 2012. Figures 4.3 and 4.4, consisting of data organized by gender, show similar trends. These trends are evidence for the fact that blended learning does have potential in the future.

There are various reasons why blended learning has been unsuccessful in the past. To start, blended learning is extremely new and, as a result, students and teachers have not had much time to adjust from a traditional classroom setting to a blended learning style classroom. This may explain why the majority of significant results were seen among 3rd graders, who are young and have been less exposed to a traditional learning environment. Additionally, DCPS is an urban school district and, like the majority of urban school districts, does not have the funding that would allow schools to purchase adequate materials that would aid in blended learning. Along with these reasons as to why blended learning has been unsuccessful in the past are reasons why blended learning has the potential to be successful in the future. As previously stated, the *Capital Commitment* plan began in 2012, the final year for which data was gathered, and will continue into 2017. Future research should compare high and low users of blended learning during these 5 years, 2012-2017, during which the district and teachers would have more practice with using blended learning strategies. Also, in 2012, DC Public Schools was given $10 million to give out to schools that could provide a convincing plan for how technology would be used. Of the 59 schools that won awards, 8 of them were included in this study [3]. With the means to obtain the appropriate resources that would make blended learning effective, there is an opportunity for significant changes in proficiency rates in the next 5 years.

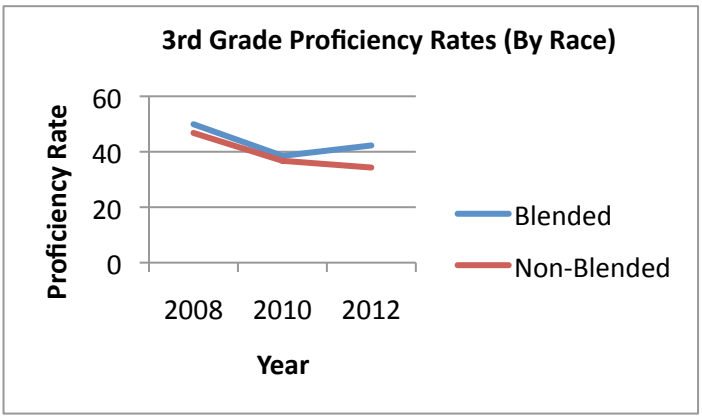

Figure 4.1

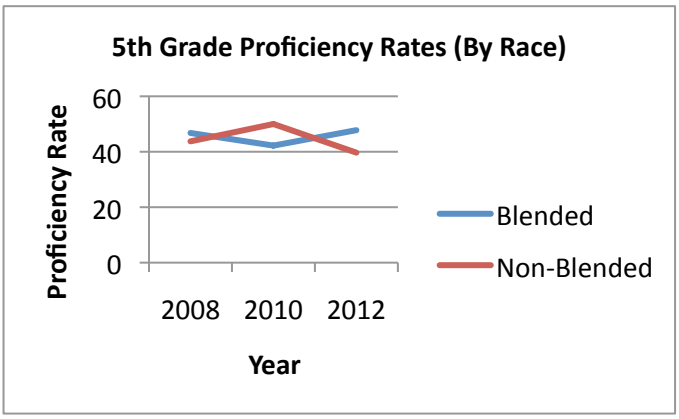

Figure 4.2

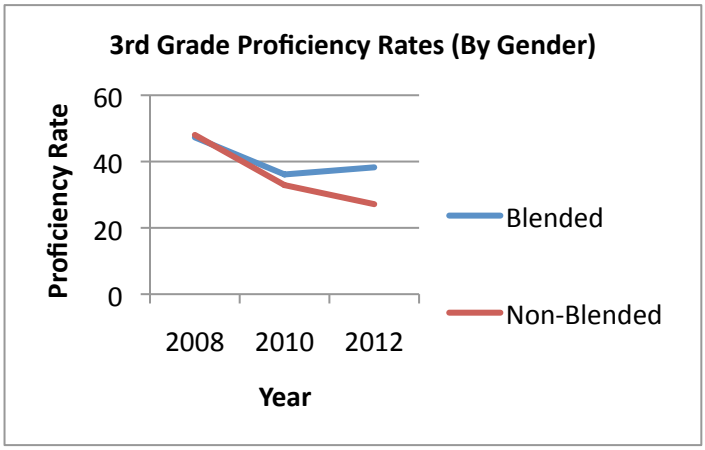

Figure 4.3

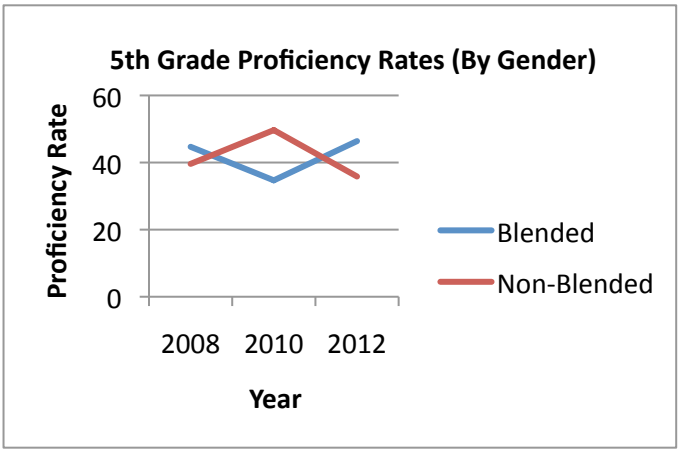

Figure 4.4

References

[1] Wexler, N. (2013, May 23). *DCPS middle school tries a new way of teaching math*. Retrieved from http://greatergreatereducation.org/post/18923/dcps-middle-school-tries-a-new-way-of-teaching-math/

[2] “DC Public Schools.” Facts and Statistics. Retrieved October 10, 2013 from http://dc.gov/DCPS/About+DCPS/Who+We+Are/Facts+and+Statistics

[3] “DC Public Schools.” Proving What’s Possible. Retrieved October 10, 2013 from http://dc.gov/DCPS/About+DCPS/Strategic+Documents/Proving+What's+Possible

Appendices

Hypotheses Continued from Figure 2.1
H_0: There is no difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2008. H_1: There is a difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2008.
H_0: There is no difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2008. H_1: There is a difference in mathematics proficiency rates from grade 3 between high and low user of blended learning among race in 2008.
H_0: There is no difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2008. H_1: There is a difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2008.
H_0: There is no difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2008. H_1: There is a difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2008.
H_0: There is no difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2010. H_1: There is a difference in reading proficiency rates from grade 3 between high and low user of blended learning among race in 2010.
H_0: There is no difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2012. H_1: There is a difference in reading proficiency rates from grade 5 between high and low user of blended learning among race in 2012.
H_0: There is no difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2012. H_1: There is a difference in mathematics proficiency rates from grade 5 between high and low user of blended learning among race in 2012.
H_0: There is no difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008. H_1: There is a difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008.

H_0: There is no difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008. H_1: There is a difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008.
H_0: There is no difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008. H_1: There is a difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008.
H_0: There is no difference in mathematics proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008. H_1: There is a difference in mathematics proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2008.
H_0: There is no difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010. H_1: There is a difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010.
H_0: There is no difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010. H_1: There is a difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010.
H_0: There is no difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010. H_1: There is a difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010.
H_0: There is no difference in mathematics proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2010. H_1: There is a difference in mathematics proficiency rates from grade 5 between schools that

are high users of blended learning and schools that are low users of blended learning among genders in 2010.
H_0: There is no difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012. H_1: There is a difference in reading proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012.
H_0: There is no difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012. H_1: There is a difference in mathematics proficiency rates from grade 3 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012.
H_0: There is no difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012. H_1: There is a difference in reading proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012.
H_0: There is no difference in mathematics proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012. H_1: There is a difference in mathematics proficiency rates from grade 5 between schools that are high users of blended learning and schools that are low users of blended learning among genders in 2012.
H_0: There is no difference in reading proficiency rates between 2008 and 2012. H_1: There is a difference in reading proficiency rates between 2008 and 2012.
H_0: There is no difference in mathematics proficiency rates between 2008 and 2012. H_1: There is a difference in mathematics proficiency rates between 2008 and 2012
H_0: There is no difference in reading proficiency rates between 2008 and 2012 among the lowest performing schools. H_1: There is a difference in reading proficiency rates between 2008 and 2012 among the lowest performing schools.

H_0: There is no difference in reading proficiency rates between 2008 and 2012 among the highest performing schools. H_1: There is a difference in reading proficiency rates between 2008 and 2012 among the highest performing schools.
H_0: There is no difference in mathematics proficiency rates between 2008 and 2012 among the lowest performing schools. H_1: There is a difference in mathematics proficiency rates between 2008 and 2012 among the lowest performing schools.
H_0: There is no difference in mathematics proficiency rates between 2008 and 2012 among the highest performing schools. H_1: There is a difference in mathematics proficiency rates between 2008 and 2012 among the highest performing schools.

Figure A.1

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Gender: 2008				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	.98	.42	2.29	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	.08	.97	2.29	Do not reject null
H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	.73	.54	2.38	Do not reject null
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	.39	.76	2.29	Do not reject null

Figure A.2

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Gender: 2010				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	1.17	.34	2.3	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	.45	.72	2.32	Do not reject null

H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	.29	.83	2.26	Do not reject null
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	.2	.9	2.26	Do not reject null

Figure A.3

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Gender: 2012				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	.35	.78	2.27	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	.44	.73	2.27	Do not reject null
H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	1.08	.37	2.26	Do not reject null
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	.75	.52	2.25	Do not reject null

Figure A.4

Comparing Blended Learning vs. Non-Blended Learning Classrooms Among Race: 2008				
Hypothesis	F	*p-value*	F Critical	Decision Rule
H_0: There is no difference in reading, 5th grade H_1: There is a difference in reading, 5th grade	2.15	.13	3.16	Do not reject null
H_0: There is no difference in math, 5th grade H_1: There is a difference in math, 5th grade	1.76	.19	3.16	Do not reject null
H_0: There is no difference in reading, 3rd grade H_1: There is a difference in reading, 3rd grade	.69	.56	3.19	Do not reject null
H_0: There is no difference in math, 3rd grade H_1: There is a difference in math, 3rd grade	.86	.48	3.2	Do not reject null

Figure A.5

Comparing the African American Population Between High and Low Users of Blended Learning: 2010 & 2012				
Hypothesis	t	*p-value*	t Critical	Decision Rule
H_0: There is no difference in reading, 3rd grade: 2010 H_1: There is a difference in reading, 3rd grade: 2010	.71	.49	2.12	Do not reject null
H_0: There is no difference in math, 3rd grade: 2010 H_1: There is a difference in math, 3rd grade: 2010	.88	.39	2.11	Do not reject null
H_0: There is no difference in reading, 3rd grade: 2012 H_1: There is a difference in reading, 3rd grade: 2012	1.21	.44	2.12	Do not reject null
H_0: There is no difference in math, 3rd grade: 2012 H_1: There is a difference in math, 3rd grade: 2012	1.23	.23	2.12	Do not reject null

Figure A.6

Comparing 2008 to 2012 Proficiency Rates: Excluded the Lowest Performing Schools				
Hypothesis	t	*p-value*	t Critical	Decision Rule
H_0: There is no difference in reading proficiency rates from 2008-2012 excluding the lowest performing schools. H_1: There is a difference in reading proficiency rates from 2008-2012 excluding the lowest performing schools.	-.95	.35	2.02	Do not reject null
H_0: There is no difference in math proficiency rates from 2008-2012 excluding the lowest performing schools. H_1: There is a difference in math proficiency rates form 2008-2012 excluding the lowest performing schools.	.03	.97	2.02	Do not reject null

Figure A.7