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The Impact of Home Computer and Internet Access on NAEP Science Scores

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Abstract

This study conducted a secondary analysis of the National Assessment of Educational Progress (NAEP) assessment, exploring the effect of home computer and internet access on science average scale scores among 8th grade students. In order to gain a better understanding of the impact of home computer and internet access on NAEP Science scores of 8th grade students, this study used a quantitative descriptive research design to analyze secondary data extracted from the 2015 NAEP data set. The results by the NAEP Data Explorer indicate that the average scale score of students who had home access to a computer (M=156.29, SD=33.14) was significantly higher (p<.05) than students without home access to a computer (M=136.37, SD=34.48). On the question of home internet access, the results showed that the average scale score of students who had home internet access (M=155.56, SD=32.94) was significantly higher (p<.05) than students without home internet access (M=134.92, SD=40.03). The results indicate a significant advantage for students with home access to technology but may point to more complex socioeconomic factors beyond ownership of a computer or connection to the internet.

Keywords

NAEP, Science, Assessments, Home Factors, Computers, Internet

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1. Introduction

Science education is a topic of increasing importance in the United States. Although educators, administrators, commentators, and parents all seem to agree that science education is extremely important, standardized test scores in the area of science have seen declines in recent years. Many commentators see the rhetoric surrounding science education and the reality of falling test scores and search for root causes and possible solutions.

One potential saving grace is the constant evolution of technology and the increased consumer access to that technology for educational purposes. In the early 1980s, less than 10% of United States households had access to a personal computer. By the late 1990s, that percentage had increased to 11%. By 2016, that number had skyrocketed to 89% [1]. In just 30 years, the rarity of household computers was completely inverted. Whereas 90% of households were once computer-free, 90% of households now have at least one personal computer.

Commercial internet is a more recent phenomenon, but since home internet hit the market, it has closely tracked with personal computer ownership. In 1997, less than 20% of households were internet-connected. By the year 2003, that number was over 50%. In 2013, the number increased to nearly 80%, before declining slightly in succeeding years, due in large part to the advent of smartphones [1].

With the clear majority of United States households having access to both personal computers and the internet, students have access to educational avenues that were not possible for previous generations. Resources such as educational YouTube videos, learning sites like Khan Academy, and other

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free resources have the potential to help increase student performance in a variety of areas. Since science is an area that has received public approval of its importance and public scorn for falling achievement, it is certainly an area that deserves investigation.

The purpose of this study is to examine the connections between the nationwide performance of 8th graders on the NAEP Science Assessment and the students' access to both computers and the internet at home. Almost every study of the subject shows that science achievement is declining among students in the United States [2, 3]. At the same time, studies have shown that instructional time for science education is actually decreasing in primary schools and has been for two decades [4]. The past two decades corresponds roughly to the time where computer and internet access is more widely available than ever before, which should mean that students have more avenues for creative educational opportunities. However, if science instructional time has been decreasing during the same period, what exactly is responsible for the decline of science scores?

While there are studies that examine United States K12 science achievement in a general or focused sense, [2, 3], there are much fewer studies that examine NAEP Science Assessment scores in particular. With regard to computer access, there are studies that examine computer access on a large scale, but with generalized results that are not directly applicable to science [5]. Other studies have tested computer access and its effect on test scores in European countries [6, 7], but there are none that examine computer access and its effect on the NAEP Science assessment.

With regard to the question of internet access, there are multiple studies about home internet access and its effect on technology literacy, mathematics, and language skills [8, 9]. There is at least one study that directly examines the effect of home internet access on science scores (among other subjects), but the assessment in question was the PISA exam, not the NAEP, and the population examined was in Europe, not in the United States [10]. There is a noticeable gap in the available research that can only be filled with a study that examines the effect of home computer and internet access and its effect on student scores on the NAEP Science Assessment.

Knowing the effect on computer and internet access on NAEP science scores would be immediately valuable for K12 teachers, particularly 8th grade science teachers, since that is the population the scores are drawn from. The results could be helpful for teachers in primary grades as well, potentially prompting them to add science-oriented activities to curriculum in early grades to ground students in scientific concepts by the time they reach middle- and high-school. The results could help administrators incorporate more technology into classrooms or start programs to allow students to check out technology that may increase achievement. Finally, the results could be helpful to communities, as they find solutions to grant greater access to computers and the internet in the remaining 10% of households who lack access.

This study will examine the following questions: (1) Are NAEP Science scores of 8th grade students higher for students who have access to a computer at home? (2) Are NAEP Science scores of 8th grade students higher for students who have access to the internet at home?

The theoretical framework for this research adopts a scientific inquiry-based approach. The framework was described in great details in *The Impact of Conversations on Fourth Grade Reading Performance – What NAEP Data Explorer Tells*? [11]. In summary, the research methods combined the inquiry process with scientific knowledge, reasoning, and critical thinking. The authors started with an extensive exploration of the dataset, and that led to the designing of the research questions. The research questions further guided us to mine the data with great in-depth.

2. Literature Review

The review of literature begins with studies that have examined science achievement at the K12 level. Studies that explicitly tackle NAEP Science assessment scores are rare indeed, as most studied grapple with science achievement in the classroom directly. Some authors offer either novel or well-worn solutions to the problem of science achievement. The review also includes some encouraging news about the trend of NAEP Science assessment scores.

In searching for variables that may affect standardized test scores, one factor that has been interesting to researchers is the effect that student access to technology at home and what impact that access may have on achievement. There are questions about whether computer and internet access improves student achievement in subjects like technology, engineering, computer literacy, and mathematics. However, there is a noticeable lack of research about how access to computers and internet affect the "S" of STEM fields--namely, science. It is worth noting that the NAEP assessment itself was administered via computer for the first time in 2009 [12].

2.1. The State of K12 Science Education

The NAEP scores for science have come under scrutiny recently as more researchers are concerned about the achievement in science at the K12 level. Even though 74% of

Americans rank science as very important, the 2009 NAEP scores showed that only 30% of 8th grade test-takers scoring proficient or above [13]. This disparity between those who believe science to be important and the comparatively low level of science achievement has led some researchers to ask what factors lead to success and what factors lead to failure.

Other researchers have weighed in on the possibilities of improving science achievement among K12 students. Schneider et al. [2] saw the achievement scores in science declining, and offered a solution in project-based science. In this approach, students "need to find solutions to real problems by asking and refining questions, designing and conducting investigations, gathering and analyzing information and data, making interpretations" (p. 411). Project-based learning is one method to make science feel more immediate and less distant from the student. The idea no longer sounds novel, being more than fifteen years removed from the publication of the article, but the adoption of project-based learning may still have ripple effects in science achievement at it is introduced and refined throughout school districts.

Some researchers have put forth that science education has grown stagnant. Kapila and Iskander [3] found that school children often lost interest in science due to outdated lab equipment that was unfamiliar to them and that they saw as irrelevant. The authors envision science curriculum that is transformed by modern technology, such as tablets and mobile phones. Part of their vision includes technology literacy, which touches on, but does not directly address, the possible effect of access to technology on test scores in science.

Since many of these studies were done, some good news has emerged in the NAEP Science assessment. In 2009, the percentage of students at or above the Proficient achievement level has increased in the most recent two testing cycles. In 2009, the percentage of 8th grade students taking the NAEP Science assessment and scoring above Proficient was only 29%. That number increased to 32% in the 2011 testing cycle, and to 33% in the 2015 testing cycle, all of which are statistically significant changes [14]. So while the science assessment scores were once cause for grave concern, they now seem to be on an uphill climb. The question is, for the students who are below Proficient or even Basic achievement level, are they being held back by lack of access to technology at home?

2.2. Studies of Home Computer Usage

The question of the decline in the quality of science education emerges at the same time computers have nearly saturated the home market. Several authors have done studies on students who had computers at home and the effect it had on their academic performance. Fairlie and Robinson [5] conducted a large-scale experimental study (n=1,123) of middle- and high-school students across fifteen schools in California. The control group of students had no computer access at home, and the treatment group were given free computers. The researchers examined a host of factors, including course grades, standardized test scores, attendance, discipline, turning in work on time, and other factors. The results of their experiment showed that the computers had no effect on any educational outcomes tested.

Naevdal [6] conducted a study examining the effect of home computer access on English test scores. His study found a positive relationship between time spent on a home computer and performance in English classes, with the relationship even more pronounced among the female population. Naevdal's study took place in Norway, which makes it difficult to use as a direct comparison to data generated by NAEP assessments, but it is still useful as a general data point.

One study that occurred early in the age of home computers was done by Papanastasiou et al. [7]. This study, which examined the TIMSS assessment rather than the NAEP assessment, asked the provocative question, "Can computer use hurt science achievement?" In the digital age, such a notion seems outlandish, but the researchers pointed out that this international study found that the three countries where computer use was most prevalent in the classroom were the three countries that had the lowest achievement in mathematics and science. However, data also indicated that among countries these low-achieving countries (including the United States) the subgroup who had computers access at home had higher achievement than their peers.

Another study by Wittwer and Senkbeil [15] researched the effect of home computer access on students' mathematics scores. This study was done in Germany among 4,660 students. Their findings showed that computer access was not a significant predictor of mathematical achievement. Again, the study is not directly comparable to NAEP assessments, but is useful as an overall trend marker.

2.3. The Rise of the Connected Household

In addition to studies that examine computer use, researchers have undertaken the study of how internet access at home affects students' academic performance. Lei and Zhou [8] performed a survey study of 1,576 students in China and its effect on students' technology literacy. The authors were concerned about the "digital gap" experts noticed in China and other places, where access to the internet created unequal outcomes among students. The results of the survey showed

that students with internet access at home reported higher levels of computer and internet self-efficacy than those without internet access. This indicates that students with internet access (53.5% of the sample) felt more comfortable, fluent, and at-ease with technology than peers without internet access.

Wainer, Vieira, and Melguizo [9] also studied the effect of home access to the internet. Their study focused specifically on primary students in Brazil. The study used Brazil's "Prova Brasil" standardized test which is administered every two years and includes the subjects Computer Literacy, Internet Literacy, Math, and Portuguese. Echoing the results of Lei and Zhou [8], the results indicated that students with internet access at home outperformed students without internet access at home in the most recent dataset.

Biagi and Loi [10] performed a similar study, only with students in 23 European countries. The researchers used the results of the PISA, a multi-national standardized test for 15 year-olds. The test subjects included mathematics, reading, science, and cross-curricular problem-solving. By using the attached questionnaire, the researchers were able to determine which students had a computer with internet access at home. Surprisingly, the results showed that, with very few exceptions, students with home internet access performed worse than students without home internet access. Even when controlling for socioeconomic level, the authors conclude that investing in the teaching of technology is a misapplication of school funds.

The existing studies examining home computer and internet access are helpful in interpreting NAEP results, but they have severe limitations. First, many of the studies are outdated, having been written before 2010. In the last ten years, technology has evolved considerably, prompting the need for updated studies. Second, many of the studies were performed outside the United States, making the usefulness of their results limited when analyzing NAEP data. Finally, the results of the studies vary wildly, with some studies finding increased performance for students with home computer and internet access, some finding no effect, and a few finding a negative effect.

While there are several studies that examine the topics of technology scores, the effects of computers at home, and the effects of access to the internet at home, there has not yet been a study that examines the effect of home computer and internet access on technology scores.

3. Research Methods

This secondary analysis of NAEP data used a quantitative descriptive research design that compared differences in average scale scores of 8th grade students taking the NAEP Science assessment. The NAEP Data Explorer was used to collect data.

3.1. NAEP

The NAEP, administered by the National Center for Education Statistics (NCES) began in 1969 as a truly nation-wide assessment [16]. The assessment is given to a statistically representative sample and reported nationally for all subjects and by state or district for a few subjects.

The National Assessment of Educational Progress (NAEP) Science Assessment is a nationwide assessment that measures student knowledge in various grades of Earth science, astronomy, physical science, and other topics related to science [16]. The NAEP science assessment began in 1969 and has been delivered at irregular intervals in the intervening years [17]. The scale scores presented represent average student performance on the assessment. In 2015, the NAEP Science Assessment was given to over 110,000 8th grade students, who are the subject of the present study.

Since the NAEP is a nationwide assessment, it is often used to compare achievement from state to state, region to region, or district to district. The national aspect of the assessment allows comparisons of urban areas to rural areas, of public schools to private schools, and many other possible scenarios.

3.2. Scoring Scale

The NAEP Science assessment has a scale of 0-300. There are three achievement levels in the assessment: Basic, Proficient, and Advanced [18]. Each grade and assessment type has a different cut score. For the 8th grade Science assessment, the minimum score is 141; for Proficient, the minimum score is 170; for Advanced, the minimum score is 215 [19]. The cut score ranges are presented in Table 1.

Table 1. Cut Scores for 8th grade Science achievement levels.

	Below Basic	Basic	Proficient	Advanced
Score range	0-140	141-169	170-214	215-300

3.3. Sampling Process

The NAEP uses a sampling frame to create a representative student sample by combining data from the Common Core of Data (CCD) and the Private School Survey (PSS) [20]. The multistage sampling process allows the assessment to be administered to a smaller group of students rather than the entire population of the target grade. Usually, 30 students per grade per subjects are randomly selected from a given school. The test books are randomly distributed to the students. Using Balanced Incomplete Block spiraling, each student only completes a portion of the questions for each given subject, but when taken together, the entire subject's

questions are answered by different students in the given school [20].

NAEP provides aggregate data for purposes of analysis, but does not disclose individual scores to protect the anonymity of participants. The NAEP exam is given at certain key stages in students' academic careers. Usually, the NAEP scores come from grades 4, 8, or 12. Some assessments, however, are only available for specific grades levels and/or specific years. The NAEP Science Assessment, which is the focus on the present study, was only available for for the year 2015. For the Science Assessment, only national results are available--not state results [20].

3.4. NAEP Background Questionnaires

In addition to the standardized assessments, the NAEP is accompanied by voluntary surveys for teachers, students, and administrators. These questionnaires capture information about demographics, access to resources, educational background, factors beyond school, and much more. The questions often help researchers correlate test scores with explanatory variables [21].

The three types of survey questionnaires used in the NAEP are:

1) Student questionnaires. These are used to collect demographic and personal data about students who participate in the assessment.
2) Teacher questionnaires. These are used to collect information about teacher background, training, and types of activities.
3) School questionnaires. These are used to collect information about the school itself, including information about facilities, policies, and technology featured in the learning environment.

3.5. Data for the Present Study and Variable Selection

The present study used the online NAEP Data Explorer to identify Science proficiency scores and questionnaire items on factors beyond the school for the year 2015. The NAEP Data Explorer allows users to create customized reports, tables, and significance tests. For national results, the sample size is between 10,000 and 20,000 students [21]. For the NAEP Grade 8 Science assessment in 2015, the sample was 110,900 students from 6,050 schools [22, 23]. Only the national school reports are available for the NAEP Science assessment, and thus only national results were used in the present study.

The present study uses the average scale scores for the NAEP Science assessment. The two variables selected for analysis were: 1) computer at home and 2) at home have access to internet.

3.6. Statistical Methods

Descriptive tables and tests of significant differences were calculated by NAEP Data Explorer [23]. A *t* test for either independent or overlapping groups is used depending on the necessity of the comparison [25]. For the present population, the groups are independent; therefore, independent *t* tests are used for comparison. In the present study, the *t* test determines whether the mean of the proficiency scores is significantly different between the population of students in question. All comparisons assume an alpha level of 0.05 and are reported with standard errors [26]. NAEP uses plausibility checks to ensure no errors or artifacts are introduced in the process of statistical analysis [23]. To determine Cohen's *d* effect size, an online effect size calculator was used [27, 28].

4. Results

The NAEP results are presented in aggregate with non-identifiable information, and thus do not give exact frequencies of students for average scale scores [20]. The tables below were generated either directly from the NAEP Data Explorer. The figures below were constructed from the data generated by NAEP Data Explorer.

4.1. Science Scores Overall

The National average scale scores for all grade 8 students are presented in Table 2 and Figure 1. The average scale score for grade 8 students on the 2015 NAEP Science assessment was 153.94 (scale-range 0-300) with a standard deviation of 34.01. This average score of 153.94 places the average test-taker in the Basic range, which is from 141-169 [23]. In the sample of all test-takers, 32.06% were below Basic achievement, 33.74% were at Basic, 32.32% were at Proficient, and 1.88% were at Advanced.

Table 2. NAEP Science Assessment: Grade 8 Average Scale Scores.

Year	Jurisdiction	Average scale score	Standard deviation	Percent below Basic	Percent at Basic	Percent at Proficient	Percent at Advanced
2015	National	153.94	34.01	32.06	33.74	32.32	1.88

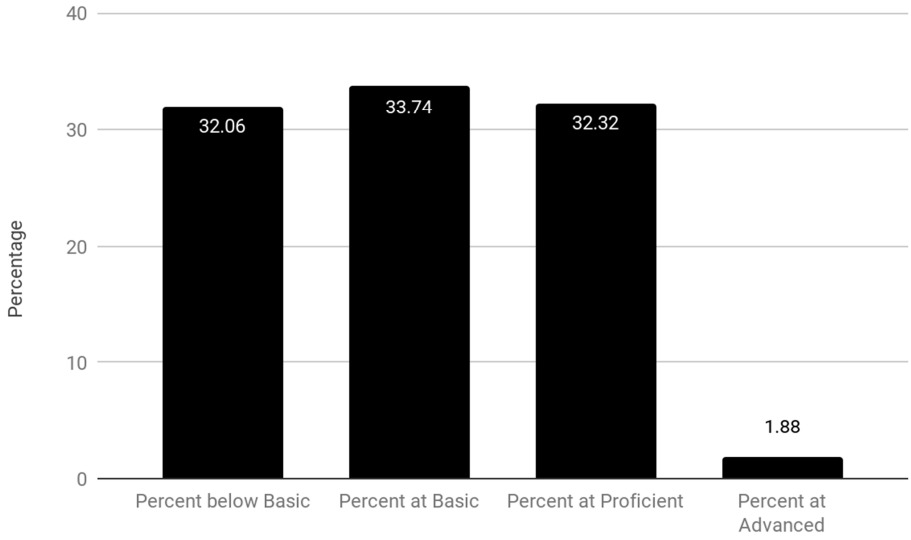

Figure 1. NAEP Science Assessment: 8th Grade Achievement Levels.

4.2. Research Question #1: Student Computer Access

Are NAEP Science scores of 8th grade students higher for students who have access to a computer at home? There are only a few studies examining the effect of home computer access on standardized test scores. Of the studies available, they examine different populations in different countries, with different standardized tests. There are no studies that directly examined the question of home computer access on NAEP Science achievement.

Table 3 shows the NAEP Science assessment average scale score, standard deviation, and percentage of students who have computer access at home versus those who lack that access. The average scale score on the NAEP Science assessment for students with computer access at home was 156.29 with a 33.14 standard deviation. This group represented 88% of all 8th grade test takers. The average scale score on the NAEP Science assessment for students without computer access at home was 136.37 with a standard deviation of 34.48. This group represented 12% of all test-takers.

Table 3. NAEP Science Assessment: Grade 8 Average Scale Scores by Home Computer Access.

Year	Jurisdiction	Computer at home	Average scale score	Standard deviation	Percentage
2015	National	Yes	156.29	33.14	88.50
		No	136.37	34.48	12.50

Table 4 shows the result of Cohen's d effect size tests on the question of home access to computers. The effect size was medium (d=0.59) [25].

Table 4. NAEP Science Assessment - 8th grade computer at home effect sizes.

Computer at home	Mean	Standard deviation	Cohen's d	Result
Yes	156.29	33.14	0.59	Medium
No	136.37	34.48		

Table 5 shows the results of t tests generated by NAEP Data Explorer between the groups with home computer access and those without home computer access. The t test has a default alpha level of .05 (NCES). There was a statistically significant difference (p<.05) between the average scale scores of the students with home computer access (M=156.29, SD=33.14) and the students without home computer access (M=136.37, SD=34.48).

Table 5. NAEP Science assessment: 8th grade home computer access significance testing.

	Yes (156.29)	No (136.37)
Yes (156.29)		> Diff=19.92 P-value=0.0000
No (136.37)	< Diff=-19.92 P-value=0.0000	

LEGEND: <: Significantly lower. >: Significantly higher. x: No significant difference.

Table 6 and Figure 2 represent the percentage of achievement levels of students who have computer access at home versus those who lack that access. The percentage of students below Basic achievement level is 29.35% for students with home computer access and 52.28% for students without home computer access. The percentage of students at Basic achievement level is 34.16% for students with home computer access and 31.29% for students without home computer access. The percentage of students at Proficient achievement level is 34.46% for students with home computer access and 16.12% for students without home computer access. The percentage of students at Advanced achievement level is 2.09% for students with home computer access and 0% for students without home computer access.

Table 6. NAEP Science Assessment: Grade 8 Achievement Levels by Home Computer Access.

Year	Jurisdiction	Computer at home	Average scale score	Percent below Basic	Percent at Basic	Percent at Proficient	Percent at Advanced
2015	National	Yes	156.29	29.35	34.16	34.40	2.09
		No	136.37	52.28	31.29	16.12	0

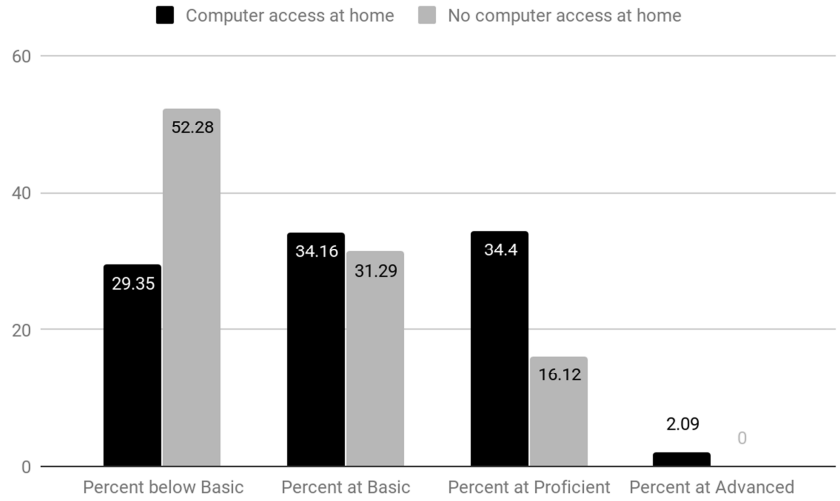

Figure 2. NAEP Science Assessment – 8th Grade Achievement Levels by Computer Access.

4.4. Research Question #2: Student Internet Access

Are NAEP Science scores of 8th grade students higher for students who have access to the internet at home? There are only a few studies examining the effect of home internet access on standardized test scores. Of the available studies, most of them examine Europe, Asia, and Latin America. The question of home internet access specifically on NAEP Science scores is one that has not seen direct study.

Table 7 shows the NAEP Science assessment average scale score, standard deviation, and percentage of students who have internet access at home versus those who lack that access. The average scale score on the NAEP Science assessment for students with internet access at home was 155.56 with a 32.94 standard deviation. This group represented 92% of all 8th grade test takers. The average scale score on the NAEP Science assessment for students without internet access at home was 134.92 with a standard deviation of 40.03. This group represented 8% of all test-takers.

Table 7. NAEP Science Assessment: Grade 8 Average Scale Scores by Home Internet Access.

Year	Jurisdiction	Internet at home	Average scale score	Standard deviation	Percentage
2015	National	Yes	155.56	32.94	92.0
		No	134.92	40.03	8.0

Table 8 shows the result of Cohen's d effect size tests on the question of home access to the internet. The effect size was medium (d=0.56) [25].

Table 8. NAEP Science Assessment – 8th grade computer at home effect sizes.

Internet at home	Mean	Standard deviation	Cohen's d	Result
Yes	155.56	32.94	0.56	Medium
No	134.92	40.03		

Table 9 shows the results of *t* tests generated by NAEP Data Explorer between the groups with home internet access and those without home computer access. The *t* test has a default alpha level of .05 [25]. There was a statistically significant difference ($p<.05$) between the average scale scores of the students with home computer access (M=155.56, SD=32.94) and the students without home internet access (M=134.92, SD=40.03).

Table 9. NAEP Science assessment: 8th grade home internet access significance testing.

	Yes (155.56)	**No (134.92)**
Yes (155.56)		> Diff=20.64 P-value=0.0000
No (134.92)	< Diff=-20.64 P-value=0.0000	

LEGEND: <: Significantly lower. >: Significantly higher. X: No significant difference.

Table 10 and Figure 3 represent the percentage of achievement levels of students who have internet access at home versus those who lack that access. The percentage of students below Basic achievement level is 30.32% for students with home internet access and 52.48% for students without home internet access. The percentage of students at Basic achievement level is 34.29% for students with home internet access and 27.34% for students without home internet access. The percentage of students at Proficient achievement level is 33.41% for students with home internet access and 19.46% for students without home internet access. The percentage of students at Advanced achievement level is 1.98% for students with home internet access and 0.72% for students without home internet access.

Table 10. NAEP Science Assessment: Grade 8 Achievement Levels by Home Internet Access.

Year	**Jurisdiction**	**Internet at home**	**Average scale score**	**Percent below Basic**	**Percent at Basic**	**Percent at Proficient**	**Percent at Advanced**
2015	National	Yes	155.56	30.32	34.29	33.41	1.98
		No	134.92	52.48	27.34	19.46	0.72

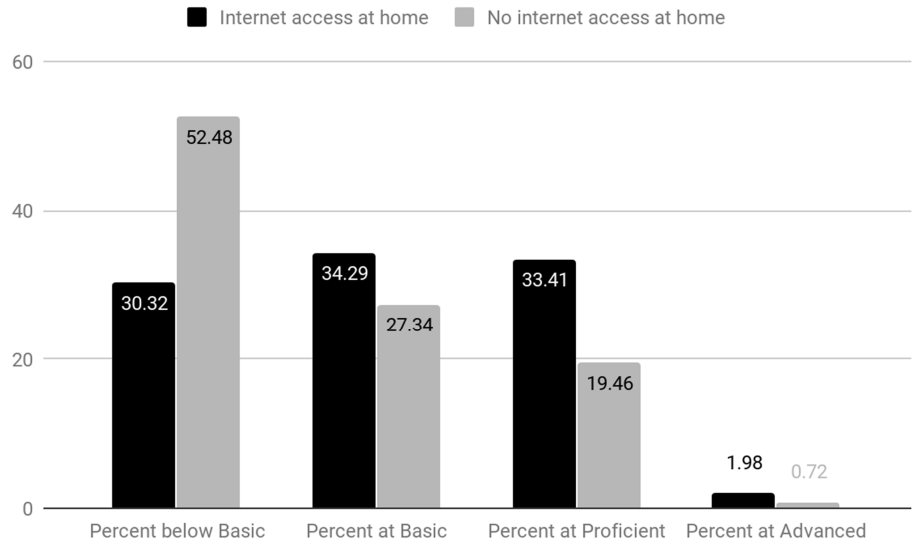

Figure 3. NAEP Science Assessment – 8th Grade Achievement Levels by Internet Access.

5. Discussion

This study aimed to examine the science achievement gap between students with home access to technology and those without. The research was prompted by the national importance of science education, but relative lack of results [13]. In an era where computer ownership and internet access is approaching a saturation point, examining the science scores of populations with access against populations without access should yield valuable results. Until now, there has been no research that explicitly examines home technology access and its impact on science scores.

The NAEP average scale scores revealed that 98% of all students were roughly evenly split into three achievement levels: below Basic, Basic, and Proficient. Less than 2% fell into the Advanced category. The average scale score of 153.94 is important to keep in mind when examining the populations with home access to computers and internet.

5.1. 8th Grade Students NAEP Science Scores and Computers at Home

The average score of 156.29 for students with home access to computers is very close to the overall average of average scale score of 153.94. This makes sense, considering that the group with computer access was far larger, comprising 88% of the sample. The average scale score of 136.37 for students without home computer access is much lower than the average scale score of the general population. The difference between the means of the groups was found to be statistically significant with a medium effect size.

Looking at achievement levels, students without home computer access were almost twice as likely to be below Basic achievement level, and less than half as likely to be at Proficient achievement level. Most striking is the finding that of the already small percentage of students who achieved the Advanced achievement level, none of them--0%--were from the sample without home computer access.

This research question is supported by the data--8th grade students with home access to computers have higher NAEP science scores than those without that access. This result echoes the findings by Naevdal [6] and Papanastasiou et al. [7], where a positive relationship between home computer access and educational outcomes was observed. However, this finding directly contradicts studies by Wittwer and Senkbeil [15] and Fairlie and Robinson [5], both of which found computer access had no significant impact on educational outcomes.

5.2. 8th Grade Students NAEP Science Scores and the Internet at Home

The average scale score of 155.56 for students with home internet access is very similar to the overall scale score average of 153.94. For this population, an even greater percentage of students have home internet access, with 92% of students reporting access to the internet at home versus only 8% who lack that access. The fact that more students have home internet access than home computer access speaks to the recent tipping point where cell phone access stymied the growth of both personal computers and high speed internet. The average scale score of 134.92 for students without home internet access is much lower than the average scale score of students with that access. Additionally, it is lower than the population at large, and even lower compared to the scale score of students who lack home computer access. The difference in means between the two groups was found to be significant with a medium effect size.

In terms of achievement levels, the data for this question look very similar to the data generated by the question of home computer access. Students who lack home internet access are 20% more likely to be below Basic achievement level and 13% less likely to be at Proficient achievement level. Less than 1% of students without internet access score at the Advanced achievement level.

Again, this research question is supported by the data--8th grade students with home access to the internet have higher NAEP science scores than those without that access. These results concur with the findings by Lei and Zhou [8] and Wainer, Vieira, and Melguizo [9], both of which found a statistically significant positive relationship between home internet access and educational outcomes. However, the results contradict the results of Biagi & Loi [10], which found a negative relationship between home internet access and educational outcomes.

5.3. Limitations

There are several limiting factors to bear in mind in the present study. First, the average scale scores are specific to the area, grade level, and year range in which the NAEP Science assessment was given. These scores cannot be compared to scores from another subject with accuracy. In addition, Science scores cannot be accurately compared from one grade level to another, since they are developed specific to the content of the given grade. Finally, NAEP Science assessment scores after 2009 have a different framework than those developed prior to 2009, and thus cannot be directly compared [16].

6. Conclusions

A very interesting split is evident from existing research, with roughly half of previous studies finding statistical advantages for students with home access to computers and technology, and the other half finding either no difference, or in some cases disadvantages for students with ready access to technology. The present study comes down firmly on the side that sees clear advantages for the population with the greater access, but the finding may be more indicative of larger socioeconomic factors that happen to include computer and internet access.

Since only a small portion of the sample population (10% or less) were without either computer or internet access, it is reasonable to conclude that portion likely overlaps to a large degree with the lowest income bracket. If this is the case, the message that should be received from these findings is not that we need computers and internet access to improve science scores, but that we need a larger strategy to ensure that the poorest population performs better relative to the wealthy population.

Schneider et al. [2] saw project-based learning as a way

forward for K12 science education. Kapila and Iskander [3] saw updated equipment and relevant labs as a way to engage students, to make them passionate about science. Armed with the knowledge that, whether from lack of home access to computers and the internet, or from lack of socioeconomic status, there is a sizeable chunk of the K12 population that demonstrably lags behind their peers, these and other options are both welcome and necessary.

Future research into K12 science achievement should focus on creative advancements in the classroom, including the project-based learning envisioned by Schneider et al. [2] and updated, tech-rich labs proposed by Kapila and Iskander [3]. An experimental study that compares a control with old-fashioned labs and an experimental group with tech-mediated labs could yield useful data.

As the NAEP continues to evolve, state-level data for the Science assessment is bound to be included. When it is, state-level analyses should be conducted. Especially interesting would be states that have a higher proportion of home computer and internet access compared to states with a lower proportion of home computer and internet access.

There are numerous studies that examine home computer and internet access in various countries, but relatively few that examine the specific impact on science achievement. Future research should take advantage of assessments such as PISA and TIMMS to tackle the question of technology access and its effect on science achievement.

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