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Impact of Reading Ability on Academic Performance at the Primary Level

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Abstract

The present study examined the correlation between academic performance in reading and academic performance in mathematics at the primary level. The data included 95 student performances from grades two, three, four, and five. The reading performance was based on three assessment components which included comprehension, fluency, and vocabulary. The mathematics performance was based on summative assessments conducted at intervals during the 2011-2012 academic year as well as the results from the STAR test. Results indicated that a correlation did exist between reading and mathematics performance at the early elementary level when including grades two through five. Examining each grade level individually yielded similar results. A correlation did not exist at second grade between reading and mathematics performance; however, a correlation was found at grades three, four, and five. The correlation also appeared to grow in strength at higher grade levels.

Introduction

School systems are often challenged to meet the needs of students who are not performing at grade level expectations and provide support services to help those students to close the achievement gap. One program that has been adopted in the hopes of achieving that goal is Response to Intervention (RtI) which promotes early intervention for students who are only slightly behind their peers; however, state funding isn't available to operate this type of program. If schools cannot independently fund an RtI program, students must struggle until they fall far enough below benchmark to qualify for special education services, which are state funded. Logically, as the achievement gap grows larger, the odds of students closing it become increasingly less likely. Schools must take action early, but a full scale RtI program that can target students' needs in multiple subject areas is expensive. For school sites where funding is limited, such as the one involved in this study, it is possible that the limited resources available for early intervention programs can be allocated towards a single subject area which can improve student performance in other areas. Since reading is a skill utilized in every academic subject area, it is a logical domain to examine for a correlational relationship with other subject areas. In this study, data was collected on student reading performance and math performance at the school site of study. The data was then assigned to performance levels and an average performance level was determined for each student in reading and mathematics. Finally, the performance levels for each student were analyzed to determine if a correlation existed between student reading performance and mathematics performance in individual grade levels and overall in grades two through five.

Background and Need

The ability to read is an essential skill for students to master because information is presented in text throughout the world. Web sites, books, magazines, and newspapers, while sometimes including pictures for visual reference, utilize print to share information with the reader.

Educational systems also rely more heavily upon text as students reach higher grade levels. In early elementary grades, students do not typically have textbooks at home and they primarily work with decodable readers and short stories borrowed from the library. However, beginning around third grade, textbooks are introduced to the home environment and students' abilities to pull and process information from textbooks becomes increasingly necessary for student achievement. By the time students reach high school, many history teachers expect students to build their background knowledge by reading at home and then demonstrate their understanding during in-class discussions. The textbooks that students utilize in science, math, and history are typically several hundred pages in length, featuring diagrams, pictures, and, primarily, text to transmit knowledge about the subject to the reader. English teachers also assign novels and stories for reading at home. Unfortunately, textbooks are challenging for students to access. Textbooks use advanced vocabulary, cover a vast number of topics, use direct language that doesn't engage the reader, and lack the structure that promotes reading comprehension (Bryce, 2011). In primary school, students are still building their reading competence, but at the secondary level they are expected to have the necessary skills.

Additionally, the battery of standardized tests that students take to demonstrate competence in each of the tested subject areas, such as language arts, math, science, and social

studies, requires them to be able to read at increasingly higher levels. For example, in second grade the mathematics portion of the STAR test in California is read orally to all of the students, but at higher grade levels only the initial instructions are read aloud. The students in higher grade levels are responsible for reading and comprehending all of the directions, passages, and other printed information within the test. California schools are evaluated based on student performance on these standardized tests and approximately forty percent of students going to public school are attending schools undergoing "program improvement" for failing to achieve the goals of No Child Left Behind (Crane, Huang, Derby, Makkonen, & Goel, 2008). Students are not performing well on their tests; it could be because they are struggling to read and comprehend the test questions that they are being confronted with.

Students need practice reading in order to develop their phonemic awareness, phonics, fluency, vocabulary, and comprehension. The mastery of these skills will grant them access to increasingly complex knowledge in other academic subject areas.

Statement of Problem

It is important to understand the correlation between reading performance and academic performance in other subject areas at the elementary grade level and to determine if there are key years where the correlation is strong enough to consider utilizing a reading intervention program as the primary intervention for low student performance in other academic areas. For this study, reading performance includes fluency, comprehension, and vocabulary abilities as compared to grade level norms. Academic performance encompasses student performance on summative assessments in mathematics. In most math coursework, students are required to read and interpret written equations, graphs, and other documents, which have similar properties to text.

For example, students read text left to right and math equations are also read left to right. Additionally, students are expected to read and interpret math equations in order to solve them, which is a similar process to reading and interpreting text.

Purpose Statement

The purpose of this study is to extend the current research linking reading performance to academic performance by examining the relationship between reading and mathematics at the elementary level.

Research Question

What is the strength of correlation between reading performance and mathematical performance at the elementary level? Additionally, does the correlation grow stronger as children advance through each grade level?

Theoretical Rationale

This study assumes that reading performance is related to academic performance at the secondary level. If a correlation exists at earlier grade levels, it may suggest that early reading intervention programs will benefit all other academic disciplines. This study also assumes that the summative mathematics assessments produced by Pearson as part of their enVisionMATH program are accurate measures of student mathematical knowledge at each grade level. This study also assumes that the McLeod Assessment of Reading Comprehension, the Woodcock-Johnson III Test of Achievement, and the End of Year Oral Fluency Assessments produced by McGraw-Hill are accurate measures of student reading comprehension, vocabulary knowledge, and reading fluency. The math assessments have been adopted by the school site where this study is being conducted. The reading assessments are part of the screening process used by the school

site for its reading intervention program. The availability of data and resources make these

logical choices for this study.

Literature Review

The literature reviewed in this section focuses on the central theme of reading performance to provide an understanding of the complexities and influences involved in the development of reading skills and how they relate to other factors. The literature also includes correlational studies on reading performance and the development of other academic skills. Additionally, some studies included examined the impact on reading from other outside influences, such as parental employment, genetic traits, and early childhood education programs.

Review of the Previous Research

The connection between reading and other academic subject areas or skill sets has been explored by several researchers who have approached the concept from various perspectives. Researchers whose work is included in this review have performed correlational studies relating reading with another academic subject area utilizing data on student performance. Some have examined behavioral factors; others explored genetic factors through the use of twin studies; some have examined the socio-economic factors; and still others have examined the relationship from the perspective of disabilities and special education. Current research highlights the importance of reading in the success of students and citizens in industrialized nations.

Reading and Academic Performance

The relationship between reading ability and academic performance seems like a logical connection since textual information is prevalent in our society. Espin and Deno (1993) found that a relationship exists between basic reading literacy and student academic success. Their study involved 121 tenth-grade students in a rural school in a small mid-western community. Their study was based on the connection between a student's reading measure and that student's

score from a classroom study task, grade point average, and achievement test results.

Another recent study focusing on secondary students was conducted by Cromley (2009). This study focused specifically on reading and proficiency in science with an international perspective and included several countries, including the United States. Cromley found that there was a very high correlation between reading comprehension and science proficiency, with the mean for all of the nations being .819. The United States was among the nations with the highest correlation between reading and science. Cromley noted that the 2006 tests used in this study to measure science achievement, the Programme on International Student Assessment (PISA), was designed to require less reading, which emphasizes the high correlation between reading and science achievement.

Mathematics is another subject area in which performance can be linked to reading ability. A study conducted by Vilenius-Tuohimaa, Aunola, and Nurmia (2008) looked at the relationship between students' ability to solve math word problems and students' text comprehension skills. Their study included 225 fourth grade students and found that the better a student's reading comprehension skills, the better his or her performance on mathematical word problems. In addition to the correlation between reading comprehension and word problem solving, the study also found that both of those skills were related to technical reading. Although their results showed that technical reading ability could predict a higher skill level at reading comprehension and math problem solving, when they controlled for technical reading, the covariance between word problem solving and reading comprehension was still present. The authors explain that a reader with poor decoding skills struggles with the text itself and isn't able to perform the tasks requiring logical reasoning strategies. It is a reasonable explanation that a

student who struggles to decode text is going to perform poorly in all subject areas because there are more hindrances in comprehending text .

There are several components to reading which can impact mathematical performance. A study conducted by Grimm (2008) examined the relationship between early reading skills and growth in math skills. His study examined third grade students and found that students who had a higher level of reading comprehension tended to learn problem solving and data interpretation skills faster than those with weaker reading comprehension. Interestingly, student computational skills were unaffected by early reading comprehension, which indicates that reading comprehension is linked to a more conceptual understanding of math (Grimm, 2008). A study with a focus on reading comprehension explicitly related to math was conducted in Turkey by Duru and Koklu (2011). The authors looked at middle school students' ability to read a mathematical text and convert it into an algebraic equation and vice-versa. The data from the study indicated that students had low reading comprehension which prevented them from comprehending the mathematical texts and algebraic equations representing those texts. The authors believed that there were several factors involved, such as students' inability to organize prior knowledge and their lack of knowledge about the meaning of symbols, signs, and words used in mathematics (Duru & Koklu, 2011). The study indicates that vocabulary is an important component of reading which supports comprehension.

Reading Development and Instruction

In the state of Florida, roughly twenty percent of students are receiving reading intervention. Interventions in Kindergarten focuses on phonological awareness, phonics, and word recognition and are usually taught by a paraprofessional in the classroom, while

interventions in third grade focuses on engaging students for longer periods of time with

lengthier texts involving more complex skills and are taught by specialized reading intervention

teachers (Wanzek & Cavanaugh, 2010). The shift from intervention being offered by a

paraprofessional to a reading intervention teacher may be because students' reading scores at the

second-gade and third-grade levels consistently grow more rapidly than their peers when they are

engaged in high-level thinking about the texts that they read (Peterson & Taylor, 2012). In

another study, which examined English language learners fluency and comprehension, over half

of the students assessed had a significant gap between their reading fluency and comprehension

scores and found that fluency increased at a greater rate than reading comprehension (Quirk &

Beem, 2012). On average, roughly 15% of students in grades two and three are word callers,

which means that they decode words and can say them, but they do not know the meaning of the

words. This demonstrates the risk that textbooks pose to students who are learning English or

who have strong decoding skills combined with a limited vocabulary because they may be

decoding the words, but they may not be correctly interpreting them. This is the most true of EL

students at the intermediate proficiency level (Quirk & Beem, 2012). One method to scaffold for

those EL students is to provide them with cognate instruction in order to connect root words in

English to root words in their native language when they share historical roots (Goodwin,

Lipsky, & Ahn, 2012).

Genetic Factors and Learning Disabilities

Approaching from a genetic standpoint, one study authored by Petrill, Logan, Hart,

Vincent, Thompson, Kovas, and Plomin (2012), focused specifically on math fluency and its

relationship with untimed math performance, decoding fluency, and untimed reading

performance. The study assessed twins around the age of ten in a ninety-minute session and then reassessed them a year later. They found that although related to each other, math fluency was independent from other math and reading measures. They attributed the variance to genetic factors and suggested that math fluency may be genetically distinct. However, they still found significant evidence of a genetic overlap between math and reading factors, which supports the link that this study is exploring. Another genetic study examined reading achievement and independent reading and found that roughly 50% of the genetic factors for those two skills overlap (Harlaar, Thompson, Deater-Deckard, DeThorne, & Petrill, 2011).

Haworth, Kovas, Harlaar, Hayiou-Thomas, Petrill, Dale, and Plomin (2009) conducted a study of 8,000 twins who were twelve years old. The authors examined genetics and learning disabilities. They found genetic correlations between reading and mathematics disabilities of .61 and between mathematics and language of .67. The results indicate a connection between reading and mathematics in genes.

Disabilities reveal a great deal about how reading and mathematical performance are related. A study by Morgan, Garkas, and Wu (2011) used data from the NCES students in kindergarten and again in fifth grade to determine their growth. In reading, students with learning disabilities (LD) averaged the lowest performance in kindergarten and in fifth grade. Students with speech language impairments (SLI) performed better than the LD students, but below non-disabled students. In mathematics, students with LD are below in Kindergarten and initially make progress to close the achievement gap, but suddenly their performance drops and the gap grows. Students with SLI initially drop in mathematics, but the performance gap between SLI students and non-disabled students remains constant. The hierarchy of performance between LD,

SLI, and non-disabled students held between reading and mathematics. Another study which examined the mathematical performance of students with reading disabilities found that their comparison group and students with reading comprehension difficulties did not differe in their arithmetic fact fluency or operations and that both performed higher than students with dyslexia. However, on applied problems, all of the reading disability groups performed lower than the non-disabled comparison group. Students with dyslexia demonstrated the weakest mathematics performance in the study and were 5.6 times as likely to have a deficit in fact fluency, 8.54 times as likely to have a deficit in operations, and 4.98 times as likely to have a deficit in applied problems (Vukovic, Lesaux, & Siegel, 2010). Reading ability is causal to academic performance because reading disabilities negatively impact math performance, while mathematics disabilities do not affect progress in reading (Jordan, Kaplan, & Hanich, 2002).

Impacts on Reading Ability

One study examined social and behavioral predictors of reading and math trajectories through middle school by examining Kindergarten behaviors. Their results were not consistent across their samples, but they did find some which showed a small relationship between internalizing behaviors and social skills in Kindergarten to later reading ability (Hooper, Roberts, Sideris, Burchinal, & Zeisel, 2010). This indicates that there are other factors that impact literacy and academic performance.

A study involving 2,517 fourth grade students in the mid-western United States who were tracked for four years also found evidence that supports the idea of reading influencing math more than math influencing reading. The authors focus was on examining the success of closing the achievement gap between low and high performing students. They found that growth over

time in mathematics was more rapid and positively associated with a high initial reading level in fourth grade. However, initial performance in mathematics in fourth grade had a negative association with growth rates in reading, unless the student was high performing in math, in which case they had a slow positive growth rate in reading (Shin, Davison, Long, Chan, & Heistad, 2013). A study conducted by Sarama, Lange, Clements, & Wolfe (2012) examined the impact of a pre-kindergarten mathematical curriculum called Building Blocks on development of later mathematical achievement and language skills. When compared to a control group, the authors found that the new curriculum did improve math performance, however it did not impact the ability of students to recognize letters nor did it impact the length of their sentences. The early age focus helps to provide support for the idea that reading ability impacts mathematics performance, while mathematics performance does not impact reading ability.

While increased reading performance has been linked to increased academic performance, it is not related to delinquency for boys or girls. Instead, attention problems, background disadvantages, and antisocial behavior were linked to delinquency. Boys and girls with antisocial behaviors at age nine are predicted to have poorer reading literacy at age fifteen (Sheila, 1994);(Maguin, Loeber, & LeMahieu, 1993). Additionally, a study that examined ten year olds and then reassessed them a year later found that independent reading performance does not significantly relate to reading achievement a year later, while reading achievement does lead to greater independent reading performance (Harlaar et al., 2011). Not surprising, lower performing readers have a lower interest in reading, while higher performing readers have a greater interest in reading. However, changes in both groups' interest levels fluctuated parallel to each other as students advance through grade levels, which indicates that age isn't a factor.

Additionally, background variables, such as cognitive ability and socio-economic status, were more predictive of reading ability than the level of reading interest (Kirby, Ball, Geier, Parilla, & Wade-Wooby, 2011).

Socio-Economic Factors

Another study conducted in Britain looked at the impact on reading development in children with unemployed mothers and, although there was large variability between families, they found that there is a minor negative correlation for women with low educational qualifications who are unemployed for the child's first year (Verropoulou & Joshi, 2009). A similar study conducted in the United States by Yetis-Bayraktar, Budig, and Tomaskovic-Devey (2013) looked at the impact of a mother's work complexity and occupation on her children's reading and mathematical performance. The children in the study were between the ages of six and thirteen and their reading and mathematical performances were measured using the Revised Woodcock-Johnson Test of Achievement, which is a tool to measure cognitive development. The data on the mothers was collected from the Panel Study of Income Dynamics from the years 1984 through 1996. They found that having an employed mother was significantly associated with higher child reading and mathematics scores. They also found that reading scores improve when mothers are in either white or blue collar complex occupations. However, math scores improved only with white collar occupational complexity. The complexity of a mother's job positively impacts student performance. While accounting for one of their control variables the data reconfirmed earlier studies which found an association between higher student reading and mathematics performance and mothers who were higher earning, higher-educated, married, and white, placing them in a higher socioeconomic class (Yetis-Bayraktar et al., 2013). Contrary to

the studies on mothers, another study that focused on welfare and childhood development found that girls and children living with siblings who had both parents employed or fathers employed had significantly higher reading scores than their peers. Strangely, the same study also found that a country's reading literacy rate was negatively correlated with gross domestic product (GDP) per capita and unemployment protection. As unemployment rates went up, so did literacy (Siddiqi, Subramanian, Berkman, Hertzman, & Kawachi, 2007). Although the parent's employment status and educational background are factors in student success, Stylianides and Stylianides (2011) conducted a study on the impact of parental involvement on urban children's math, reading, science, and social studies achievement and found that children benefited academically from increased interactions with their parents. Those with low access to their parents benefited more so from additional interactions than did children who already had more. They also found that the children in their study who received the least amount of interaction with their parents tended to belong to ethnic minority groups and low socioeconomic families.

Socioeconomic status may be a critical component to academic success for additional reasons beyond parental education and background. A large study involving 72,660 students in Vietnam found that those who ate more meals per day were higher achievers in mathematics than those who ate fewer meals (Hungi, 2008). While Vietnam is a developing country, it is plausible that similar results would occur elsewhere, including in industrialized nations, which may be a reason why public schools in California offer free and reduced lunch programs.

Looking past the K-12 education spectrum into adulthood, reading still plays an important factor. Inmates in prisons typically have a lower reading performance than their peers who are not incarcerated. A study which focused on prisoners in Alabama found that inmates

under the age of 24 were reading at an early fifth grade level, inmates between 25 and 39 were

reading at a seventh grade level, and inmates 40 and up were also reading at a seventh grade

level (Shippen, Houchins, Crites, Derzis, & Patterson, 2010). Although the study indicates that

performance growth still occurs for the younger inmates, it plateaued as they aged for a reason

that wasn't identified. None of the inmates' literacy levels were high enough to successfully pass

the General Education Development test, an assessment taken to earn a Certificate of High

School Equivalency.

Summary of Major Themes

There are many factors that impact reading and many other areas impacted by reading.

Factors related to the development of reading, such as socio-economic background, parental

employment, genetics, and social and behavioral skills demonstrated in kindergarten, help to

explain the complexities involved in the development of reading skills. Focusing specifically on

reading and its relationship to other academic areas, as this current study does, there have been

several studies conducted linking reading comprehension to success in science and mathematics.

The impact that reading ability has on the future of students is especially clear in the Shippen et

al. (2010) study showing that the prison population in the study lacked the ability to pass a high

school equivalency exam. The studies reviewed indicate the many hurdles to reading

development, they highlight the links between reading achievement and achievement in other

areas, and they show the long term implications of reading development.

How Present Study will Extend Literature

The present study will examine the relationship between reading and academic

performance at the primary school level across second through fifth grades. It will also examine

the change in correlation between reading performance and math performance at each individual grade level second through fifth. Earlier studies were focused on specific grade levels and skill sets, while the present study has a more global perspective which incorporates several grade levels together, several reading skill sets, and broad math benchmarks that included diagrams and charts, number problems, and word problems. This study expands on earlier research by transitioning from the broad upper elementary correlation by also examining the correlation between reading and mathematics at individual grade levels.

Method

This study utilizes data from a school site database containing reading performance, as measured by a battery of fluency, comprehension, and vocabulary tests; and academic performance in math, as measured by a series of assessments. The fluency test was from the school site of study's adopted English language arts curriculum, developed by SRA/McGraw-Hill. The vocabulary test was test 17 from Woodcock Johnson III Tests of Cognitive Abilities. The comprehension test was the McLeod Assessment of Reading Comprehension. Several of the mathematics assessments were from the adopted curriculum at the school site of study, which were part of the enVision MATH program, published by Pearson Education. Student performance on each assessment was ranked one through four on each individual assessment; then the average math and reading performance level was computed. Finally, the data was processed through a web-based statistical software package to determine if a correlation between reading and math performance existed.

Sample and Site

The participants for this study come from a rural school in Northern California, selected purposefully because the researcher is employed there, which offers education from the preschool level through eighth grade. It is a small school with a student population of approximately 250. There are fewer than twenty students in most classes. Nearly three-fourths of the students come from socioeconomically disadvantaged backgrounds and over a third are English language learners. All students at each of the grade levels are assessed in mathematics as part of their traditional schooling. The three reading assessments selected for this study were designed to accurately assess second grade and older students. Since several studies have already

shown that reading impacts academic performance in math and science at the secondary level, data was collected and analyzed from the entire second through fifth grade student population at the school site. This focused the study on the primary grade levels that the assessments were designed to test and excluded the population of secondary students at the school. A total of 95 students were examined. The student population included 27 second grade-students, 17 third-grade students, 30 fourth-grade students, and 21 fifth-grade students.

Access and Permissions

The site principal requested that the researcher conduct the three reading assessments as part of his regular duties at the school to identify students who need to participate in the after-school intervention reading support program. The principal then granted the researcher permission to access and utilize data from both the reading assessments that he conducted and the mathematics assessments that other teachers conducted, which were both stored in the school's Aeries database.

Data Gathering Strategies

Data on student performance in mathematics was obtained from the Aeries school database. Students were given benchmark exams over the course of the year from their enVision MATH program, published by Pearson Education. The mean score for the first five cumulative tests for each student were used to determine the average performance level of each student. Some students, who transferred to the school during the year and did not have five cumulative tests on record, had their average performance based on all available cumulative tests from this school year. These tests were administered by the individual classroom teachers, as part of the curriculum, over the course of the year in the classrooms where students received instruction.

The data on student performance in reading was also obtained from the Aeries school database. The three parts of reading ability that were assessed were fluency, vocabulary, and comprehension, with each student receiving a composite overall score. The assessment was conducted in the researcher's classroom in the afternoon during the month of May, 2012. The fluency test used was developed by the publisher of the school's imagineIT reading program, SRA/McGraw-Hill. Students were required to read a grade-level appropriate passage to themselves twice before reading it aloud in one minute to the examiner who documented the number of words read and subtracted the number of errors to determine the number of words per minute read fluently. The publisher provided benchmark scores for each grade level which allowed students to be placed into four performance levels. The next assessment given was test 17 from Woodcock Johnson III Tests of Cognitive Abilities, which assesses vocabulary in three parts. For each part, students continue until they miss four words in a grouping. The words are grouped in chunks of six with increasing difficulty in each grouping. The first part of the test requires students to provide synonyms, the second part requires students to provide antonyms, and the third part requires students to provide analogies. The scoring table is used to identify the grade level matching with the number of words correctly given by the student during the assessment. The test used to assess comprehension was the McLeod Assessment of Reading Comprehension. The test uses the "cloze" technique where students write words into blank spaces left in a series of paragraphs. Each paragraph increases in difficulty and students have a total of fifteen minutes to complete the test. The administration of the test followed the scripted directions from the test publisher to ensure standardization between each administration. After conducting all three tests, the mean performance was taken for each student to determine his or

her average reading level.

To maintain student confidentiality, printed documentation containing student names and the master list connecting those names with coded numbers was kept stored in a locked filing cabinet inside of the researcher's classroom, which was secured when no adults were present. The working copies, which traveled with the researcher between the school site and his home, used codes instead of student names. The codes indicated to the researcher which grade level the student was in and allowed him to match data collected on reading performance with data collected on math performance.

Data Analysis Approach

After the data was collected, each student's reading level and math performance was entered into a spreadsheet of composite scores. Then the data was processed by a web-based statistical software package to determine if a correlation, as measured by the Pearson's r, existed. After determining the relationship between reading and mathematics overall at the elementary level, the data was disaggregated by grade level. Then grade level data was processed by the same web-based statistical software package to determine if the correlation changed between grade levels. Additionally, a scatterplot was produced from the spreadsheet to visually present the data using OpenOffice.org Calc.

Ethical Standards

This study adheres to the Ethical Standards in Human Subjects Research of the American Psychological Association (Publication Manual of the American Psychological Association, 2010). Additionally, the project was reviewed and approved by the Dominican University of California Institutional Review Board.

Findings

The study included records from a total of 95 students from second through fifth grade. There was a strong correlation between reading performance and mathematics performance when looking at the entire elementary spread. Looking at each grade level, the data indicated a moderate correlation between reading and math performance at the second grade level, but it was not significant. However, the correlation became strong at the third, fourth, and fifth grade levels, which indicates that the correlation grew stronger as students transitioned to upper elementary.

Description of Site, Individuals, Data

There were 95 total student records utilized in this study, with 27 from second grade, 17 from third grade, 30 from fourth grade, and 21 from fifth grade. Student records from the Woodcock Johnson III assessment of reading vocabulary and the McLeod Assessment of Reading Comprehension were available in the database; however, there were gaps in each grade level for data on reading fluency. The school site conducts reading fluency benchmarks four times per year to determine student reading growth. At the time of this study, the fourth and most recent benchmark process had occurred. The fluency benchmark was completed and recorded in the database in grades two through four; however, it was not recorded in grade five. The most recent fluency assessment for fifth grade was the third fluency benchmark of the year, which was completed in February, 2012. The fluency rate of each student is compared to the rate expected of a student at their grade level given the time elapsed during the school year. The fluency benchmarks were provided by the publisher of the school site's adopted English language arts curriculum. All students are placed into performance categories after each benchmark, so missing the fourth benchmark of the fifth grade was a minor issue because the third benchmark placed

each student into a performance category appropriate for the amount of progress through the fifth

grade school year. Each student could still be placed into a reading fluency performance

category. The researcher ranked student performance in comprehension, vocabulary, and fluency

on a scale of one to four, with four being the highest performance level. Then he took the mean

of each area of reading performance to determine each student's overall reading performance
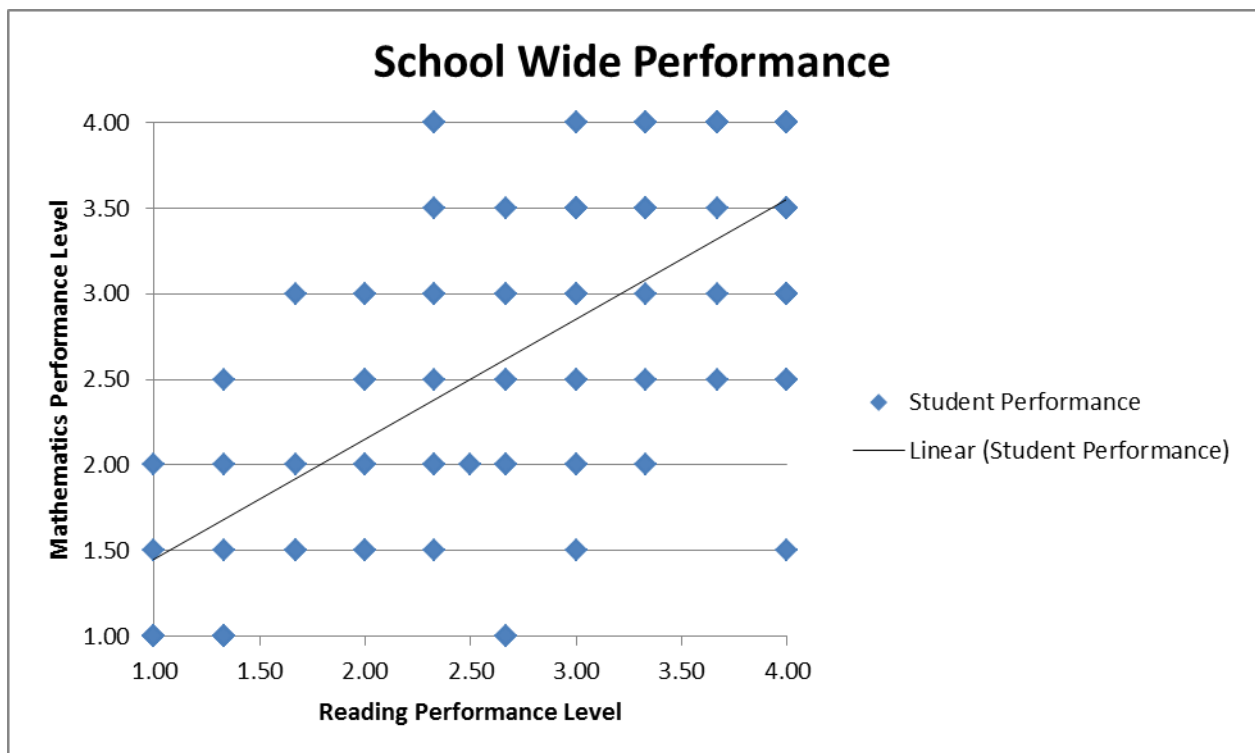
level.

Similar to the reading benchmarks, the math benchmarks occur four times during the

school year, however the math benchmarks assess different standards that students are expected

to master at their grade level. Since each math benchmark assessment covers a different area of

focus, the mean student performance over all of the benchmarks would yield ideal data for

determining an overall student performance level. Unfortunately, a significant gap was found in

the database for the mathematics benchmarks. One fourth grade class did not have any data

recorded for any of the four benchmarks, while the other fourth grade class had a complete

record. The remaining grades had two or more benchmarks available, but none had complete

records for all four of the benchmark assessments. The records for the California Standardized

Test were complete for each student in mathematics. Since the benchmark data was incomplete

and the CST is designed to asses a student's mastery of the state standards, the researcher

decided to incorporate them in calculating the mean math performance of each student. Using the

CST results and the available math benchmark data allowed the researcher to create an improved

image of student mathematical performance as compared to basing it solely on the benchmark

data as originally intended. The researcher ranked student performance on the CST and each

available math benchmark on a scale of one to four, with four representing the highest

performance level. Then he took the mean of the performance levels to determine each student's

overall math performance level.

Grade	Second		Third		Fourth		Fifth	
Mean	Reading	Math	Reading	Math	Reading	Math	Reading	Math
	3.00	2.50	1.33	1.00	2.00	1.50	4.00	3.50
Performance	2.33	4.00	4.00	3.50	1.33	1.00	2.67	2.50
	3.67	2.50	1.00	1.00	3.00	3.00	4.00	4.00
Level per	3.33	3.50	1.00	2.00	3.33	3.00	1.67	3.00
	3.67	4.00	2.67	2.50	4.00	4.00	1.33	1.50
Student by	4.00	2.50	4.00	3.00	3.00	3.00	4.00	4.00
	3.00	4.00	3.00	1.50	3.67	4.00	4.00	3.50
Subject	3.00	3.50	3.33	2.00	3.00	2.00	4.00	1.50
	2.67	2.00	1.00	1.00	1.00	1.50	2.33	3.50
Area	3.67	4.00	2.67	3.50	3.00	4.00	2.33	2.50
	2.00	3.00	3.00	2.50	1.33	2.50	2.50	2.00
	3.00	3.00	2.33	3.00	1.33	2.00	2.00	2.50
	4.00	3.00	3.67	3.50	4.00	4.00	3.33	3.50
	2.00	2.00	2.33	2.00	2.33	1.50	1.67	1.50
	3.67	4.00	4.00	3.00	1.67	2.00	1.67	1.50
	4.00	3.00	2.67	3.00	1.00	1.00	3.67	3.00
	3.00	3.50	2.00	1.50	3.00	2.00	2.67	2.00
	3.00	3.50			1.33	1.00	4.00	2.50
	3.33	4.00			4.00	4.00	3.33	3.50
	2.00	2.50			4.00	3.00	2.00	2.00
	2.33	3.00			3.67	4.00	3.33	2.50
	4.00	4.00			2.00	3.00		
	3.00	3.50			4.00	2.50		
	3.33	4.00			2.67	1.00		
	4.00	4.00			2.33	2.00		
	4.00	3.50			2.33	4.00		
	3.33	4.00			1.33	1.00		
					2.67	3.00		
					2.67	1.00		
					1.00	1.00		

Analyzing the data of each student for grades two through five, there is a strong positive

correlation between reading performance level and math performance level with an *r* value of

.67, which is highly significant at the 95% confidence interval with a P-value of less than 0.0001

on a two-tailed test. Analyzing second grade alone, the data shows a moderate positive

correlation with an *r* value of .3715, however it is not statistically significant at the 95%

confidence interval because it has a P-value of 0.056476 on a two-tailed test. The third grade has

a very strong positive correlation with an *r* value of .7447, which is highly significant with a P-

value of .000607 at the 95% confidence interval. The fourth grade has a very strong positive

correlation with an *r* value of .7202 and it is highly significant with a P-value of less than .0001

at the 95% confidence interval. The fifth grade has a strong correlation with an *r* value of .5847

and it is highly significant with a P-value of .005392 at the 95% confidence interval.

Analysis of Themes

What is the strength of correlation between reading performance and math performance at the

elementary level? The strength of correlation between reading performance and academic

performance is strong with a Pearson *r* of .67. Does the correlation grow stronger as children

advance through each grade level? The correlation was not significant at second grade and the

data set indicated only a moderate correlation, however the correlation became very strong in

third and fourth grade and was strong in fifth grade. This indicates that the relationship does

grow stronger after students advance beyond second grade.

Discussion

The growth of the correlation between reading performance and math performance from second grade through fifth grade and the cumulative correlation when examining the combined performance of all the students at the test site support the findings of other researchers.

These results lead to a plethora of additional questions. Why does the correlation exist? How can the correlation be further examined to better help rural schools with a large number of socio-economically disadvantaged students better meet their students' needs? One possibility would be to use the same data utilized in this study, but focus on individual aspects of reading performance, such as vocabulary, to see which has the highest correlation with student performance in math.

This study highlights the necessity of identifying underperforming students in math or reading prior to the establishment of the correlation and build up their skills early to improve the likelihood that their initial weakness will not compromise their performance in the other academic areas later. This study's findings that a correlation between reading and math performance exists is a first step, but until further research is conducted, schools must operate under the assumption that reading is the key to math performance, although this study didn't determine the directionality of the relationship. The study by Jordan, et al. (2002) found that reading disabilities impacted math performance and math disabilities did not impact reading performance, does the same idea of reading impacting math hold true for students who do not have disabilities? Knowing the directionality or causation of the relationship would be a very powerful tool for a district attempting to hone their intervention program to focus on improving key skills.

Comparison of Findings with Existing Studies

This study's findings correlating reading and math performance expand upon and support the Vilenius-Tuohimaa, et al. (2008) study, which found that text comprehension skills were related to the ability of students to solve math word problems. Although this study focused on the correlation between reading and math performance, the broader concept of reading being linked to other academic content areas is supported by this study in conjunction with the results of Cromley's (2009) study, which correlated reading and science achievement, and the Espin and Deno (1993) study, which found basic literacy and academic success were related.

The method and focus of this study is similar to these other studies as well. The research of Espin and Deno (1993) examined the relationship between basic reading literacy and academic success by looking at reading measures, much like this current study did. However, this current study focused on math cumulative assessments, the curriculum benchmarks and state standardized test, as opposed to examining student performance in a more general sense based on tasks, grades, and achievement tests in multiple subject areas. This study also examined a wider age range of students than the Vilenius-Tuehimaa, Aunola, and Nurmia (2008) study which had a narrow focus on fourth grade students and their text comprehension skills and ability to solve math word problems. This study included those specific skills in conjunction with others, such as vocabulary, reading fluency, and basic number problems.

Limitations of Study

There were several limitations that this study faced. The population of the school site was small and the incomplete record keeping required a greater reliance on the California Standardized Tests. Although the test is designed to assess student ability on concepts from the

entire school year, it is completed in a short and intense period of time by students and their true

performance may not be displayed. Additionally, the scope of the study prevents us from

declaring that reading and math performance are correlated in schools that are dissimilar from

the one included in this study, which was small and rural. Although the literature reviewed in this

study indicated that reading performance was causal for improvement in mathematics, the data

set from this study did not attempt to assess the directionality or causation of the relationship and

it cannot be concluded that reading performance increases math performance nor that math

performance increases reading performance.

Implications for Future Research

Additional research at the site of this study to identify the directionality of the

relationship between reading performance and math performance would increase the value of

this study. This would probably need to be conducted in a similar manner to the Jordan, et al.

(2002) study and involve students with disabilities. Partnering that focus with the outlier students

who performed strongly in one area while not in the other may also reveal directionality if outlier

students are strong in only one academic area. Additional research could also examine the

relationship between reading or math and another subject area that is highly reliant on skills from

both, such as science. To extend the current study, incorporating socio-economic factors into the

combined performance findings for reading and math may also prove valuable and present a

potential relationship that could also be studied further considering the number of students

identified as socio-economically disadvantaged at the school site where this study was

conducted. Another route to extend the current study would be to examine why the correlation

between reading and math exists. What are the similarities and differences in how students

process text and numbers?

Overall Significance of the Study

This study provides a new incentive for our school site to identify underperforming students and provide them with early intervention opportunities in order to boost their performance. Since reading and math performance are not correlated in second grade, striking early may be the best option because it would provide the opportunity to focus on boosting a particular skill set without influence from another and then have the gains on one side further display themselves as the student progresses to higher grade levels where the correlation between reading and math performance grows stronger. This study also adds to the existing research by providing additional evidence to support the findings that a relationship between reading and math performance exists and that it changes over time depending upon the age level being examined. Additionally, it provides evidence for the need to provide early intervention to support students who are struggling in reading or math because of the strength of the correlation between achievement in the two subjects.

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