An Examination of Educational Resources on Student Performance

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Abstract

This study examined the relationship between educational resources and student performance in mathematics and science on the Program for International Student Achievement (PISA). Many countries face educational inequality and achievement gaps between high performing and low performing students. The resources invested in education determine—to a large extent—the student performance. This study examined the resources that have the greatest potential to increase student performance. The educational resources of time, material and finance are defined within the study. The measurement of these resources on the international scale uses the PISA questionnaire, which is completed by students, parents, and school principals. Student performance in mathematics and science is also evaluated using the PISA tool. This study used a correlational approach to analyze the relationship between educational resources and student performance. Results identified the optimum areas in which a country should invest their educational resources to increase student performance. Results show a strong relationship between educational materials, cumulative spending, pre-school attendance, and student performance on the science and mathematics 2012 PISA. No relationship was found between student performance on the 2012 PISA and the following variables: student learning time in school, class size, participation in extracurricular activities, and teacher salaries. Implications and future studies are discussed in the final section of this article. The findings of this study have the potential to support changes in education that could increase student performance and increase the social and economic impacts those students will have in the future.

Keywords: student performance, educational resources, PISA, mathematics, science

AN EXAMINATION OF EDUCATIONAL RESOURCES ON STUDENT PERFORMANCE

This study examined the relationship between educational resources and student performance in mathematics and science on the 2012 Program for International Student Achievement (PISA). By identifying the resources that had the strongest relationship with student performance, it was possible to suggest areas of focus for educational leaders and policy makers. Decisions need to be made that prioritize spending of resources on a new school, access to computers, smaller class size, or increased teacher salaries. Every dollar spent on longer class periods, is a dollar not spent on professional development for teachers, increased internet access for students, or extracurricular activities. Leaders need to know which elements have the strongest relationship with student performance. This study examined the relationships among resources and student performance on the 2012 PISA in mathematics and science. By identifying the types of resources that have a significant relationship with student performance, a potential exists to maintain spending yet increase student performance. An adjustment of educational resources in such a manner could decrease educational inequality and close the achievement gap. If the achievement gap narrows as a result of increased student performance, it may decrease violent and non-violent crime, increase the future earned income of individuals, decrease poverty, and increase participation in society. The findings of this study have the potential to increase student performance now and increase the social and economic impact those students will have in the future.

It is not yet known whether considering this much more nuanced understanding of educational resources might uncover useful associations between greater investments in certain kinds of resources and gains in students' performance. Such research is needed to discover whether policy makers and educational leaders should take a much more nuanced approach to allocating not only financial but also other resources in their efforts to improve student learning. The specific educational resources examined in this study come from common themes expressed in the literature. There are three predominant educational resources that are identified: financial resources, material resources, and the resource of time. In this study, financial resources will focus specifically on cumulative expenditure and teacher salaries. For this study material resources will focus specifically on availability of computers at school, instructional use for the internet, and the quality or physical infrastructure and schools' educational resources. Finally, resources associated with time will focus specifically on students' learning time in school, class size, pre-school attendance, and extracurricular activities. These three educational resources, and their impact on student performance, were the focus of this study.

Background of the Problem

Educational inequality, the difference in educational opportunities for students, is a problem at the local, national, and global level (Darling-Hammond, 2010; Education Publishing Company Ltd., 2008; Le Donné, 2014; Mostafa, 2010; Ravitch, 2020; Takayama, 2013). Educational inequality, on the international scale, has led to a significant achievement gap between high performing and low performing students (Le Donné, 2014; Mostafa, 2010; Takayama, 2013). Students who are low performers are more likely to live in poverty (Education Publishing Company Ltd., 2008; Le Donné, 2014; Mostafa, 2010; Robinson, 2017; Takayama, 2013). According to Levitt and Dubner (2005), mothers who perform at a low educational level have a much higher chance of their children being incarcerated. Additionally, the findings of a study in the United States (U.S.) (Education Publishing Company Ltd., 2008;) showed that teens who live in regions with low student performance have a higher probability of committing violent crimes.

Moreover, the achievement gap in many countries is expanding (OECD, 2012; OECD, 2013a; OECD, 2013b; Ripley, 2013). Mathis (2011) reported that 20% of the achievement gap in the U.S. is attributable to social class. Darling-Hammond (2014) stated the achievement gap on the international stage continues to expand as a result of growing child poverty, increasing segregation, income inequality, and disparities in access to educational resources.

Historical studies in several countries show a link between the greater availability of educational resources and higher student performance (Archibald, 2006; Aztekin & Yilmaz, 2014; Demir, 2012; Greenwal et al., 1996; Kilic et al., 2013; OECD, 2014). The lack of educational resources is a major cause for low student performance and an increase in such resources would improve student performance (Archibald, 2006; Aztekin, & Yilmaz, 2014; Demir, 2012; Greenwal, et al., 1996; Kilic et al., 2013; OECD, 2014). Though effective resource allocation can maximize the efficiency of investment in education and increase student performance, there are limits. Educational institutions are directed by local and national programs. The direction of leaders can have a significant impact on student performance, perhaps more so than efficiency of educational spending. Additionally, because many countries have a tradition of democratic elections, they have a political environment filled with new leaders, visions, and policies. Hanushek and Wößmann (2015) stated that it might take as much as 40 years to experience the full effect of educational reform. Further, only 2.5% of the educational workforce is exchanged each year with new workers coming in and old workers leaving, so it takes 40 years to fully turn over the workforce with individuals who attended a reformed education. Governments have mandates tied to special education, school certification, civil rights, standardized testing, and various other initiatives that require participation and funding. The problems of educational inequality and the achievement gap could be reduced by more efficient spending, but an effective solution would require other initiatives, resources, and attention from a multifaceted economic and social perspective. The results from this study can be used to inform decisions about educational spending, but only within the confines of educational sovereignty.

History of PISA

In this study student performance will be measured by the PISA, a test developed by Andreas Schleicher who worked with the Organization for Economic Co-operation (OECD) to develop the Program for International Student Assessment (PISA). PISA's assessment of critical thinking, problem solving, and communication skills in science, mathematics, reading, and writing would show the world which countries were teaching students to think for themselves (Ripley, 2013). The PISA assessment was first administered in 2000, with three-year intervals in 2003, 2006, 2009, and 2012 (OECD, 2013a; OECD, 2013b; OECD, 2014).

The Program for International Student Assessment (PISA) focuses on two aspects of education and includes both a survey that examines variables associated with educational resources and an assessment which looks at academic performance. Created by the Organization for Economic Cooperation and Development (OECD), a group of nations with a goal of greater economic growth and development, this survey is completed by students, parents, and school principals. The 2012 PISA/OECD survey was completed in 63 countries (OECD, 2013). The PISA asks students, parents, and principals questions about their experiences related to the stated resources: financial, material, and time (Gumus, 2011; OECD, 2013a). The survey also collects information regarding student, family, and school characteristics, allowing researchers to investigate the possible interactions between educational resources and student achievement, and the opportunity to compare student performance across many countries (Gumus, 2011; OECD, 2013a; OECD, 2013b; OECD, 2014). By using data internationally, researchers have the potential to identify various societal variables that impact student performance.

Using data collected from the PISA 2000 to 2009 results, researchers determined the countries with the highest student performance overall. The Finnish students ranked the highest on the PISA (OCED, 2014). Students from the country with the highest per pupil spending, Luxembourg, along with students from the country with the highest teacher salaries, Spain, ranked far below student performance in Finland. Finland's per pupil spending is average for the countries PISA covers and for comparison, is almost 5,000 USD less than the USA which spends almost 12,000 USD per pupil (OECD, 2013a; OECD, 2013b; OECD, 2014; Ripley, 2013).

Some countries allocate substantial resources to their education program, yet many of these systems are outperformed by nations that have varying levels of investment (OECD, 2013a). Data collected from PISA shows educational institutions, despite their educational resources, have difficulty advancing student performance (OECD, 2013b; Ripley, 2013). A possible explanation is that countries are not investing in the most effective educational resource to improve student performance (OECD, 2013a; OECD, 2013b).

It is possible the PISA score is not connected to the alignment of educational resources; however, that determination cannot be made until such research has been conducted. The mathematics PISA is scored on a scale up to 650 points and students from Shanghai, China scored on average above 600 points, while students from Viet Nam scored slightly above 500 points, and those from Luxembourg scored slightly below 500 (OECD, 2013b). However, the country of Viet Nam spends less than 10,000 USD per pupil; Shanghai-China spends a little less than 50,000 USD per pupil; and Luxembourg spends just under 200,000 USD per pupil (OECD, 2013b). According to the OECD (2013b), Luxembourg spent 190,000 USD per pupil more than Viet Nam, but the students of Luxembourg have an overall lower performance. Additionally, between 2003 and 2012 Mexico started spending almost 5,000 USD less per pupil and increased their mathematics performance almost 30 points, while Sweden increased their per pupil spending more than 25,000 USD and their mathematics performance dropped more than 30 points (OECD, 2013b). Overall, however, many studies indicate that educational resources are linked to educational achievement, even though some countries' PISA numbers do not currently reflect those results.

Statement of the Problem

Despite similar availability and allocation of educational resources, educational inequality and results in student performance on the 2012 PISA vary widely across the globe. The 2012 PISA installment is the most recent PISA data I could analyze at the time of this study. It appears that the results of later studies are showing similar results to 2012. If leaders could identify resources that had the strongest relationship with student performance on the 2012 PISA, educational leaders could allocate their resources more efficiently. More efficient resource allocation could increase student performance, without additional investment, which could result in a closing achievement gap and increased educational equality.

Purpose of the Study

The purpose of this study was to identify the resources with the greatest relationship to student performance on the 2012 PISA. Sixty-three countries participated in the 2012 PISA. In this study, I reviewed the educational resources (financial, material, and time) that each country invested in its education program and compared the resource investment to the countries' student performance in science and mathematics on the 2012 PISA. By analyzing the relationship between the countries' resources and student performance, relationships between educational resources and student performance is clearer. The impact of a nation's expenditures and distribution of educational resources was compared to the nation's student performance on the PISA to determine if there is a high impact or, any impact at all, that can be determined between these variables. The results of this study indicate that there were, indeed, positive correlations between resource allocation and achievement in mathematics and science.

Research Questions

Knowing the identified resources that had the strongest relationship with student performance on the 2012 PISA, educational leaders could allocate their resources more efficiently. To determine these relationships, I developed the following research questions:

- Which of the educational resources of time, financial, and material have the strongest relationships with student performance in science and mathematics on the 2012 PISA?
- What are the most significant resources one can use to consistently increase student performance?

The research questions were developed on the following hypothesis: More efficient resource allocation can increase student performance, without additional investment, which could result in a closing achievement gap and increased educational equality.

Significance of the Study

This study has added to the literature through an examination of the relationship between educational resources and student performance. Although this research is limited to the PISA 2012 data and OECD survey results, researchers can use the most recent data from the PISA and OECD when replicating this study. Additionally, educational leaders and policy makers at the international, national, local, and school level can use this information when allocating and distributing resources in an effort to prevent social and economic problems in the future by increasing student performance on the PISA in mathematics and science. Educational leaders can use the information from this study to determine the quality and quantity of resources to be spent on cumulative educational expenditure, available computers at school, and student learning time in school. Educational leaders who allocate resources more effectively can improve student performance, on the PISA in mathematics and science, by focusing on the resources with greatest impact on student performance which in turn may adjust educational inequality and the achievement gap, in addition to having a specific impact on student individual future income and participation in society. The most important goal is to close the achievement gap among students, schools, and nations to give more people an equitable education.

Literature Review

This study seeks to decrease educational inequality and lessen the achievement gap by determining the educational resources that have the greatest relationship with student performance on the 2012 PISA. By identifying the resources that have the strongest relationships with student performance, it could be possible to adjust resource allocation to be more efficient and increase student performance without increasing the need to invest more resources. Educational inequality, educational resources (time, finances, and material), and how resources are used have been widely studied. Some scholars argue that the way in which educational resources are used has a greater impact on student performance than the quantity of resources they have available (Ripley, 2013).

This study seeks to construct a global understanding of relationships described above by Engel (2015) and Edwards (2012) within the large pool of available data. Knowing that this data is used to develop reforms, and reforms have yet to significantly reduce educational inequality; researchers can return to the raw data, questioning the current assumptions and frameworks that technology, teacher accountability, and standardized testing, can address the achievement gap.

High student performance is important, not only for a student to be well educated, but for the student to be successful as an adult. Research has found that an educated and active citizen body is critical for effective governance in a democratic society (Gutman, 1987; Westheimer & Kahne, 2004). Additionally, student performance is the greatest predictor of individual earned income as an adult and individual participation in society (OECD, 2004; OECD, 2013; OECD, 2014; OECD/UNESCO, 2003; Ripley, 2013). Hanushek and Wößmann, (2015) analyzed international testing data to find the relevance of education in economic growth. There was an assumption that one year of schooling in different countries is equivalent; however, Hanushek and Wößmann (2015) concluded that it is the knowledge base held by the country's population, what the people know, that determines if a country is rich or poor, thus the quality of education varies in each country. These researchers concluded that countries that do well on international tests have greater economic growth; additionally, 75% of a country's economic growth rate incorporates the mathematics and science skills of the population (Hanushek & Wößmann, 2015).

Resource of Time

Studies suggest the educational resource of time impacts student performance (Angrist & Lavy, 1997; Belinski et al., 2009; Bloom, 1977; Eccles & Barber, 1999; Fischer, 1981; Guskey, 2001). The resource of time consists of: 1. The amount of individual student—teacher time, 2. Students' time spent invested in the school or the greater school community outside of school academic hours, and 3. The amount of time a student spends on learning (e.g., the age at which children start their education, the length of their classes). Similarly, time, as an educational resource, defined by OECD (2013), consists of: students' learning time in school, class size, extracurricular activities, and students' attendance at pre-primary school. Angrist and Lavy (1997) show that a decrease in class size has a significant increase in student reading and mathematics scores for 4th and 5th graders. Each student receives more individual time with the teacher if there are fewer students in the class. Therefore, Angrist and Lavy (1997) suggest these are the reasons for improved performance. Additionally, Bloom (1977) and Guskey (2001) state that to reduce variation in students' achievement and to have all students learn well, educators must increase learning time. Fisher (1981) also found that additional student learning time in school and smaller class sizes increased student performance. Additionally, student involvement in extracurricular activities been correlated with increased academic performance (Eccles & Barber, 1999) because the student's time is invested in school and education becomes more of a priority, even if the extracurricular activities are not academic. Berlinski et al. (2009) found that pre-primary education increased student test scores by 8%, the student's time in school and academics started early as did their skill development.

Material Resources

Researchers have identified educational material resources, such as computers, pencils, books, paper, staplers, copiers, printers, etc., to have a positive impact on student performance. According to Evans (2006), Faith (2009), and Gouda et al. (2013), the material resource consists of the following components: a. availability of computers, b. instructional use of the internet, c. the quality of the physical infrastructure, and d. the school's educational resources. Likewise, material resources, defined by OECD (2013), consist of both physical infrastructure and educational resources. Faith (2009) explains that physical infrastructure and material educational resources such as computers and internet access have a statistically significant positive impact on student achievement in the fourth and eighth grade. The study (Faith, 2009) identifies that between 55.8% and 77.2% of variation in student achievement can be attributed to investment in educational resources.

Financial Resources

Studies by the Education Commission of the States (1992), the Federal Deposit Insurance Corporation (2007), Gius (2013), Husted (2005), Ripley (2013), and Vegas and Coffin (2015) suggest that financial educational resources have an impact on student performance; additionally, they state that financial resources consist of the total amount of money spent on education and money spent on teacher's salary. Financial resources, defined by OECD (2013), consist of teacher's salary and expenditures for education. Gius (2013) performed a study which showed that positive changes in teacher pay had decreased the district level dropout rate by 2.36% and increased the graduation rate by 3.04% over a 7-year period. Additionally, Vegas and Coffin (2015) discovered that overall expenditure had a positive correlation to student performance—as mean student performance was approximately 14 points higher on the PISA scale for every additional USD $1,000 spent.

These results have been replicated by more recent studies. For example, the Learning Policy Institute found that a meta-analysis of research conducted by Bruce Baker (2018) from Rutgers Graduate School of Education indicates that finances matter when it comes to student achievement. According to the LPI Brief, written by Baker (2018), there were three important conclusions from the meta-analysis:

1. An analysis of the relationship between financial resources and student outcomes, money matters in a positive way for student achievement.

2. Educational resources that cost money (e.g., smaller class sizes, salaries for expert teachers) are positively correlated with student achievement.
3. Test scores and graduation rates rise when school districts sustain their efforts to improve educational resources.

There appear to be two issues related to resources: 1. The quantity and quality of the resources, and 2. How resources are allocated. These issues are at the heart of this study.

Conclusion

There are some countries that allocate substantial resources to their education program, yet many of these systems are outperformed by nations that have varying levels of investment (OECD, 2013a). Data collected from PISA shows educational institutions, despite their educational resources, have difficulty advancing student performance (OECD, 2013b; Ripley, 2013). The problem this study examines is the educational inequality and varying results in national student performance on the 2012 PISA, despite similar availability and allocation of educational resources. Knowing the identified resources that had the strongest relationship with student performance on the 2012 PISA, educational leaders could allocate their resources more efficiently. More efficient resource allocation could increase student performance, without additional investment, which could result in a closing achievement gap and increased educational equality. The resources of time, material, and financial resources have been identified as having a relationship with student performance; however, information is not available regarding which relationships have the greatest impact on student performance. A comparison of the impact these resources have is needed, it is not enough to determine if a relationship exists. A narrow view of one resource relationship with student performance is limited; however, a broader of view of which resources have the greatest relationship with student performance can be more informative.

The Program for International Student Achievement, known as PISA, has collected data on the allocation of educational resources and student performance. Certain resources may be more closely related to improved student performance on the PISA. In the mid-1960's, Finnish students earned a score of 510; by 2010, Finnish students earned a score of 545, gaining 35 points in 50 years which is a modest but steady improvement (Ripley, 2013). In the same span, the USA went from 485 to just above 490, and in 50 years, France's score had no change; Canada's student performance increased from 490 to 525, while Norway's student performance decreased from 490 to just above 465 (Ripley, 2013). The data shows that over time some countries increased student performance, others did not change, and some countries had declining performance.

The impact of educational resources on student performance is not well studied. Research is needed so that policy makers and educational leaders can make careful decisions regarding resource allocations. This study addresses part of that gap by looking at the quantity of a resource and its impact on student performance. The distribution of educational resources is not limited to financial means, education requires talented and dedicated people, facilities to support and advance education, and time dedicated to proper preparation and instruction (OECD; OECD, 2012; OECD, 2013a; OECD, 2013b). I examine the impact educational resources have on student performance, specifically the resources of time, material resources, financial resources and their impact on student performance in mathematics and science on the 2012 PISA.

Methodology

This study reviewed the 2012 PISA data to determine the educational resources that have the greatest relationship with student performance. By identifying the resources that have the strongest relationship with student performance it could be possible for school districts to adjust resource allocation to be more efficient and increase student performance without investing more resources. This section looks at the correlational methodology used to determine the relationship between educational resources and student performance on the 2012 PISA.

Research Design

The research design for this study is a correlational study. A correlational study, according to Gall et al. (2007), allows for an investigation that examines the direction and magnitude of the relationship among variables using correlation statistics. Correlational analysis can be used to examine complex relations among many variables. This study used 11 variables for performance in science and 12 for mathematics, for a total of 23 interactions between each resource variable and measures of student performance. The number of variables, with different units of measure, provide a complexity within this study that correlational analysis can manage.

The OECD has already collected data from 63 countries around the world. The information collected is in two forms: 1) a test assessing student academic performance in mathematics and science and 2) a survey completed by school teachers, principals, parents, and other members of the education community. The survey provides information on the allocation of resources within the educational system. A qualitative or mixed method study would not be appropriate for analyzing the data collected by the OECD. A correlational analyses study is necessary to determine the strength of the relationship between the educational resources and student performance. With this method, I answer the research question: Which of the educational resources of time, financial, and material have the strongest relationship with student performance in science and mathematics on the 2012 PISA? This method allows me to analyze the data even where there are varying units of measure, as there are in this study. It can be difficult to analyze statistics of various, seemingly incomparable, units of measure into something useful and meaningful; in such cases it is appropriate to employ correlational statistics.

I used a correlational analysis methodology; additionally, Intellectus Statistics software was used for calculations and graphing. Intellectus Statistics software was also used to determine r, the Pearson correlation coefficient, and p, the probability value, with a 95%

confidence interval. This methodology (Gall, 2007) can examine the complex relationships between resources and student performance.

Research Method and Rationale

This quantitative study employed correlation analyses to determine the relationship of time, material, and financial educational resources with student performance in science and mathematics on the 2012 PISA. The OECD has already collected data regarding student performance and resource allocation. The data collection section in this article expands on the specific data harvested from the OECD 2012 PISA. With the data collected from the OECD database, I converted the data to a z-score. A z-score conversion is necessary because some of the survey questions are answered in percentages, others in number of minutes, dollar amount, etc. The units are different and, in this study, the use of z-scores put each element of the educational resource on the same scale, making comparison easier. I used Intellectus Statistics software to convert the data to a z-score, the formula for a z-score is: (score - mean) / standard deviation. Each resource element needed to be compared to the mathematics and science 2012 PISA scores. Scatterplot graphs were created to compare the z-score of each resource element on one axis and the countries' student performance z-score in mathematics and science on the other. Intellectus Statistics software was used to create the scatterplot graphs, and to subsequently determine the Pearson correlation coefficient, *r,* and *p*-value, with a 95% confidence interval. This methodology (Gall et al., 2007) can examine the complex relationships between resources and student performance. Once calculated, the correlation coefficients were compared to understand the magnitude of each suggested resource with student performance.

Participants

The member countries of the OECD, and non-member countries, participating in the PISA and OECD research composed the participant pool. The 2012 assessment was administered to 510,000 students who were between 15 years 3 months and 16 years 2 months years old (OECD, 2013). Sixty-three countries participated in the 2012 PISA; the data collected from those 63 countries were used in this study. Country participation was voluntary, and included: Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Columbia, Costa Rica, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong-China, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Latvia, Liechtenstein, Lithuania, Luxembourg, Macao-China, Malaysia, Mexico, Montenegro, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Qatar, Romania, Russian Federation, Republic of Serbia, Shanghai-China, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taipei-China, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, and Uruguay (OECD, 2013).

The sampling techniques of the OECD and participating countries, along with parental and governmental consent to participate in the PISA, have already been determined, validated, submitted, and approved by the participants or their guardians. According to the OECD (2015), schools are randomly selected in each participating country by the international contractor for participation in PISA. The OECD (2015) also states that the selection of schools and students is kept as inclusive as possible, so that the sample of students comes from a broad range of backgrounds and abilities. This study used the mean scores, by country, to analyze academic student performance. Specific student scores are available, however the data for specific students does not contain identifying information as each student is referred to only as a number.

Sampling

The OECD's School Sampling process used a cluster model; the target cluster size did not fall below 35 students (OECD, 2014). According to the OECD (2014), an international contractor used the countries' school sampling frame to select the school sample. Each school prepared a list of eligible students,

> each school drawing an additional grade sample was to prepare a list of age and grade-eligible students that included all PISA-eligible students in the designated grade (e.g., Grade 10); and all other 15-year-old students (using the appropriate 12-month age span agreed upon for each participating country) currently enrolled in other grades. This form was referred to as a student listing form. (OECD, 2014, p. 85)

The following criteria were considered important, according to the OECD (2014):

- Age-eligible students were all born in 1996 (or the appropriate 12-month age span agreed upon for the participating country).
- The list was to include students who might not be tested due to a disability or limited language proficiency.
- Students who could not be tested were to be excluded from the assessment after the student sample was selected. It was stressed that students were to be excluded after the students' sample was drawn, not prior.
- It was suggested that schools retain a copy of the student list in case the National Project Manager (NPM) had to contact the school with questions.
- Student lists were to be up to date at the time of sampling rather than a list prepared at the beginning of the school year. Students were identified by their unique student identification numbers.

Once the list of PISA-eligible students from a school was received by the international contractor, the student sample was to be selected (OECD, 2014). It was "required to use KeyQuest, the PISA Consortium sampling software, to select the student samples unless otherwise agreed upon. For PISA 2012, all countries used KeyQuest" (OECD, 2014, p. 85). The overall response rate, according to the OECD (2014), for the 2012 PISA was 85%. To select the student, and ensure the students participating in the 2012 PISA are representative of their country, the OECD developed the following framework and guidelines:

> Selected students attending the same school cannot be considered as independent observations as assumed with a simple random sample because they are usually more similar to one another than to students attending other schools. For instance, the students are offered the same school resources, may have the same teachers and therefore are taught a common implemented curriculum, and so on. (OECD, 2014, p. 186)

The OECD (2014) stated that differences among schools can be larger if different educational programs are not consistently available. For example, one would expect to observe greater differences between a vocational school and an academic school rather than between two comprehensive schools. To have more reliable data, the OECD has taken strides to have a diverse sample of schools and students. The OECD writes, as it addressed how geographic places of residence could have had an impact:

> It is well known that within a country, within sub-national entities and within a city, people tend to live in areas according to their financial resources. As children usually attend schools close to their home, it is likely that students attending the same school come from similar social and economic backgrounds. A simple random sample of 4,000 students is thus likely to cover the diversity of the population better than a sample of 100 schools with 40 students observed within each school. It follows that the uncertainty associated with any population parameter estimate (i.e., standard error) will be larger for a clustered sample estimate than for a simple random sample estimate of the same size. (OECD, 2014, p. 186).

Within the participating countries, the schools that will take the PISA are randomly selected (OECD, 2015). The PISA aims to assess performance at the national level, not an individual student level, so not every student completes the same test (OECD, 2015), providing a broader assessment. Additionally, there are 13 different survey booklets and three different questionnaires distributed randomly to the randomly selected participating students (OECD, 2015). Different assessments are used to gain more data about the general population; a single student would not have enough time to complete all the assessments. The OECD assesses between 4,500–10,000 students in each participating country (OECD, 2013).

Variables

This study analyzed which educational resources had the strongest relationship with student performance in mathematics and science on the 2012 PISA. Later in this section I will expand on the educational resource variables, and the variables of student performance. To determine the relationship between the two variables, it was necessary to graph each resource element against student performance, both mathematics and science. Each graph had information from all 63 participating countries, allowing a large sample size for determining the relationship strength between the variables.

In this study, student performance was analyzed on the international scale, looking at national scores in science and mathematics. Analyzing national student performance scores requires a tool that can collect data consistently, independently, and without bias while assessing students from many nations. A table with the survey questions used to collect data on each resource is provided in Appendix A. Financial educational resources, according to the OECD (2013), include:

- cumulative expenditure on education and
- teacher salaries, ratio per GDP.

Material educational resources, according to the OECD (2013), include:

- physical infrastructure quality,
- educational resource quality,
- availability of computers at school, and
- proportion or computers that have access the internet.

Time educational resources, according to the OECD (2013), include:

- student learning time in school: Mathematics & Science,

- class size,
- extracurricular activities, and
- student attendance at pre-primary school

Results

This study looked to determine the educational resources that have the greatest relationship with student performance on the 2012 PISA. By identifying the resources that have the strongest relationship with student performance, it may be possible to adjust resource allocation to be more efficient and increase student performance without investing more resources. This section looks at the results of a correlational analysis, where data collected from the OECD on student performance and educational resources is assessed.

Study Findings

A Pearson correlation analysis was conducted to determine the strength of the relationship between each educational resource and student performance in mathematics and science. Cohen's standard was used to evaluate the strength of the relationship, where coefficients between .10 and .29 represent a small association, coefficients between .30 and .49 represent a moderate association, and coefficients equal to or above .50 indicate a large association (Cohen, 1988). A Pearson correlation requires that the relationship between each pair of variables is linear (Conover & Iman, 1981). This assumption is violated if there is curvature among the points on the scatterplot between any pair of variables.

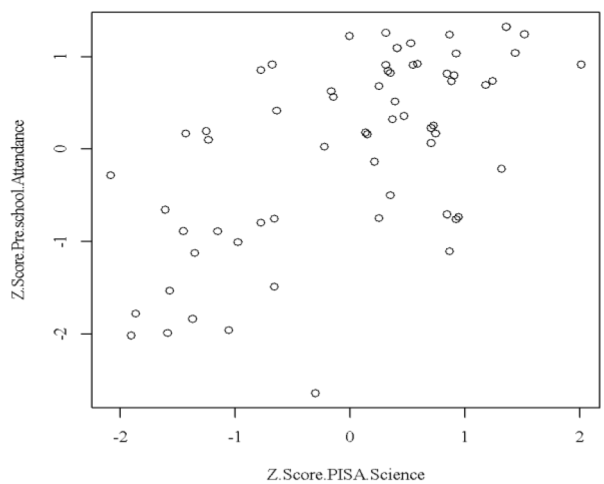
I present evidence from my data analysis. When a relationship between student performance and an educational resource is found to be significant ($p \leq 0.05$), the relevant scatterplot graph of the two variables is presented; however, if there is no significant relationship then the scatterplot is not presented, as it does not help determine which resources have the strongest relationship with student performance.

Science and Mathematics Scores and Pre-School

There was a significant positive correlation between PISA science scores and pre-school attendance (r = 0.60, p < .001; Table 1). The correlation coefficient between PISA science scores and pre-school attendance was 0.60 indicating a strong relationship. As pre-school attendance increases, PISA science scores tend to increase (Figure 1).

Figure 1

Science and Pre-School Attendance



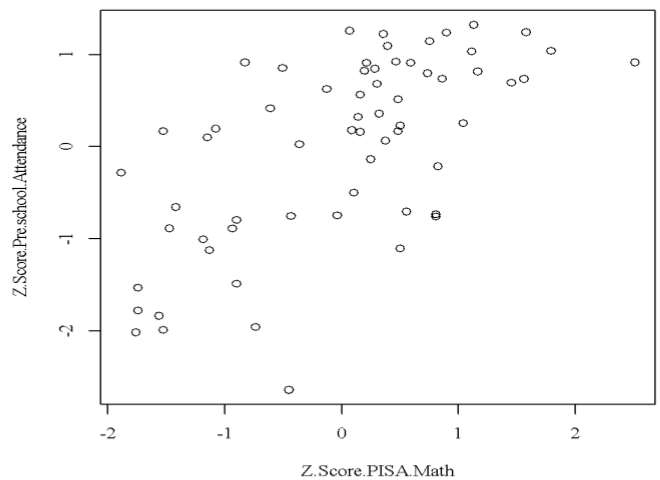
Note. Scatterplot between PISA science scores and pre-school attendance. Pearson correlation coefficient = 0.60. Source: OECD. (2012). Education spending.

There was a significant positive correlation between PISA mathematics scores and pre-school attendance (r = 0.64, p < .001; Table 2). The correlation coefficient between PISA mathematics scores and pre-school attendance was 0.64 indicating a large relationship (Figure 2). This indicates that as pre-school attendance increases, PISA mathematics scores tend to increase.

These scores indicate an important correlation between both mathematics and science scores on the PISA and student attendance at pre-school. Pre-school may be an important area for educational leaders to consider in terms of closing the achievement gap for young students.

Figure 2

Mathematics Scores and Pre-School



Note. Scatterplot between PISA mathematics scores and pre-school attendance. Pearson correlation coefficient = 0.64. Source: OECD. (2012). Education spending.

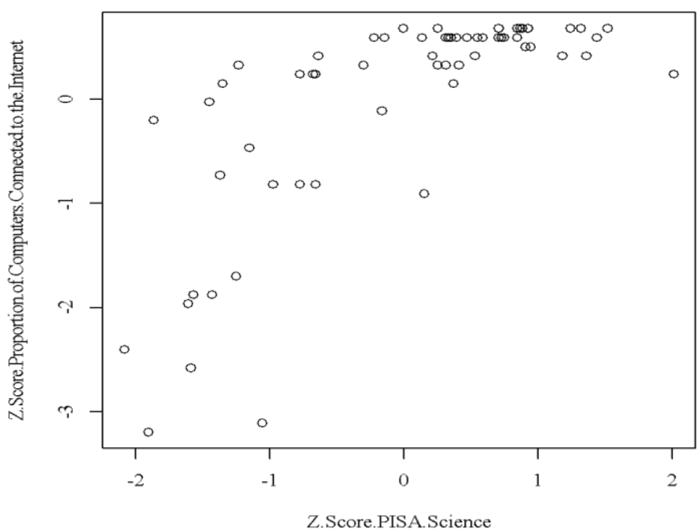
Science and Mathematics Scores and Computers

There was a significant positive correlation (Figure 3) between the science scores and the proportion of computers connected to the internet ($r = 0.74$, $p < .001$; Table 1). The correlation coefficient between science scores and the proportion of computers connected to the internet was 0.74 indicating a strong relationship. This indicates that as the proportion of computers connected to the internet increases, the PISA science scores tend to increase. Figure 3 presents a scatterplot of the correlation.

The data also revealed a significant positive correlation between PISA science scores and the number of computers for educational purpose at school ($r = 0.46$, $p < .001$; Table 1). The correlation coefficient between PISA science scores and the number of computers for educational purpose at school was 0.46 indicating a moderate relationship. As the number of computers for educational purpose at school increases, PISA science scores tend to increase (Figure 4).

Figure 3

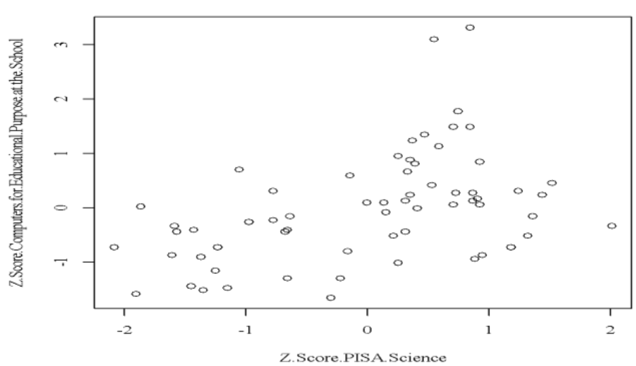
Science Scores and Internet Computers



Note. Relationship between PISA science scores and the proportion of computers connected to the internet. Pearson correlation coefficient = 0.74. Source: OECD. (2012). Education spending.

Figure 4

Science Scores and Educational Computers

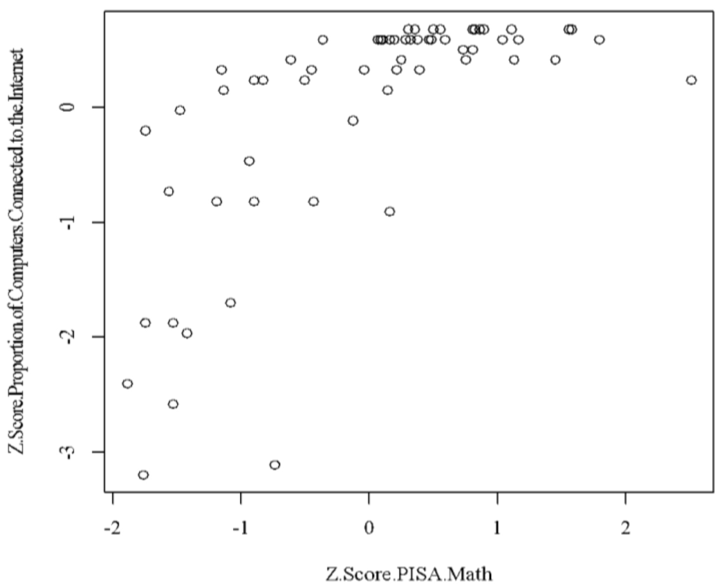


Note. Scatterplot between PISA science scores and the number of computers for educational purpose at school. Pearson correlation coefficient = 0.46. Source: OECD. (2012). Education spending.

There was a significant positive correlation between PISA mathematics scores and the proportion of computers connected to the internet (r = 0.69, p < .001; Table 2). The correlation coefficient between PISA mathematics scores and the proportion of computers connected to the internet was 0.69 indicating a large relationship (Figure 5). This indicates that as the proportion of computers connected to the internet increases, PISA mathematics scores tend to increase.

Figure 5

Mathematics and Internet Computers

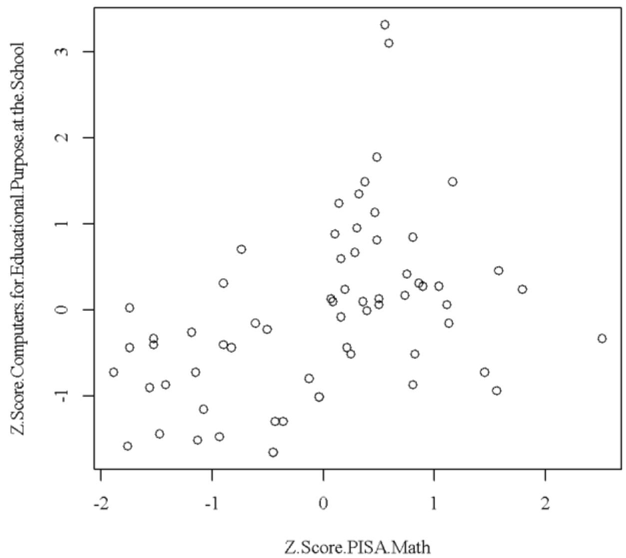


Note. Scatterplot between PISA mathematics scores and proportion of computers connected to the internet. Pearson correlation coefficient = 0.69. Source: OECD. (2012). Education spending.

There was a significant positive correlation between PISA math scores and the number of computers for educational purposes at the school (r = 0.41, p < .001). The correlation coefficient between PISA math scores and the number of computers for educational purposes at the school was 0.41 indicating a moderate relationship (Table 2). This indicates that as the number of computers for educational purposes at the school increases, PISA math scores tend to increase (Figure 6).

Figure 6

PISA Mathematics Scores and Computers



Note. Scatterplot between PISA math scores and the number of computers for educational purposes at the school.

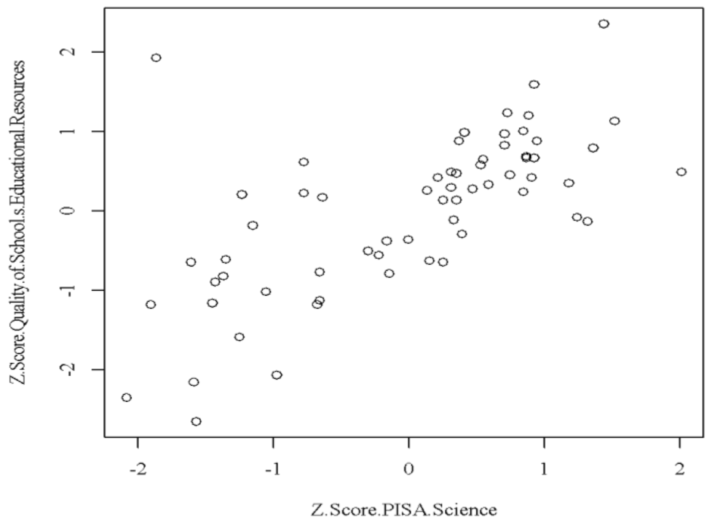
The data indicates a significant and strong relationship between the proportion of computers connected to the internet and mathematics and sciences scores on the PISA. In terms of the number of computers dedicated for educational purposes, the relationship with mathematics and science was significant with a moderate correlation size.

Science and Mathematics Scores and Educational Resources

There was a significant positive correlation between PISA science scores and the quality of school educational resources ($r = 0.68$, $p < .001$; Table 1). The correlation coefficient between PISA science scores and the quality of school's educational resources was 0.68 indicating a strong relationship. This indicates that as quality of school's educational resources increases, PISA science scores tend to increase (Figure 7).

Figure 7

Science Scores and Quality of Educational Resources



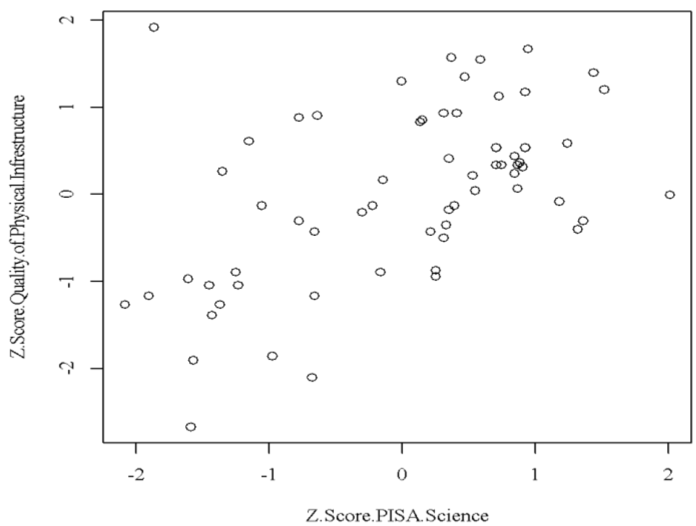
Note. Relationship between PISA science scores and the quality of schools' educational resources. Pearson correlation coefficient = 0.68. Data from OECD. (2012). Education spending.

Additionally, there was a significant positive correlation between PISA science scores and the quality of physical infrastructure ($r = 0.52$, $p < .001$; Table 1). The correlation coefficient between PISA science scores and the quality of physical infrastructure was 0.52 indicating a large relationship. This indicates that as the quality of physical infrastructure increases, PISA science scores tend to increase (Figure 8).

There was a significant positive correlation between PISA mathematics scores and the quality of school's educational resources ($r = 0.69$, $p < .001$; Table 2). The correlation coefficient between PISA mathematics scores and the quality of school's educational resources was 0.69 indicating a large relationship (Figure 9). This indicates that as the quality of school's educational resources increases, PISA mathematics scores tend to increase.

Figure 8

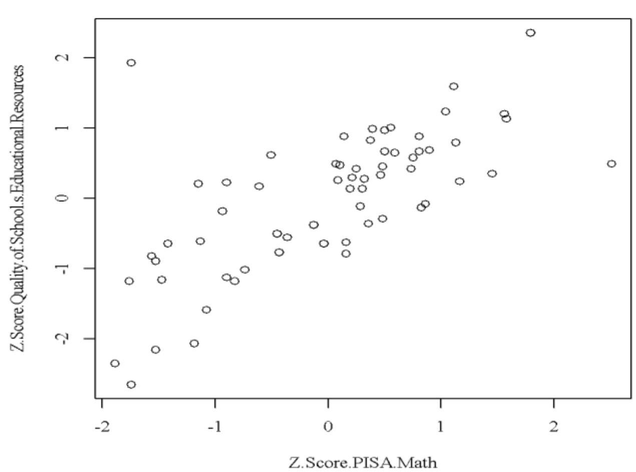
Science Scores and Physical Infrastructure



Note. Scatterplot between PISA science scores and quality of physical infrastructure. Pearson correlation coefficient = 0.52. Data from OECD. (2012). Education spending.

Figure 9

Mathematics Scores and Quality of Education Resources

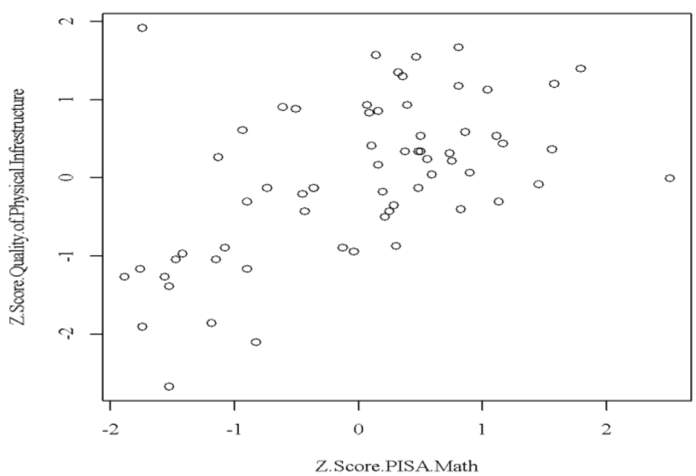


Note. Scatterplot between PISA mathematics scores and the quality of school's educational resources. Pearson correlation coefficient = 0.69. Data from OECD. (2012). Education spending.

There was a significant positive correlation between PISA mathematics scores and the quality of physical infrastructure ($r = 0.54$, $p < .001$; Table 2). The correlation coefficient between PISA mathematics scores and the quality of physical infrastructure was 0.54 indicating a large relationship (Figure 10) This indicates that as the quality of physical infrastructure increases, PISA mathematics scores tend to increase.

Figure 10

Mathematics Scores and Physical Infrastructure



Note. Scatterplot between PISA mathematics scores and the quality of physical infrastructure. Pearson correlation coefficient = 0.41. Data from OECD. (2012). Education spending.

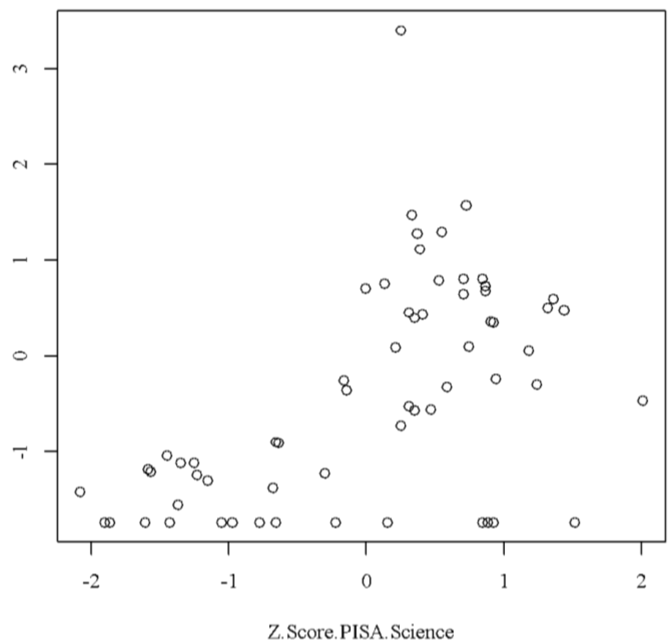
Scores indicate the that for both mathematics and science there was a significant and strong positive relationship between student PISA scores and the quality of school resources. The same was true for mathematics and sciences scores and the quality of school infrastructure.

Science and Mathematics Scores and Cumulative Expenditures

A significant positive correlation was also found between PISA science scores and cumulative expenditure ($r = 0.55$, $p < .001$; Table 1). The correlation coefficient between PISA science scores and cumulative expenditure was 0.55 indicating a large relationship. This indicates that as cumulative expenditure increases, PISA science scores tend to increase (Figure 11).

Figure 11

Science Scores and Cumulative Expenditures

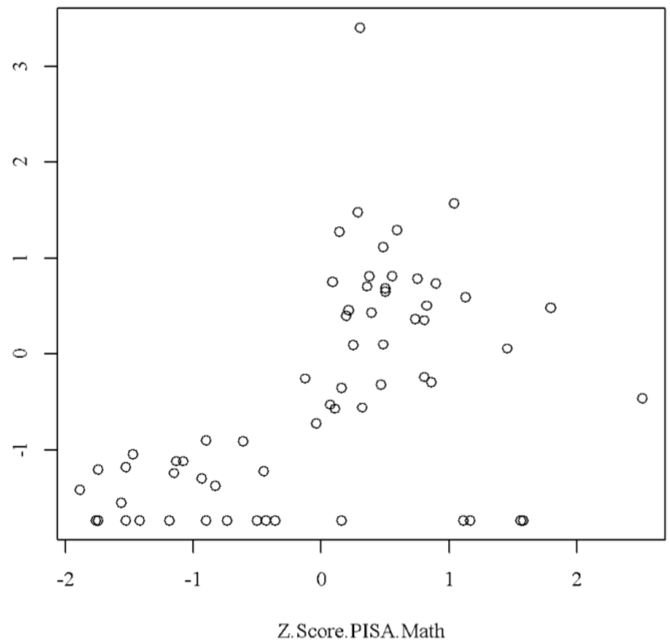


Note. Scatterplot between PISA science scores and cumulative expenditure. Pearson correlation coefficient = 0.55. Data from OECD. (2012). Education spending.

There was a significant positive correlation between PISA mathematics scores and cumulative expenditure (r = 0.50, p < .001; Table 2). The correlation coefficient between PISA mathematics scores and cumulative expenditure was 0.50 indicating a large relationship This indicates that as cumulative expenditure increases, PISA mathematics scores tend to increase (Figure 12).

Figure 12

Mathematics Scores and Cumulative Expenditures



Note. Scatterplot between PISA mathematics scores and cumulative expenditure. Pearson correlation coefficient = 0.50. Data from OECD. (2012). Education spending.

The results of this study indicate that there was a strong positive relationship between mathematics PISA scores and cumulative expenditures. The data also indicate a positive and strong relationship between science scores and cumulative expenditures in schools.

Summary

As can be observed in Table 1, there were six educational resources that had significant correlational relationships with science scores of the PISA. The significant correlations between science scores and educational resources included: 1. Pre-School attendance, 2. Quality of physical infrastructure, 3. Quality of schools' educational resources, 4. Quantity of computers for educational purposes, 5. Proportion of computers connected to the internet, and 6. Cumulative expenditure. Items that did not have significant correlations with science scores included: 1. Student learning time in school, 2. Class size, 3. Extracurricular activities at school, and 4.

Teacher salaries. The two highest effect sizes were generated by the proportion of computers connected to the internet (0.74) and the quality of a school's educational resources (0.68). These scores indicate how schools allocate their resources matters.

Table 1

Correlation Between Science and Educational Resources

Resource Variable	*r*	*p*
Time		
Student learning time in school	0.07	.590
Science		
Class size	-0.16	.220
Extracurricular activities at school	0.09	.480
Pre-school attendance	0.60	<.001
Material		
Quality of physical infrastructure	0.52	<.001
Quality of schools' educational resources	0.68	<.001
Computers for educational purposes	0.46	<.001
Proportion of computers connected to the internet	0.74	<.001
Financial		
Cumulative expenditure	0.55	<.001
Teacher salaries	0.22	.090

Note. Resource table relationship with student performance on Science PISA, this table provides a summary of information.

Table 2 displays the six correlations between mathematics PISA scores and educational resources that were statistically significant. The six significant areas included: 1. Pre-school attendance, 2. Quality of physical infrastructure, 3. Quality of schools' educational resources, 4. Computers for educational purposes, 5. Proportion of computers connected to the internet, and 6. Cumulative expenditure. These were the same resources that were significant between science and education resources. The highest effect sizes were also related to the science scores—Proportion of computers connected to the internet and Quality of schools' educational resources. The scores for mathematics and science also indicate the importance of pre-school attendance for student achievement in mathematics and science.

Table 2

Correlation Between Mathematics and Educational Resources

Resource Variable	*r*	*p*
Time		
Student learning time in school	0.01	.940
Mathematics		
Class size	-0.10	.430
Extracurricular activities at school	0.08	.530
Pre-school attendance	0.64	<.001
Material		
Quality of physical infrastructure	0.54	<.001
Quality of schools' educational resources	0.69	<.001
Computers for educational purposes	0.41	<.001
Proportion of computers connected to the internet	0.69	<.001
Financial		
Cumulative expenditure	0.50	<.001
Teacher salaries	0.15	.240

Note. Resource table relationship with student performance on Mathematics PISA, this table provides a summary of information.

Summary/Conclusions of Results

I found a significant positive relationship between student performance on the science and mathematics 2012 PISA and six resource variables. These variables include: 1. Proportion of computers connected to the internet (mathematics 0.69, science 0.74), 2. Quality of schools' educational resources (mathematics 0.69, science 0.68), 3. Pre-School attendance (mathematics 0.64, science 0.60), 4. Quality of physical infrastructure (mathematics 0.54, science 0.52), 5. Cumulative expenditure (mathematics 0.50, science 0.55), and 6. computers for educational purposes (mathematics 0.41, science 0.46). The scores for mathematics and science were basically consistent. This indicates that resource allocation for mathematics and science could follow along the same resource path when educators are contemplating allocation of resources that will raise achievement in mathematics and science.

Discussion

In this study I assessed the correlation between ten resource areas and student achievement in mathematics and science. I evaluated which of the educational resources of time, finances, and/or material had the strongest relationships with student performance in science and mathematics on the 2012 PISA. I suggest that as variables such as pre-school attendance are addressed, student performance will increase, as will the individual student's future economic and social impact. With increased performance, research shows (OECD, 2004; OECD, 2013; OECD, 2014; OECD/UNESCO, 2003; Ripley, 2013) that the achievement gap and educational inequality may decrease. This will offer individual students opportunities for higher future earned income and greater participation in society.

Performance may increase, but it could have a different relationship for different individuals and the result may not be constant. As student performance continues to increase their economic and social impact will also grow. My study attempts to identify optimum areas in which stakeholders can invest educational resources to increase student performance on the PISA, perhaps without increasing cost of education and thereby, possibly reducing educational inequality.

Key Findings

My findings suggest that educational resources have varying relationships with student performance in science and mathematics, but the resources that were significant were significant for both mathematics and science. Educators who are interested in advancing student achievement in both mathematics and science should seriously consider supporting resources in the following six areas: 1. Proportion of computers connected to the internet, 2. Quality of school educational resources, 3. Pre-School attendance, 4. The quality of the Physical Structures, 5. Cumulative spending, and 6. The number of computers used for educational purposes.

Additionally, an analysis of specific resource strands shows varying relationships within an educational resource, such as time, material, and financial support. As a result, each resource’s relationship with student performance in mathematics and science should be looked at individually. By looking on the international level, researchers can analyze a broad range of policies and practices associated with educational resources and their impact on student performance. The results of this study suggest that the amount of computer connections to the internet for students to use, the quality of educational resources, pre-school attendance, the physical infrastructure, cumulative expenditure, and the number of computers used for educational purposes have a significant relationship with student performance in mathematics and science. Other disciplines may have different resource needs.

Resources and Student Performance in Science and Mathematics

I found that the resource of time has a limited relationship with student performance in mathematics and science. Angrist and Lavy (1997), Belinski et al. (2009), Eccles and Barber (1999) and Fisher (1981) state that the resource of time has a positive link with student performance; however, I found no relationship between student performance and class size (mathematics -0.10, science -0.16), students' learning time in school (mathematics 0.01, science 0.07), and student participation in extracurricular activities at school (mathematics 0.08, science 0.09). My findings might be a result of looking at the resource of time through an international lens, Hanushek and Wößmann (2015) explain that one year of schooling can be very different in each country; additionally, they state that time spent in school is not as relevant as the knowledge of the population

The variables, in order of correlation coefficient, suggest a priority list or resources that should receive support. This might indicate that school leaders seeking to increase student performance in mathematics and science should first increase the proportion of computers connected to the internet, increase the quality of schools educational resources, and increase pre-school attendance before decreasing class size or increasing the number of available teachers. It is important to remember these variables were compared to each other, and the results are limited to the pool of educational resources. This study cannot conclude that the proportion of computers connected to the internet is the most important resource because it has the highest coefficient only that this resource has a higher correlation than the other variables it was compared to in this study.

Educational Materials. The large scale of this study suggests that by adjusting the investment in educational materials, to find the optimum level of investment before the allocated resources have a diminishing return in student performance, national governments will be able to most efficiently utilize the benefits of educational materials without continued waste of scarce resources. I found that educational materials have a positive relationship with student performance. My results echo those previously found by Evans (2006), Faith (2009), and Gouda et al. (2013). However, neither the literature nor my study determines causation. Educational materials may not have a strong relationship with student performance, but instead might only indicate that countries with high test scores, which also have growing economies (Hanushek & Wößmann, 2015), have the means to purchase more computers, have a higher proportion of computers with internet capabilities, construct and renovate school buildings, and have more resources. The literature (Darling-Hammond, 2014) suggests that child poverty, segregation, income inequality and disparities in access to educational resources will diminish if resources are distributed efficiently. Additional research needs to be conducted to determine if expenditure of educational materials causes increased student performance, or if increased student performance creates a need for more resources.

Cumulative Spending. The relationship between student performance and financial resources vary. My results show no significant relationship between teacher salaries and student performance (mathematics 0.15, science 0.22) on the 2012 PISA. Though Gius (2013), found that competitive teacher salaries, and changes in teacher pay had a statistically significant, positive effect on student performance and district-level graduation rate. It is possible other variables contributed to positive outcomes instead of the adjustment in teacher salaries. Hanushek and Wößmann, (2015) found that teacher salaries and other pay incentives only have a positive relationship with student performance when students need to pass an external exam to graduate.

Along with the Education Commission of the States (1992), the Federal Deposit Insurance Corporation (2007), Husted (2005), Ripley (2013), and Vegas and Coffin (2015), I found that cumulative spending impacts student performance (mathematics 0.50, science 0.55). Some say (Hanushek & Wößmann, 2015) spending on education does not have a direct relationship with student performance, but they also maintain that such a resource is not completely irrelevant. Cumulative spending impacts student performance only to the point that cumulative spending impacts the resources and variables that do directly impact student performance (OECD, 2014). This explanation might apply to students in countries with high cumulative expenditure, such as Lichtenstein, who are being out performed by students in Finland who receive much less spending (OECD, 2013a; OECD, 2013b; OECD, 2014; Ripley, 2013).

Pre-School Attendance. Time spent in school, class size, and extracurricular activities might impact student performance only as far as they affect student confidence, interest in subject, and perceived relationship with the teacher or even the quality of instruction the student receives. I was not able to determine causation but correlation and found no relationship between student performance and class size, students' learning time in school, and student participation in extracurricular activities at school. I did find a positive relationship between pre-school attendance and student performance (mathematics 0.64, science 0.60). Angrist and Lavy (1997) and Fisher (1981) found that increasing student teacher time has a positive relationship with student performance. I found a similar relationship with pre-school attendance, but not with increased learning time in the classroom.

Research of pre-school attendance suggests that it is important in many ways for students' future growth and success. By increasing pre-school availability and attendance, national governments will be able to increase student performance with the most desirable rate of return for expenditure and performance. Additional research needs to be conducted to specifically identify and better define the student-teacher time that correlates with increased student performance.

Limitations

The information collected from the OCED database originated as student or principal self-reporting and may not be as accurate as conscious and subconscious factors may cause inaccurate self-reporting. The analysis of the correlations is limited to linear relationships between variables, even if the correlation coefficient is zero, a non-linear relationship might exist. Additionally, the PISA items selected for each resource category are proxies and may not be the best proxies available. This study may suggest positive or negative interactions between variables; however, this study is unable to prove causation and can only suggest such a link exists. This study is looking at the educational resources in terms of quantity. This study is not looking at the quality of resources. The distinction has no impact for the financial resource strand of cumulative spending; however, all the other resource strands have no measure of the quality of the educational resource. Given these limitations, it is recommended to confirm findings before adjusting policy.

Recommendations for Future Research

The results of this study suggest the need for future research in several areas. We know that educational materials have a relationship with student performance, but we do not know the point of investment where educational materials yield maximum results. By understanding the investment and the return of this resource, educational leaders will be able to reach the highest potential of student performance through educational materials before the relationship is dissipated. By capping the resources invested in educational materials, after maximizing their impact, the cost of education becomes more transparent and a mechanism to reach student needs can become more attainable.

It is known that pre-school attendance and availability is important because of the relationship it has with student performance. We do not know how long a student needs to attend preschool, what happens during this learning opportunity, and how to maximize performance efficiency. This study was not able to identify the ways in which resources spent on teachers and teacher professional development can best reach its maximum efficiency. The literature asserts that teachers and teacher professional development has a significant relationship with student performance (Afterschool Alliance, 2007; Althauser, 2015; Hattie, 2009; Ripley, 2013; Ross & Begeny, 2014). Additional research needs to be done to determine how this study could be designed to specifically target those resources.

Final Thoughts

Ultimately, this study showed the relationship between educational resources and student performance in science and mathematics on the 2012 PISA. This study should be replicated in the subsequent PISA installments, the 2015 PISA results are now available to verify the results and expand the data set. Additional research should be done to determine the degree in which investment and preschool attendance increases student performance on the PISA. Additional research could confirm that increased student performance on the PISA directly improves, or is correlated to, their future economic and social impact. By continuing to refine our understanding of what educational resources, as broad minimum parameters, have the strongest relationship with student performance, researchers will be able to efficiently reduce the achievement gap and decrease educational inequality, by doing so there will be a decrease in child poverty, segregation, and income inequality. A more efficiently resourced education may also be a better education.

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Appendix A

PISA Scores by Nation

Nation	Science	Mathematics	Nation	Science	Mathematics
Australia	521	504	Albania	397	394
Austria	506	506	Argentina	406	388
Belgium	505	515	Brazil	405	391
Canada	525	518	Bulgaria	446	439
Chile	445	423	Colombia	399	376
Czech Republic	508	499	Costa Rica	429	407
Denmark	498	500	Croatia	491	471
Estonia	541	521	Hong Kong-China	555	561
Finland	545	519	Indonesia	382	375
France	499	495	Jordan	409	386
Germany	524	514	Kazakhstan	425	432
Greece	467	453	Latvia	502	491
Hungary	494	477	Liechtenstein	525	535
Iceland	478	493	Lithuania	496	479
Ireland	522	501	Macao-China	521	538
Israel	470	466	Malaysia	420	421
Italy	494	485	Montenegro	410	410
Japan	547	536	Peru	373	368
Korea	538	554	Qatar	384	376
Luxembourg	491	490	Romania	439	445
Mexico	415	413	Russian Federation	486	482
Netherlands	522	523	Serbia	445	449
New Zealand	516	500	Shanghai-China	580	613
Norway	495	489	Singapore	551	573
Poland	526	518	Chinese Taipei	523	560
Portugal	489	487	Thailand	444	427
Slovak Republic	471	482	Tunisia	398	388
Slovenia	514	501	United Arab Emirates	439	423
Spain	496	484	Uruguay	416	409
Sweden	485	478			
Switzerland	515	531			
Turkey	463	448			
United Kingdom	514	494			
United States	497	481			

Appendix B

Education Spending 2012/2015 & 2012 Scores

Nation	2012	2015	Science	Mathematics
Australia	16 002.7	20 344.2	521	504
Austria	16 475.7	17 555.2	506	506
Belgium	15 953.0	17 320.2	505	515
Chile	8 354.5	6 677.1	445	423
Czech Republic	10 421.6	10 890.7	508	499
Estonia	8 489.8	12 867.5	541	521
Finland	18 045.9	17 591.2	545	519
France	15 392.1	16 144.8	499	495
Germany	17 143.4	17 035.6	524	514
Greece	3 811.4	4 094.5	467	453
Hungary	9 039.4	8 761.5	494	477
Iceland	10 897.7	12 670.7	478	493
Indonesia	3 058.7	3 764.7	382	375
Ireland	15 621.7	13 229.4	522	501
Israel	11 681.3	11 003.2	470	466
Italy	10 669.4	11 257.1	494	485
Japan	18 827.6	19 289.2	547	536
Korea	11 390.7	10 108.9	538	554
Latvia	7 411.3	10 136.7	502	491
Lithuania	8 964.0	9 656.9	496	479
Luxembourg		48 906.9	491	490
Mexico	8 188.0	8 169.7	415	413
Netherlands	18 757.8	19 286.2	522	523
New Zealand	13 602.6	15 165.7	516	500
Norway	20 051.8	20 973.0	495	489
Poland	7 731.4	9 687.4	526	518
Portugal	9 798.2	11 765.9	489	487
Russia	8 173.6	8 369.1	486	482
Slovak Republic	9 281.7	15 873.9	471	482
Slovenia	10 014.5	10 208.1	514	501
Spain	12 083.0	12 605.2	496	484
Sweden	23 141.6	24 417.4	485	478
Switzerland	24 848.2		515	531
Turkey	10 116.1	8 900.7	463	448
United Kingdom	24 111.7	26 320.1	514	494
United States	27 527.0	30 003.2	497	481