

ORAL READING FLUENCY: PREDICTING OUTCOMES FOR
CULTURALLY AND LINGUISTICALLY
DIVERSE STUDENTS

by

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A dissertation submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Educational Psychology

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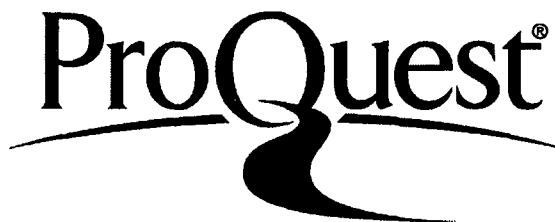
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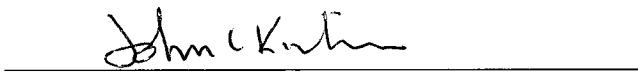
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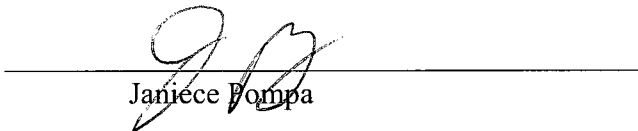
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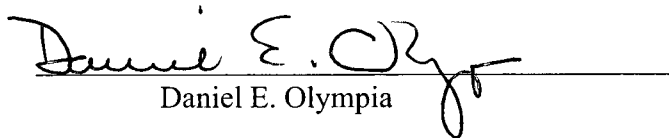
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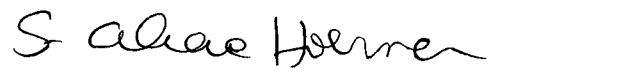
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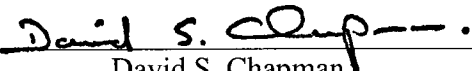
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ABSTRACT

The present study investigated Oral Reading Fluency and its ability to predict academic achievement in language arts and mathematics on 6,484 first through fourth grade students. Student, teacher, and school information from the 2006-2007 academic school year was collected from databases maintained by Salt Lake City School District. The information indicated that the student sample was 45.3% Caucasian, 39.0% Hispanic, and 15.6% Other (Non-Caucasian, Non-Hispanic). Data on a variety of variables were collected on 6,484 students, 330 teachers, and 29 schools. Hierarchical linear modeling was used to analyze the data in a three-level model. The present investigation examined the impact of student, teacher, and school variables on Oral Reading Fluency, language arts achievement, and mathematics achievement.

Findings indicated that there were significant differences between Oral Reading Fluency scores and the three ethnic student groups for language arts achievement and mathematics achievement. The results also indicated that the predictive power of Oral Reading Fluency decreased as grade levels increased. In addition, DIBELS Oral Reading Fluency predicted academic achievement in language arts and mathematics equally well for both English-Speaking students and English Language Learners. However, English-Speaking students outperformed English Language Learners in both language arts achievement and mathematics achievement. The results of the present investigation

support the use of Oral Reading Fluency to predict academic achievement outcomes of culturally and linguistically diverse students.

Para toda mi familia.

Venimos a este país sin nada y mis padres sacrificaron todo para que sus hijos tuvieran éxito. Nunca lo olvidaré.

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CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

Teaching in a culturally and linguistically diverse society such as the United States has become more challenging for educators. The significant increase of immigrants in the United States has created a need for school systems to address this area. According to Hobbs and Stoops (2002), 1 out of every 8 Americans was Caucasian at the end of the 18th century. At the end of the 19th century, 1 out of every 4 Americans was Caucasian. Population estimates reported by the Census Bureau in 2004 indicated that Hispanics accounted for 14.1% of the total United States population, followed by African Americans at 13.4%, Asians at 4.8%, American Indians at 1.5%, and Pacific Islanders at 0.3%.

According to a report from the Department of Commerce, Larsen (2004) estimated that there were 33.5 million foreign-born individuals living in the United States. The vast majority were Latin Americans with 53.3%, followed by Asians at 25%, Europeans at 13.7%, and others at 8%.

Estimates on school enrollment also reflect the continuing trend of a diverse population in the United States. Day and Jamieson (2003) reported that African American and Hispanic student populations comprised the largest ethnic groups with

14.9% each. Asian students accounted for 4.3%, followed by American Indian at 1.1%, and Pacific Islander at 0.2%.

As can be discerned from the information above, reported Limited English Proficiency student enrollment numbers have also continued to increase. The Survey of the States' Limited English Proficient Students and Available Educational Programs and Services 2000-2001 Summary Report revealed that since the 1990-1991 school year, the general student population has only grown by 12% but the Limited English Proficient population has grown by an astounding 105% (Kindler, 2002). Kindler's report also revealed that in the 2000-2001 school year, there were 4.58 million students who were classified as Limited English Proficient. This number represents 9.6% of the total number of students enrolled in prekindergarten through 12th grade. The data also indicated that over 460 languages were spoken by Limited English Proficient students in the United States. The Spanish language was spoken by 79.2% of Limited English Proficient students, followed by Vietnamese at 2%, Hmong at 1.6%, Cantonese and Korean at 1% each.

State-by-state comparisons of the number of Limited English Proficient students found that California had the largest number with 1,511,646. Puerto Rico had the second highest number with 598,063, followed by Texas with 570,022, Florida with 254,517, New York with 239,097, Illinois with 140,528, and Arizona with 135,248 (Kindler, 2002).

As the English Language Learner population in this country continues to rise at a very alarming rate, educators are challenged in many aspects of their job. One of these challenges involves the identification of reading problems in children.

Reading achievement has been shown to be a strong predictor of subsequent school progress (Anderson & Freebody, 1981). According to Good, Gruba, and Kaminski (2001), reading is an essential outcome to both academic achievement and a successful life. Deno (1989) and Adams (1990) reiterated those comments by stating that children with a good foundation of reading skills are more likely to succeed in school and more likely to have successful lives.

In 2003, the National Assessment of Educational Progress (NAEP) reported that nearly 4 in 10 children in the fourth grade read below the basic level on NAEP tests of reading. For schools with the highest levels of poverty, the numbers were alarming. The data for these schools showed that nearly 7 in 10 fourth-grade children were below basic level on NAEP tests of reading.

The research literature on children who develop poor reading skills has found a strong correlation with poor societal outcomes. For example, McGill-Franzen (1987) found that children with poor reading skills had higher rates of truancy, teen pregnancy, unemployment, substance abuse, and juvenile delinquency. In addition, Schenk, Fitzsimmons, Bullard, Taylor, and Satz (1980) found that poor readers experience more behavioral and academic difficulties at school.

The National Institute for Literacy (1998) reported that the inability to read is strongly correlated with unemployment, poverty, and crime. Unemployment data from the National Census (2001) indicated that 42% of 16- to 24-year-old high school dropouts reported no income for that year. Data from the National Institute of Literacy found that 70% of all prisoners were reading at the lowest levels of proficiency. In addition, the Coalition for Juvenile Justice (2001) reported that more than one-third of all juvenile

offenders read below the fourth grade level and 82% of all prisoners were high school dropouts.

Thus, the need for measures that analyze and predict possible outcomes of the information acquired and learned by students is necessary. One measure that has been effective in identifying students who are not progressing as expected in their reading proficiency is the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). The present study will investigate the predictive ability of DIBELS Oral Reading Fluency on academic outcomes of English Language Learners.

English Language Learners: Challenging the Educational System

Dramatic demographic changes are taking place in the educational system of the United States. Chapa (1990) analyzed and compared November 1979 and June 1988 Current Population Surveys from the United States Bureau of the Census. His findings showed that for children ages 5-17 in 1979, there were an estimated 4 million children classified as Non-English Language Background (NELB) and 2.5 million children classified as Limited English Proficient out of the total student population of 46.4 million. By 1988, there were an estimated 5.8 million NELB children and 3.7 million LEP children ages 5-17 out of the total student population of 47.5 million.

Data summarized by the Office of English Language Acquisition, Language Enhancement and Academic Achievement for Limited English Proficient Students (OELA) from different governmental agencies continued to lend support to the phenomenal growth trend of LEP students in the nation's schools. OELA data trends from 1991-1992 to 2001-2002 indicate that in 1991, there were an estimated 2.4 million

LEP students enrolled in grades K-12. By 2002, this number had grown to an estimated 4.7 million. In other words, since 1991 the number of LEP students enrolled in grades K-12 has grown by an astonishing 95%.

The Descriptive Study of Services to ELP Students and LEP Students with Disabilities (2003) reported data on Limited English Proficient (LEP) and Special Education LEP (EDSP-LEP) students from the 2000 Elementary and Secondary School Civil Rights Compliance Report (E&S Survey) completed by all public schools. The E&S Survey estimated that 3.5 million students needed Limited English Proficient programs for the 2000-2001 school year in grades K-12. Ethnic group comparisons revealed that the majority of students classified were Hispanic at 76.8%.

According to Capps, Fix, Murray, Ost, Passel, and Herwanto (2005), the states of California, Texas, New York, Florida, and Illinois accounted for 68% of all LEP students in elementary schools in 2000. Capps et al. also reported that between 1990 and 2000, states in the Southwest, Midwest, and interior West experienced growth rates above 100% compared to the national average of 46% for children in prekindergarten to 5th grade. The states with astonishing LEP growth included Nevada and Nebraska above 300%, followed by South Dakota, Georgia, Arkansas, and Oregon above 200%.

It is interesting to note that while the LEP population is growing at a rapid rate in the United States across schools, the rate is increasing more rapidly in secondary as opposed to elementary schools (Capps et al., 2005). According to data presented by Capps et al., the secondary LEP population grew by 64% while the elementary LEP population grew by 46% during the 1990s.

In Utah, the state reflects the national trend of continued LEP student growth. Data from the Utah State Office of Education revealed that in 2001, the total number of students classified as LEP was 44,058. By 2003, the total number had risen to 52,760 LEP students. From 1991 to the end of 2002, the number of LEP students had grown by an estimated 83.5%. Spanish was spoken by 65% of LEP students, followed by Other Languages at 19%, Navajo at 7%, and Vietnamese at 2%. Other languages at 1% included Korean, Russian, Japanese, Chinese, and Portuguese. By the end of the 2005-2006 school year, there were an estimated 59,294 LEP students throughout the state of Utah.

As far as special education students needing LEP programs, the E&S Survey estimated a total of 274,756 students in grades K-12 required these programs. Elementary schools made up 50.5% of the total EDSP-LEP population. Junior high schools were next with 22.8%, followed by high schools with 18.6%. Data also revealed that 66% of EDSP-LEP students were male.

An issue that has been debated for decades and deserves some consideration is whether or not ELL students are overrepresented in special education. Lloyd Dunn (1968) addressed the issue and pointed out that culturally and linguistically diverse students were disproportionately being placed in special education classrooms for the mentally retarded. Two years later, Evelyn Deno (1970) wrote about the reliance on a medical model to determine the placement of minority students in special education programs.

Most of the research in the overrepresentation area has focused on inappropriate referral process and assessment practices of culturally and linguistically diverse students

(Carrasquillo, 1991; Figueroa & Hernandez, 2000; Garcia & Ortiz, 1988; Jones, 1976; Maldonado-Colon, 1986). However, current research trends have placed emphasis on a multivariate perspective that examines variables such as quality of academic instruction, systemic issues, demographic changes, socioeconomic changes, and academic achievement (Artiles, Rueda, Salazar, & Higareda, 2005; Artiles & Trent, 1994; Hosp & Reschly, 2004; Lopez, 2006).

Artiles and Trent (1994) suggested that an “encompassing reform agenda” needs to be developed to address the issue of overrepresentation of minority children in special education programs. Accordingly, they proposed the following domains for the reform agenda: concept refinement, culturally sensitive research, systemic reform, personnel preparation, and advocacy and policy making.

Academic Outcomes of English Language Learners

Research on academic outcomes of English Language Learners has focused on literacy development. More specifically, research has been conducted in the areas of reading skills and phonological development (Haager & Windmueller, 2001; Juel, Griffith, & Gough, 1986; Limbos & Geva, 2001; Linan-Thompson, Vaughn, Hickman-Davis, & Kouzekanani, 2003; Lindsey, Manis, & Bailey, 2003; O’Connor, Jenkins, & Slocum, 1995; Ramirez & Shapiro 2006).

Ramirez and Shapiro (2006) investigated oral reading fluency growth rates in 62 Hispanic students and 83 general education students in grades 1-5. Each student was assessed using curriculum-based measurement. The students were tested three times a year in reading English passages with the Hispanic students also being tested in reading

Spanish passages. Results indicated that all Hispanic students read English passages less fluently when compared to the general education students. Hispanic students also did not read as fluently in Spanish when compared to the general education students reading in English. Finally, rates of reading growth were faster for the general education students reading in English than for Hispanics reading in Spanish.

Cross-language transfer and cross-linguistic prediction of reading difficulties from Spanish to English was examined by Lindsey, Manis, and Bailey (2003). The sample consisted of 249 Hispanic kindergarten students. Each student was assessed in Spanish and English with different standardized measures. Correlations indicated that phonological awareness was predictive of word-identification skills, but more importantly, it was not language-specific. Finally, correlations also showed that letter and word knowledge, print concepts, and sentence memory variables also transferred from Spanish to English.

O'Connor, Jenkins, and Slocum (1995) examined the effects of instructional design in developing phonological skills in 66 kindergarten children. Results indicated that treatment groups improved in their phonological abilities. These abilities were transferred to a reading analog task. In addition, regression analysis of reading analog scores indicated that the phonological variables of blending and segmenting contributed to individual differences in scores.

In a longitudinal study of first and second grade students, Juel, Griffith, and Gough (1986) examined the acquisition of early literacy skills. More specifically, the authors tested a model which focused on word recognition, spelling, reading comprehension, and writing. The sample consisted of 129 first grade children but only

80 subjects completed the study in the second year. Results found that phonemic awareness had a strong effect on word recognition and spelling whereas for reading comprehension and writing, phonemic awareness had a lesser impact.

Linan-Thompson, Vaughn, Hickman-Davis, and Kouzekanani (2003) studied the effects of supplemental reading instruction on 26 second-grade students. These students were identified as English Language Learners who were at risk for reading problems. The students were evaluated using standardized tests including the DIBELS Phoneme Segmentation Fluency measure. Reading instruction was then provided for 30 to 35 minutes each day over a 13-week period. Each session addressed fluent reading, phonological awareness, instructional-level reading, word study, and writing. Pretest to posttest scores showed that students made significant gains on word attack, passage comprehension, phoneme segmentation fluency, and oral reading fluency outcome measures. A follow-up study of over 16 weeks revealed significant gains in oral reading fluency and significant losses in phoneme segmentation fluency.

An interesting study using DIBELS was conducted by Haager and Windmueller (2001). The researchers implemented a project in which university and school personnel worked together in an effort to improve reading outcomes of 335 ELL students. A total of 17 teachers implemented the reading interventions to first and second grade students. Each student was assessed using the DIBELS measures. Results indicated that students improved on all measures, however, a significant subset fell within the at-risk range, especially in reading fluency.

Dynamic Indicators of Basic Early Literacy Skills

The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) are a standardized set of individually administered measures that measure the development of early literacy in children. More specifically, DIBELS are designed to assess phonemic awareness, alphabetic understanding, accuracy and fluency connected with text, vocabulary development, and reading comprehension.

Phonemic awareness “is the ability to hear and manipulate individual sounds with spoken language” (National Research Council, 1998, as cited in Coyne & Harn, 2006). For example, the word “cat” can be segmented into the phonemes /c/ /a/ /t/ and new words could be created by substituting a phoneme such as /b/ for /c/, thus creating the word “bat.” O’Connor, Jenkins, and Slocum’s (1995) study of 268 kindergartners found that manipulating phonological components such as blending and segmenting of words are essential in later reading proficiency.

The DIBELS measures of phonological awareness are Initial Sound Fluency (ISF) and Phoneme Segmentation Fluency (PSF). The ISF (formerly Onset Recognition Fluency) measures a child’s ability to identify and reproduce the initial sound from four pictures. The ISF can be administered at the beginning of preschool until the middle of kindergarten. Each probe contains 12 items and a stopwatch is used to measure response time. The examiner presents the four pictures and names the objects. The examiner then asks the child to identify the picture that begins with the target sound. Every fourth item, the child is asked to produce the beginning sound from an orally presented target word. Each probe is scored by dividing the total amount of time taken to respond to all 12 items

by the number of correct responses. This score is then converted to the number of correct sounds per minute.

The Phoneme Segmentation Fluency subtest measures the child's ability to fluently segment three- and four-phoneme words into individual phonemes. The PSF can be administered from the middle of kindergarten until the end of first grade. The examiner presents the words orally and the child is required to say the words in segmented phonemes. There are 20 alternate forms available and scoring is based on the correct number of phonemes produced by the child in one minute.

Alphabetic understanding "is the ability to associate sounds or phonemes with letters and use these sounds to read words" (Moats, 1999; Torgensen, 2002, as cited in Coyne & Harn, 2006). Since the English language is alphabetic, decoding is essential in our ability to recognize words (Coyne & Harn, 2006). The DIBELS measure that assesses this principle is Nonsense Word Fluency (NWF). Nonsense Word Fluency measures letter sound correspondence in randomly ordered vowel-consonant and consonant-vowel-consonant nonsense words. The examiner shows the student a sheet of paper with the nonsense words. The child is asked to read the individual letter sound of each letter or read the nonsense word. Scoring is based on the number of letter-sounds produced correctly by the student in 1 minute. The NWF can be administered from the middle of Kindergarten until the end of first grade and it has more than 20 alternate forms.

Fluency is defined as "the ability to read a text quickly, accurately, and with proper expression" (National Reading Panel, 2000). On the DIBELS, accuracy and fluency connected with text is assessed by the Oral Reading Fluency (ORF) measure.

The ORF passages and procedures are derived from the Curriculum-Based Measurement of Reading program. The ORF is administered by having a student read aloud each of three passages for 1 minute. Errors scored include words omitted, substituted, and hesitations of more than 3 seconds. If the student self-corrects a word within 3 seconds, it is scored as correct. The passages are grade-specific and the median of correct words per minute from the passages is the ORF rate. The ORF can be administered from the middle of first grade until the end of sixth grade.

In addition to the ISF, PSF, NWF, and ORF measures, the DIBELS Letter Naming Fluency (LNF) test is administered to children at the beginning of Kindergarten and can be administered only until the beginning of first grade. The LNF provides a measure of early literacy risk. Administration involves presenting students with randomly ordered upper and lower case letters. The students are asked to name as many letters as they can during 1-minute probes. If the student does not know a letter, the examiner will say the letter. The score is the number of letters named correctly during the one minute trial. "At risk" students are those who perform in the lowest 20% in their district. If the students perform between the 20th and 40th percentile, they are considered at "some risk."

DIBELS are a useful tool in identifying children with early literacy skill acquisition difficulty and in monitoring progress through ongoing evaluations (Kaminski & Good, 1996). DIBELS are helpful to educators because they are brief, economical, easy to administer and score, and can be used to make educational decisions (Good, Gruba, & Kaminski, 2001; Hintze, Ryan, & Stoner, 2003).

Research on the validity and reliability of DIBELS has been investigated by several studies (Elliott, Lee, & Tollefson, 2001; Good, Gruba, & Kaminski 2001; Hintze, Ryan, & Stoner, 2003; Kaminski & Good, 1996; Kaminski & Good, 1992; Laimon, 1994; Rouse & Fantuzzo, 2006). These studies show adequate psychometric properties for the different DIBELS measures.

A study conducted by Kaminski and Good (1996) evaluated the efficacy of Letter Naming Fluency, Phonemic Segmentation Fluency, and Picture Naming Fluency on 18 kindergarten students. Results showed that alternate form reliability coefficients ranged from .88 to .99. Criterion-related validity coefficients ranged from .58 to .90. The authors concluded that DIBELS measures were reliable and valid indicators of early literacy skills. However, the small number of subjects prevents the generalizability of these results to other populations.

Good, Gruba, and Kaminski (2001) reported concurrent criterion related validity of DIBELS measures with several standardized tests including the Metropolitan Readiness Test, Stanford Diagnostic Reading Test, and Woodcock-Johnson Psycho-Educational Battery. Concurrent criterion related validity ranged from .36 for Initial Sound Fluency in the beginning of kindergarten to .81 for Letter Naming Fluency. Finally, the authors reported that predictive validity correlations for DIBELS measures ranged from .36 to .82.

Relatively current studies by Elliott, Lee, and Tollefson (2001) and Good, Hintze, Ryan, and Stoner (2003) have used larger samples of kindergarten children. Elliot, Lee, and Tollefson (2001) used 75 kindergarten children to investigate the psychometric adequacies of Letter Naming Fluency, Sound Naming Fluency, Initial Sound Ability, and

Phoneme Segmentation Fluency. Results indicated that concurrent validity coefficients ranged from .60 to .70 between correlations of the DIBELS measures and the criterion measures of phonological awareness, standardized achievement measures, and teacher ratings of achievement. More impressively, hierarchical regression analysis conducted on the DIBELS measures showed that 73% of the variance in scores on the Skills Cluster of the Woodcock-Johnson Psycho-Educational Battery –Revised was accounted for by the measures.

Hintze, Ryan, and Stoner (2003) investigated the correlation between DIBELS and the Comprehensive Test of Phonological Processing (CTOPP) on 86 kindergarten students. The authors reported that this was the first study to evaluate the concurrent validity and diagnostic accuracy of DIBELS with another test that measures phonological processing. Results revealed strong correlations between the two measures in the areas of phonological awareness and memory and moderate correlations in the area of rapid naming tasks. The results also questioned the suggested cut-scores or benchmark scores provided by DIBELS. The authors reported that using these cut-scores led to high percentages of true positives but this came at the expense of a high number of false positives.

To date, the largest study using kindergarten children has been conducted by Rouse and Fantuzzo (2006). Their study investigated the validity of Letter Naming Fluency, Phoneme Segmentation Fluency, and Nonsense Word Fluency with 330 kindergarten children in a large urban school district. Predictive and concurrent validity were high when comparing the DIBELS measures to standardized individual measures of

general reading ability. In addition, high convergent and discriminant validity was found between the DIBELS measures and literacy, cognitive, and social behavioral measures.

Oral Reading Fluency and Statewide Assessment Tests

Several studies have investigated the use of Oral Reading Fluency to predict performance on statewide achievement tests in language arts (Buck & Torgensen, 2003; Crawford, Tindal, & Stieber, 2001; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Good, Simmons, & Kame'enui, 2001; McGlinchey & Hixson, 2004; Stage & Jacobsen, 2001).

Stage and Jacobsen (2001) utilized oral reading fluency measures to predict reading performances on the Washington Assessment of Student Learning (WASL) statewide test. The sample consisted of 174 fourth grade students. Curriculum-based oral reading fluency probes administered in fall, winter, and spring were used. Hierarchical linear modeling growth curve analysis was used to predict the slope in oral reading fluency. Results indicated that the three oral reading fluency probes reliably predicted end of year WASL reading performance.

McGlinchey and Hixson (2004) investigated the predictive power of oral reading fluency on the Michigan Educational Assessment Program (MEAP) statewide reading test. Curriculum-based reading passages were selected from the school district's reading text. A sample of 1,362 fourth grade students from 1994 to 2001 academic school years participated in the study. The results indicated a positive relationship between oral reading rates and student performance on the MEAP statewide reading test. However, the authors indicated that the results of this study must be viewed with caution since validity studies have not been conducted on the MEAP.

Another study investigating the predictive power of oral reading fluency was conducted by Buck and Torgensen (2003). The authors explored the predictive power of oral reading fluency on the Florida Comprehensive Assessment Test –Sunshine State Standards (FCAT-SSS). The sample consisted of 1,102 third grade students from 13 schools in a Florida school district. Results indicated that the correlations between oral reading fluency and the FCAT-SSS were similar across three ethnic groups. The correlation was .70 for Caucasian students, .78 for Hispanic students, and .62 for African-American students. The results also indicated that the brief oral reading measurements predicted reading achievement on the FCAT-SSS.

Crawford, Tindal, and Stieber (2001) investigated the ability of a curriculum-based measurement of reading to predict student performance on statewide reading and math achievement tests. A sample of 51 students participated in the 2-year study. Students participated as second graders and also as third graders. Results indicated that a strong correlation existed between reading rates in second grade and reading rates in third grade. The results also indicated that student scores on statewide reading and math achievement tests were moderately correlated with oral reading rates.

Statement of the Problem

Educators working in one of the most culturally diverse societies such as the United States face a continuing challenge in providing educational services to an ever-changing population. There was little information about the predictive nature of statewide administered tests with English Language Learners. The literature review conducted for this research project also indicated that very little is known about

predicting academic outcomes for students who are classified as English Language Learners. This research study examined the predictive power of DIBELS Oral Reading Fluency which may enable educators to estimate academic achievement outcomes of English Language Learners.

Purpose of the Study

The purpose of this research project was to use a Dynamic Indicators of Basic Early Literacy Skills (DIBELS) measure to predict academic achievement on a criterion-referenced assessment measure utilized by Salt Lake City School District. More specifically, the Criterion Reference Test (CRT) along with end-of-year Oral Reading Fluency scores were used to produce outcome comparisons. The present study used factors such as gender, grade, socio-economic status, educational placement (special education vs. regular education), teacher variables, oral language proficiency level, and test scores in its data analysis.

Research Questions

Research Question 1

To what extent does DIBELS Oral Reading Fluency Measure predict the CRT academic outcomes of English-Speaking Students Versus English Language Learners?

Based upon the literature review, it was hypothesized that the Oral Reading Fluency Measure would predict academic achievement in language arts of English-Speaking students and English Language Learners. It was hypothesized that the Oral

Reading Fluency Measure would also predict academic achievement in mathematics of English-Speaking students and English Language Learners.

Research Question 2

To what extent do gender, socio-economic status, oral language proficiency level, educational placement of English-Speaking students and English Language Learners predict DIBELS Oral Reading Fluency Measure scores?

It was hypothesized that gender, socio-economic status, oral language proficiency level, and educational placement would predict DIBELS Oral Reading Fluency Measure scores.

Research Question 3

To what extent does teacher experience and endorsements account for the variance between teachers within schools?

It was hypothesized that teacher Reading and ESL endorsements would account for variance between teachers within schools for language arts achievement. It was hypothesized that teacher Reading and ESL endorsements would also account for variance between teachers within schools in mathematics achievement.

Research Question 4

Does the predictive power of DIBELS Oral Reading Fluency Measure differ between the grade levels?

It was hypothesized that the predictive power of Oral Reading Fluency Measure would decrease as grade levels increased.

Research Question 5

Are there any significant differences in the Oral Reading Fluency Measure between the three ethnic student groups that comprised this investigation?

The present study investigated the effects of Oral Reading Fluency on three ethnic groups: Caucasian students, Hispanic students, and other ethnic students (non-Caucasian and non-Hispanic). It was hypothesized that there would be significant differences between the DIBELS Oral Reading Fluency Measure scores and the three ethnic student groups for language arts achievement. It was hypothesized that there would also be significant differences between the DIBELS Oral Reading Fluency Measure scores and the three ethnic student groups for mathematics achievement.

CHAPTER II

METHODOLOGY

Participants

The present study utilized data from Salt Lake City School District, Utah. Salt Lake School District was chosen due to its high rate of diversity among the local school districts. First through fourth grade English Language Learners were selected from Salt Lake City School District's electronic databases. These databases contained a variety of information on each student such as their age, gender, grade, school, test scores, and oral language proficiency level. English-Speaking students were also included in this investigation and served as a comparison group. Some of these students may have been referred for special education evaluations according to Salt Lake City School District's special education guidelines. Students who receive special education services were included in this study. Finally, information on teacher variables such as ESL endorsement, reading endorsements, and level of training were also collected and analyzed as part of this investigation.

The proposed investigation used several factors as variables obtained from Salt Lake City School District's databases. These factors included gender, grade, socio-economic status, oral language proficiency level, teacher variables, educational

placement, CRT Language Arts scores, CRT Mathematics scores, and end of year DIBELS Oral Reading Fluency scores.

School District

Salt Lake City School District has an enrollment of approximately 24,000 students, with 55% from low-income families. There are 27 elementary schools, 3 charter schools, 5 middle schools, 4 high schools, and 2 specialized programs. Over 80 languages are spoken and 46% of the students are comprised of ethnic minorities, including 33% learning English as a second language. Based on December 2001 English Language Learners Count from the Utah State Office of Education, Salt Lake City School District had the second highest enrollment of ELL students in the state with 8,745.

Procedures

A representative who manages the databases from Salt Lake School District was contacted in the spring of 2008. The proposed study was discussed in a series of meetings. A request for external research was submitted to the Director of Research and Evaluation for Salt Lake City School District. At the same time, an application for consideration of approval of research was submitted with the University of Utah's Institutional Review Board. Approval for the current research project was obtained from both the University of Utah's Institutional Review Board and Salt Lake City School District in the summer of 2008. The principal investigator received four databases from the 2006-2007 academic year containing the necessary information to conduct the study.

The databases contained demographic characteristics as well as test scores. Student variables included gender, grade, socio-economic status, CRT test scores, end-of-year ORF scores, Oral Language Proficiency Level, and educational placement. Teacher variables included gender, ethnicity, age, degree, and teacher endorsements. School variables included number of teachers, teachers' average number of years teaching, number of students, percent minority, percent English Language Learners, percent free lunch, percent reduced lunch, and percent paid lunch.

The data samples for this investigation consisted of 9,164 students, 602 teachers, and 30 schools. Due to a limitation of the statistical analyses, cases with any missing data points were deleted from further consideration for this research study. Thus, the total samples for data analyses consisted of 6,484 students, 330 teachers, and 29 schools.

The school, teacher, and student sample consisted only of data from first through fourth grades. These grade level populations were selected for several reasons. First, the populations allowed the researcher to test for generalization effects between the grade levels. Second, the grades provided a good contrast in academic achievement. The requirements set forth by the Utah State Office of Education indicated that there were differences in the Elementary Core Curriculum for grades K-2 and 3-6. Grades K-2 content area requirements include reading/language arts, mathematics, and an integrated curriculum. Grades 3-6 content area requirements include reading/language arts, mathematics, science, social studies, arts, health education, physical education, educational technology, and library media. In addition, according to the National Assessment of Educational Progress (NEAP), fourth grade students have consistently shown high rates of reading failure, whereas the majority of first graders have mastered

reading skills such as letter-sound relationships, recognizing sight words, and understanding words in context. Third, these populations were selected due to the fact that DIBELS Oral Reading Fluency measures are assessed from the middle of first grade through sixth grade.

The present investigation used CRT language arts achievement and mathematics achievement scores for several reasons. First, data on the scores were available for all grade levels used in the current investigation. Second, science achievement CRT scores were available only for fourth grade. Additionally, CRT Utah policy states that science achievement is to be measured at the elementary level in grades fourth through sixth. Finally, due to the large volume of data, the present investigation focused on language arts and mathematics achievement.

The present investigation also used IDEA Oral Language Proficiency Test (IPT II) scores which indicated speaking and listening proficiency in English as a second language. The test is an individually-administered measure which consists of 91 items and requires 5-25 minutes to administer. The test consists of a series of questions or instructions to the student. Most items require oral responses which test the vocabulary of the student. The rest of the IPT tests comprehension by requiring the student to make a physical response such as pointing. For this investigation, the following IPT scores were coded as follows: 1= Non-English speaker, 2= Limited English speaker, 3= Fluent English speaker. A fourth level was created for this investigation: 4= English Only speaker. This category was assigned to English-Speaking students with the assumption that they know their native English language.

Variables

Independent Variables

The investigation used several factors as independent variables obtained from Salt Lake City School District's databases. These factors included gender, grade, socio-economic status, and educational placement. In addition, CRT scores also served as independent variables.

Dependent Variables

Year-end Dynamic Indicators of Basic Early Literacy Skills Oral Reading Fluency scores served as the dependent measures.

Dynamic Indicators of Basic Early Literacy Skills (DIBELS)

The Dynamic Indicators of Basic Early Literacy Skills consist of individually administered, standardized measures of early literacy development. The measures are one-minute tests used to monitor the development of early reading skills. The measures are designed to measure phonological awareness, knowledge of the alphabetic principle, and fluency connected with text. Phonological awareness measures include Initial Sound Fluency (ISF) and Phoneme Segmentation Fluency (PSF). Alphabetic principle is measured by Nonsense Word Fluency (NWF). Fluency connected with text is measured by Oral Reading Fluency (ORF). First graders are given measures from LNF, PSF, NWF, and ORF. Fourth through sixth grades are only given the ORF measure.

Of interest to this investigation was the DIBELS Oral Reading Fluency measure. This test is a measure that assesses accuracy and fluency in reading text out loud.

Administration of this test involves having students read an unfamiliar passage of grade-level material for 1 minute aloud. Errors include substituted or omitted words and hesitations of more than 3 seconds. Self-corrected words within three seconds are scored as correct. The oral reading fluency rate is the number of correct words per minute from the passage. Progress and potential fluency on each student's reading development can be determined from this measure. Salt Lake City School District uses a team of highly trained paraprofessionals that travel throughout the school district and assess students at their schools. Table 1 shows ORF end-of-year benchmark assessment goals for each grade.

Criterion-Referenced Test (CRT)

In the state of Utah, CRT consists of year-end examinations in language arts, mathematics, reading, and science for students in grades K-12. The CRTs are grade-specific tests; thus, students must take the tests that correspond to the grade in which they are enrolled. Participation is mandatory and students are categorized according to level of proficiency.

Table 1

Oral Reading Fluency End of Year Benchmark Assessment Goals

Grade	Words Correct Per Minute
1	40
2	90
3	110
4	118

The English Language Arts Criterion Referenced Tests assess the areas of reading, writing, and listening for students in grades 1 through 11. These tests are considered an integral component of the Utah Performance Assessment System for Students (UPASS) and the Federal No Child Left Behind legislation. In addition, the knowledge and skill of students are assessed by incorporating tests that contain reading passages from a variety of content areas.

The Mathematics Criterion Referenced Tests are grade-specific for elementary students, as students take the test that matches the grade in which they are registered. The CRT is course-specific for the secondary students. Thus, students enrolled in algebra take the algebra CRT. Table 2 shows the Utah Core Criterion Reference Test Levels.

Data Analysis

Student, teacher, and school information gathered from the databases was coded into individual data points. Microsoft Excel and Statistical Package for the Social Sciences were used to store the information gathered from the factor variables for this investigation. Table 3 shows the factor variables for the student, teacher, and school samples.

Hierarchical Linear Modeling

According to Raudenbush and Byrk (1986), as cited in Willms (1989), Hierarchical Linear Modeling (HLM) is a type of regression that is designed to take into account the hierarchical nature of data produced by the educational systems. The advantage of HLM is that it allows for the examination of the effects of policy-relevant

Table 2

Utah Core Criterion Reference Test Levels

Level	Description
1	Minimal: A student scoring at this level is not yet proficient on measured standards and objectives of the Core Curriculum. The student's performance indicates minimal understanding and application of key curriculum concepts.
2	Partial: A student scoring at this level is not yet proficient on measured standards and objectives of the Core Curriculum. The student's performance indicates partial understanding and application of key curriculum concepts.
3	Sufficient: A student scoring at this level is proficient on the measured standards and objectives of the Core Curriculum. The student's performance indicates sufficient understanding and application of key curriculum concepts.
4	Substantial: A student scoring at this level is proficient on measured standards and objectives of the Core Curriculum. The student's performance indicates substantial understanding and application of key curriculum concepts.

Table 3

Student, Teacher, and School Factor Variables

Sample	Factor Variable
Student	Gender
	Grade (first, second, third, fourth)
	Ethnicity (Caucasian, Hispanic, Other: Non-Caucasian, Non-Hispanic)
	Socio-economic status (free, reduced, or paid lunch)
	CRT Language Arts and Mathematics scores (Level 1 = minimal, Level 2 = partial, Level 3 = sufficient, Level 4 = substantial)
	End of Year Oral Fluency Reading score
	Oral Language Proficiency Level (IPT scores: 1= Non-English speaker, 2= Limited English speaker, 3= Fluent English speaker, 4= English Only speaker)
	Educational placement (regular or special education)
Teacher	Gender
	Ethnicity (Caucasian, Hispanic, Other: Non-Caucasian, Non-Hispanic)
	Age
	Degree (Bachelors, Advanced Degrees)
	Teacher endorsements (ESL, reading, mild/moderate, other)

Table 3 (continued).

Sample	Factor Variable
School	Number of teachers
	Teacher's average number of years teaching
	Number of students
	Percent minority
	Percent English Language Learners
	Percent free lunch
	Percent reduced lunch
	Percent paid lunch

variables on student outcomes (Willms, 1999). In other words, HLM can be used to investigate critical variables. A disadvantage of HLM is that it has limitations in handling missing data. It can tolerate missing data at level 1 but it does not allow for missing data at Level 2 or Level 3, where it assumes all data files are complete (Arnold, 1992).

Hierarchical linear models can study relationships at any level without affecting the variability related to each level in the hierarchy (Raudenbush, Byrk, & Congdon, 2005). In addition, HLM provides statistical analyses that emphasize changes in performance over time (Stage, 2001). Monte Carlo simulations on hypothetical data for this study indicated that HLM analysis maintained Type I error below the nominal level with significant statistical power (J. Kircher, personal communication, November 5, 2008).

This study employed HLM to estimate the predictive capacity of DIBELS Oral Reading Fluency measure on CRT achievement scores. Since hierarchical linear models are utilized when individual subjects are nested in groups or belong to subgroups, a three-level model of analysis was implemented. For this study, students (level 1) were nested in teachers (level 2). In turn, the teachers were nested in schools (level 3).

CHAPTER III

RESULTS

Overview of the Analyses

The purpose of this investigation was to assess the predictive power of Oral Reading Fluency measure on criterion-referenced assessments employing specific factors. The present study incorporated the following student factors: gender, grade, socio-economic status, CRT test scores, end-of-year ORF scores, oral language proficiency level, and educational placement. Teacher variables included gender, ethnicity, age, degree, and teacher endorsements. School variables included number of teachers, teacher's average number of years teaching, number of students, percent minority, percent English Language Learners, percent free lunch, percent reduced lunch, and percent paid lunch. Hierarchical Linear Modeling (HLM) was utilized to evaluate the predictive effects of Oral Reading Fluency on Mathematics and Language Arts Criterion Referenced Tests. Data were analyzed using Statistical Package for the Social Sciences (SPSS, Version 15) and with Hierarchical Linear Modeling 6.0 (Raudenbush, Byrk, & Congdon, 2008).

Data Screening

Data from 9,164 students, 602 teachers, and 30 schools were examined by investigating the means, standard deviations, and ranges of each variable. Cases with any missing data points were deleted from further consideration for this research study due to the statistical limitations of HLM. Thus, the total samples for data analyses consisted of 6,484 students, 330 teachers, and 29 schools. Even though the student sample lost approximately 29% and the teacher sample lost approximately 45% of the original cases, the loss of power in deleting these cases was minimal since the total numbers of cases in this investigation were large enough to perform the necessary statistical analyses.

Descriptive Statistics

A total of 6,484 first through fourth grade students comprised the final pool of the Level 1 student data. A total of 330 teachers comprised the Level 2 teacher data set and 29 schools comprised the Level 3 school data set. The student sample contained criterion referenced language arts and mathematics achievement scores as well as end of year Oral Reading Fluency scores. In addition, information on the students' gender, grade, IDEA Oral Language Proficiency Level, socio-economic status, and educational placement were also included in the sample. The sample consisted of 50.3% female students and 49.7 male students. The sample included 28.7% first graders, 24.8%, second graders, 23.4%, and 23.2% fourth graders. The student sample was 45.3% Caucasian, 39% Hispanic, and 12.6% other ethnicity. Descriptive frequencies are summarized in Table 4.

Table 4

Demographic Variables of Level 1 Student Sample (N=6484)

<u>Student Variable</u>	<u>Frequency</u>	<u>Percent</u>
<u>Gender</u>		
Female	3264	50.3
Male	3220	49.7
<u>Grade</u>		
First	1858	28.7
Second	1606	24.8
Third	1518	23.4
Fourth	1502	23.2
<u>Ethnicity</u>		
Caucasian	2940	45.3
Hispanic	2530	39.0
Other (Non-Caucasian, Non-Hispanic)	1014	15.6
<u>SES</u>		
Free Lunch	3199	49.3
Reduced Lunch	804	12.4
Paid Lunch	2481	38.3
<u>Educational Placement</u>		
Regular Education	5686	87.7
Special Education	798	12.3

Table 5 shows descriptive characteristics of CRT Language Arts and Mathematics test scores, end of year Oral Reading Fluency scores, and IDEA Oral Language Proficiency Level for the total sample and then for each grade level. For the total sample, CRT Language Arts and Mathematics scores had a mean of 2.92, respectively. Oral Reading Fluency scores had a mean of 89.60, with a standard deviation of 50.3 and a range from 0 to 291. IDEA Oral Language Proficiency Levels had a mean of 3.34, with a standard deviation of 0.94.

Table 6 shows descriptive characteristics of CRT Language Arts and Mathematics test scores, end of year Oral Reading Fluency scores, and IDEA Oral Language Proficiency Level for the total sample based on students' ethnicities.

Table 7 shows descriptive characteristics of IDEA Oral Language Proficiency Levels for the total sample based on students' ethnicities.

Table 8 shows descriptive characteristics for the Level 2 teacher sample. The sample consisted 91.2% female teachers and 8.8% male teachers. The teacher sample was 90.9% Caucasian, 5.2% Hispanic, and 3.9% other ethnicity. Teachers' mean age was 47 with a range of 22 to 71 and a standard deviation of 11. The sample contained 50.6% ESL endorsed teachers; 8.2% for reading, 3.6% for mild/moderate, and 8.8% for other endorsements. The sample consisted of 69.7% of teachers who had a bachelor's degree and 30.3% who had advanced degrees (MA, MS, MEd).

Table 9 shows descriptive characteristics for the Level 3 school sample. The table shows the means, standard deviations, and ranges of the Level-3 school variables. The final sample for the present investigation included 29 schools. Number of students per school ranged from 90 to 740 students, with a mean of 562.7 per school. Number of

Table 5

Means, Standard Deviations, and Ranges of Level 1 Student Sample

School Variable	Mean	SD	Range
<u>Total Sample (Grades 1- 4)</u>			
CRT Language Arts	2.92	1.05	1 - 4
CRT Mathematics	2.92	1.15	1 - 4
End of Year Oral Reading Fluency	89.60	50.03	0 - 291
IDEA Oral Language Proficiency Level	3.34	0.94	1 - 4
<u>First Grade</u>			
CRT Language Arts	2.22	1.12	1 - 4
CRT Mathematics	2.18	1.10	1 - 4
End of Year Oral Reading Fluency	53.40	39.11	0 - 211
IDEA Oral Language Proficiency Level	1.69	1.03	1 - 4
<u>Second Grade</u>			
CRT Language Arts	2.31	1.09	1 - 4
CRT Mathematics	2.29	1.11	1 - 4
End of Year Oral Reading Fluency	88.12	44.92	0 - 232
IDEA Oral Language Proficiency Level	2.39	1.06	1 - 4
<u>Third Grade</u>			
CRT Language Arts	2.36	1.11	1 - 4
CRT Mathematics	2.32	1.09	1 - 4
End of Year Oral Reading Fluency	104.54	43.48	0 - 244
IDEA Oral Language Proficiency Level	2.57	1.20	1 - 4
<u>Fourth Grade</u>			
CRT Language Arts	2.57	1.14	1 - 4
CRT Mathematics	2.59	1.14	1 - 4
End of Year Oral Reading Fluency	120.88	44.99	0 - 291
IDEA Oral Language Proficiency Level	2.43	1.13	1 - 4

Table 6

Means, Standard Deviations, and Ranges of Student Ethnicities

School Variable	Mean	SD	Range
<u>Caucasian</u>			
CRT Language Arts	3.36	0.86	1 - 4
CRT Mathematics	3.35	0.93	1 - 4
End of Year Oral Reading Fluency	106.57	50.37	0 - 291
IDEA Oral Language Proficiency Level	3.94	0.31	1 - 4
<u>Hispanic</u>			
CRT Language Arts	2.46	1.02	1 - 4
CRT Mathematics	2.51	1.11	1 - 4
End of Year Oral Reading Fluency	70.34	42.80	0 - 255
IDEA Oral Language Proficiency Level	2.64	0.94	1 - 4
<u>Other (Non-Caucasian, Non-Hispanic)</u>			
CRT Language Arts	2.83	1.09	1 - 4
CRT Mathematics	2.77	1.17	1 - 4
End of Year Oral Reading Fluency	88.49	48.22	0 - 215
IDEA Oral Language Proficiency Level	3.34	0.94	1 - 4

Table 7

IDEA Oral Language Proficiency Level by Student Ethnicities

<u>Oral Language Proficiency Level</u>	<u>Number of Students</u>
<u>Level 1: Non-English Speaker</u>	
Caucasian	2
Hispanic	142
Other	39
<u>Level 2: Limited English Speaker</u>	
Caucasian	63
Hispanic	1316
Other	219
<u>Level 3: Fluent English Speaker</u>	
Caucasian	34
Hispanic	375
Other	111
<u>Level 4: English Only Speaker</u>	
Caucasian	2841
Hispanic	697
Other	645

Table 8

Demographic Variables of Level 2 Teacher Sample (N=330)

Teacher Variable	Frequency	Percent
<u>Gender</u>		
Female	301	91.2
Male	29	8.8
<u>Ethnicity</u>		
Caucasian	300	90.9
Hispanic	17	5.2
Other (Non-Caucasian, Non-Hispanic)	13	3.9
<u>Endorsements</u>		
ESL	167	50.6
Reading	27	8.2
Mild/Moderate	12	3.6
Other	29	8.8
<u>Degree</u>		
Bachelor's of Arts/Science	230	69.7
Advanced Degrees	100	30.3

teachers ranged from 4 to 28, with a mean of 20.6 per school. Average years of teaching ranged from 12.4 to 26.2, with a mean of 20.6 per teacher. The mean percentage of minority students per school was 53% and mean percentage of ELL students was 33% per school.

For this investigation, lunch type (free, reduced, and paid) was used as an indicator of socioeconomic status. Table 9 shows the proportion of students who fell in these categories. The mean percentage of students on free lunch was 52%, with a range from 4% to 98%. The mean percentage of students on reduced lunch was 10%, with a range of 0% to 22%. Finally, the mean percentage of students on paid lunch was 36%, with a range of 2% to 22%.

Inferential Statistics

Hierarchical Linear Modeling 6.0 was used in this investigation to estimate the effects of moderating variables and participant characteristics. Variable codes are presented in Table 10, which describes the variables listed in the HLM models used in this study.

Research Question 1

To what extent does DIBELS Oral Fluency Measure predict the CRT academic outcomes of English Speaking Students Versus English Language Learners?

Table 9

Means, Standard Deviations, and Ranges of School-Level Variables (N=29)

School Variable	Mean	SD	Range
Number of Students per School	562.7	161.1	90 – 740
Number of Teachers per School	20.6	5.1	4 - 28
Average Years Teaching	17.6	3.8	12.4 – 26.2
Proportion Minority	0.53	0.31	0.09 - 0.94
Proportion ELL	0.33	0.24	0.02 - 0.68
Proportion Free Lunch	0.52	0.30	0.04 - 0.98
Proportion Reduced Lunch	0.10	0.04	0.00 - 0.22
Proportion Paid Lunch	0.36	0.32	0.02 - 0.92

Table 10

Variable Codes Used in HLM Models

Code	Variable
<u>Level 1 Student Variables</u>	
LA	Standardized CRT Language Arts achievement score
MA	Standardized CRT Mathematics achievement score
ORF	End of year Oral Reading Fluency score
ENGLISH	Identified students as English speaking or English Language Learners
CORF	Centered Oral Reading Fluency scores
INTERACTION	Score computed by multiplying the ENGLISH score by the CORF score
EDSP	Identified educational service pattern –Regular or Special education
LPL	Identified English language skill level (1= Non-English Speaker; 2= Limited English Speaker; 3= Fluent English Speaker; 4= English Only Speaker)
S_GENDER	Identified student's gender
SES	Identified Free/Reduced or Paid Lunch students
GRADE	Identified the grade of the students as first, second, third, or fourth
HISPANIC	Identified students as Hispanic
OTHER	Identified student as having another ethnicity
<u>Level 2 Teacher Variables</u>	
T_GENDER	Identified teacher's gender
T_HISPAN	Identified teacher as Hispanic
T_CAUCAS	Identified teacher as Caucasian
T_OTHER	Identified teacher as having another ethnicity
T_AGE	Identified teacher's age
T_DEGREE	Identified teacher's degree

Table 10 (continued)

Code	Variable
<u>Level 3 School Variables</u>	
N_STUDEN	Number of students
PCT_MINORITY	Percent of minority students
PCT_ELL	Percent of English Language Learners
PCT_FREE	Percent of students receiving free lunch
PCT_REDUCED	Percent of students receiving reduced lunch
PCT_PAID	Percent of students paying for lunch
T_EXP	Teacher's average number of years teaching
N_TEACHERS	Number of teachers per school

Language Arts Achievement

Level 1 Analysis of Variability Within Students

For Research Question 1, a 3 Level model was used but there were no random effects found among schools when using school as a third level variable. Three measures were used to predict language arts achievement. The model for Research Question 1 was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

the indices i, j , and k denote students, teachers, and schools where there are

$i = 1, 2, 3, \dots, n_{jk}$ students within teacher j in school k ;

$j = 1, 2, 3, \dots, j_k$ teachers within school k ; and

$k = 1, 2, 3, \dots, k$ schools

where

$(LA)_{ijk}$ = standardized Language Arts achievement score of individual student i of teacher j in school k ,

π_{0jk} = mean achievement score of students of teacher j in school k ,

π_{1jk} = effect of home language on language arts scores for teacher j in school k ,

$(ENGLISH)_{1jk}$ = dichotomous variable that identified students as English-speaking students or English Language Learners,

π_{2jk} = effect of Oral Reading Fluency on language arts for teacher j in school k ,

$(CORF)_{2jk}$ = centered Oral Reading Fluency pretest scores,

π_{3jk} = effect of interaction on language arts for teacher j in school k ,

$(INTERACTION)_{3jk}$ = cross product computed by multiplying the ENGLISH score by the CORF score,

e_{ijk} = random “student effect” or the individual difference between the score for student i and the mean of all students for teacher j in school k ; normally distributed with a mean of 0 and variance σ^2 ,

β_{00k} = mean achievement score of all students in school k ,

r_{0jk} = random “teacher effect” or the difference between the mean language arts for teacher j and the mean for school k ; normally distributed with a mean of 0 and variance τ_π ,

β_{10k} = mean slope of regression line that relates language arts to home language in school k ,

r_{1jk} = difference between the mean slope for teacher j and the mean slope for all teachers in school k ,

β_{20k} = mean slope of regression line that relates language arts to oral reading fluency in school k ,

r_{2jk} = difference between the slope for teacher j and the mean slope for all teachers in school k ,

β_{30k} = mean effect of the interaction between home language and oral reading fluency in school k ,

γ_{000} = grand mean language arts score for all students in all schools,

u_{00k} = random “school effect” or the difference between the mean language arts score for school k and the grand mean; normally distributed with a mean of 0 and variance τ_{β} ,

γ_{100} = grand mean slope that relates language arts to home language,

γ_{200} = grand mean slope that relates language arts to oral reading fluency,

γ_{300} = grand mean interaction effect of home language and oral reading fluency on language arts,

For this analysis, $(LA)_{ijk}$ was the student’s standardized Language Arts Criterion Reference Test achievement score; $(ENGLISH)_{1jk}$ identified students as English-Speaking students or English Language Learners; $(CORF)_{2jk}$ signified centered Oral Reading Fluency scores; and $(INTERACTION)_{3jk}$ score was computed by multiplying the ENGLISH score by the CORF score to determine if the interaction between the two contributes significantly to predictions of Language Arts Criterion Reference Test scores.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictors and the outcome variable for the sample of 6,484 students. The results are summarized in Table 11. ENGLISH, CORF, and INTERACTION were significant predictors of language arts achievement of students. The results indicated that English-Speaking students outperformed English Language Learners by 0.305 units on the Language Arts Criterion Reference Test. A one-unit change in Oral Reading Fluency was associated with an increase of 0.017 units on the Language Arts Criterion Reference Test. The results also indicated a significant interaction between students' home language and their Oral Reading Fluency. The results of this model were obtained using robust standard errors.

Further analyses were conducted on the interaction of Oral Reading Fluency and language arts between English-Speaking students and English Language Learners by examining their slopes. Results indicated a standard deviation of 49.98 for English-Speaking students with a standard deviation of .941 for language arts which produced a slope of .011. The results for English Language Learners indicated a standard deviation of 37.49 with a standard deviation of .971 for language arts which produced a slope of .014.

Variance analyses indicated that 61% of the variance in language arts scores was unexplained by Level 1 predictors (error), 38% was due to Level 2 effects, and 1% was due to Level 3 effects. The final estimation of Level 3 variance components also indicated that the school effects were significant, $t(28), p < .034$. Table 12 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Table 11

Question 1: Fixed Effects of ENGLISH, CORF, and their Interaction on Language Arts Achievement and Variance of the Effects Across Students

Variable	Coefficient	se	t ratio	df	p value
ENGLISH	0.305	0.040	7.506	329	0.000
CORF	0.017	0.000	29.944	329	0.000
INTERACTION	-0.003	0.000	-4.888	6480	0.000

Table 12

Question 1: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.38326	0.14689	222	1293.71453	0.000
ENGLISH slope, R1	0.32130	0.10323	250	427.84426	0.000
CORF slope, R2	0.00432	0.00002	250	593.39264	0.000
Level 1, E	0.64688	0.41845			
INTRCPT1/INTRCPT2, U00	0.08614	0.00742	28	43.02256	0.034

Proportions of variance at each of the three levels were obtained with the following three formulas:

$\sigma^2 / (\sigma^2 + \tau_\pi + \tau_\beta)$ is the proportion of variance within teachers that is explained error;

$\tau_\pi / (\sigma^2 + \tau_\pi + \tau_\beta)$ is the proportion of variance among teachers within schools; and

$\tau_\beta / (\sigma^2 + \tau_\pi + \tau_\beta)$ is the proportion of variance among schools

Level 2 Analysis of Variability Among Teachers

An exploratory analysis was conducted to test if any teacher variables could account for the variance among students in language arts. The teacher variables in this analysis included gender, ethnicity (Caucasian, Hispanic, Other), age, and degree. The model from Research Question 1 above was modified to include the teacher variables. Each Level 2 predictor variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

where

π_{0jk} = mean achievement score of students of teacher j in school k ,

β_{00k} = mean language arts achievement score of all students in school k ,

β_{01k} = mean effect of the teacher variable on language arts achievement for all teachers in school k ,

X_{01jk} = Centered teacher variable,

r_{0jk} = random “teacher effect” or the difference between the mean for teacher j and the mean for school k ; normally distributed with a mean of 0 and variance τ_{π} ,

π_{1jk} = mean effect of home language on language arts for teacher j in school k ,

β_{10k} = mean effect of home language for all teachers in school k ,

r_{1jk} = difference in the effect of home language for teacher j and the mean effect for all teachers in school k ,

π_{2jk} = mean effect of oral reading fluency on language arts for teacher j in school k ,

k ,

β_{20k} = mean effect of oral reading fluency on language arts for all teachers in school k ,

r_{2jk} = difference between the effect of oral reading fluency on language arts for teacher j and the mean effect for all teachers in school k ,

π_{3jk} = the effect of the home language by oral reading fluency interaction on language arts in school k ,

β_{30k} = mean effect of the home language by oral reading fluency interaction on language arts for all teachers in school k ,

γ_{000} = grand mean language arts score of all students in all schools,

u_{00k} = the difference between the mean of school j and the grand mean,

γ_{010} = grand mean effect of X on language arts for all teachers in all schools,

γ_{100} = grand mean effect of home language on language arts for all teachers in all schools,

γ_{200} = grand mean effect of oral reading fluency for all teachers in all schools,

γ_{300} = grand mean effect of the home language by oral reading fluency interaction for all teachers in all schools,

For this analysis, X_{01jk} represented a teacher variable. In other words, each teacher variable was substituted for X_{01jk} and individually analyzed. Only teacher gender was significant. Table 13 shows the results of this model with robust standard errors.

Table 13

Question 1: Effects of Level 2 Teacher Variables on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
T_GENDER	0.202	0.085	2.361	328	0.019	0.012
T_CAUCAS	-0.133	0.080	-1.664	328	0.097	-----
T_HISPAN	0.156	0.086	1.809	328	0.071	-----
T_OTHER	0.097	0.127	0.767	328	0.443	-----
T_AGE	0.004	0.002	1.673	328	0.095	-----
T_DEGREE	-0.065	0.044	-1.477	328	0.141	-----

Although teacher gender was significant, the proportion of variance explained by these this variable was small; the effect size was less than 0.012.

Level 3 Analysis of Variability Among Schools

An exploratory analysis was conducted to test if any school variables could account for the variance among students in language arts. The school variables in this analysis included number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, percent paid lunch, teachers' average years of teaching, and number of teachers. The model from Research Question 1 above was modified to include the school variables. Each Level 3 predictor variable was individually analyzed and represented by W_{0ijk} . The new model was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + \gamma_{01k} W_{01jk} + u_{00k}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

where

β_{00k} = mean achievement score of all students in school k ,

γ_{000} = grand mean language arts score of all students in all schools,

γ_{01k} = effect of W_{01jk} on school mean language arts scores

W_{01jk} = Centered school variable,

u_{00k} = residual effect of school j on mean language arts scores,

β_{10k} = mean effects of home language on language arts scores for all teachers in
school k ,

γ_{100} = grand mean effect of home language on language arts scores,

β_{20k} = mean effect of oral reading fluency on language arts scores for all teachers
in school k ,

γ_{200} = grand mean effect of oral reading on language arts scores for all teachers in all schools,

β_{30k} = mean effect of the interaction between home language and oral reading fluency on language arts scores for all teachers in school k ,

γ_{300} = grand mean effect of the interaction between home language and oral reading fluency for all teachers in all schools,

For this analysis, W_{01jk} represented a school variable. In other words, each school variable was substituted for W_{01jk} and individually analyzed. Percent minority, percent ELL, percent free lunch, and percent paid lunch were significant. Table 14 shows the results of this model with robust standard errors.

Table 14

Question 1: Effects of Level 3 School Variables on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
N_STUDEN	-0.0003	0.000	-1.737	27	0.093	-----
PCT_MINORITY	-0.2540	0.071	-3.541	27	0.002	0.021
PCT_ELL	-0.3510	0.095	-3.670	27	0.001	0.024
PCT_FREE	-0.2779	0.072	-3.836	27	0.001	0.019
PCT_REDUCED	0.4753	0.587	0.810	27	0.425	-----
PCT_PAID	0.2273	0.069	3.259	27	0.003	0.018
T_EXP	0.0120	0.006	1.960	27	0.060	-----
N_TEACHERS	-0.0112	0.007	-1.506	27	0.144	-----

The proportions of variance explained by these variables were small; effect sizes were less than 0.025.

Summary

ENGLISH and CORF, and INTERACTION were significant predictors of CRT language arts achievement. Analyses examining the slopes of interaction between Oral Reading Fluency and language arts indicated a steeper slope for English Language Learners than English-Speaking students. An exploratory analysis indicated that Level 2 predictor variable T_GENDER and Level 3 predictor variables PCT_MINORITY, PCT_ELL, PCT_FREE, and PCT_PAID were statistically significant. The results indicated that the percentage of minority, ELL students, and free lunch students affected language arts achievement. For example, a 1% increase in minority students was associated with a decrease of 0.25 units in language arts achievement. However, the proportions of variance accounted by the variables were small; the effect sizes were less than 0.025.

Mathematics Achievement

Level 1 Analysis of Variability Within Students

For Research Question 1, a 3 Level model was used to test the extent of Oral Reading Fluency measure to predict Mathematics Achievement CRT scores. Three measures were used to predict language arts achievement. The model for Research Question 1 was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \\ \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model are the same as those used in the language arts analyses. The only exceptions are as follows:

$(MA)_{ijk}$ = Standardized Mathematics achievement score of individual student i of teacher j in school k ,

u_{20k} = difference between effect of oral reading fluency on mathematics achievement for school k and the grand mean effect of oral reading fluency was added to the model

For this analysis, $(MA)_{ijk}$ was the student's standardized Mathematics Criterion Reference Test achievement score; $(ENGLISH)_{1jk}$ identified students as English-Speaking students or English Language Learners; $(CORF)_{2jk}$ signified centered Oral Reading Fluency scores; and $(INTERACTION)_{3jk}$ score was computed by multiplying the ENGLISH score by the CORF score to determine if the interaction between the two contributes significantly to predictions of Mathematics Criterion Reference Test scores.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictors and the outcome variable for the sample of 6,484 students. The results are summarized in Table 15. ENGLISH, CORF, and INTERACTION were significant predictors of mathematics achievement of students. The results indicated that English speaking students outperformed English Language Learners by 0.258 units on the Mathematics Criterion Reference Test. A one-unit change in Oral Reading Fluency was associated with an increase of 0.012 units on the Mathematics Criterion Reference Test. The results indicated a significant interaction between students' home language and their Oral Reading Fluency measure. The results of this model were obtained using robust standard errors.

Variance analyses indicated 71% of the variance in mathematics achievement scores was unexplained by Level 1 predictors (error), 28% was due to Level 2 effects, and 3.59% due to Level 3 effects. Table 16 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Table 15

Question 1: Effects of ENGLISH, CORF, and their Interaction on Mathematics Achievement and Variance of the Effects Across Students

Variable	Coefficient	se	t ratio	df	p value
ENGLISH	0.258	0.045	5.664	329	0.000
CORF	0.012	0.000	14.916	28	0.000
INTERACTION	-0.002	0.000	-2.539	6480	0.011

Table 16

Question 1: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.34471	0.11883	222	789.20224	0.000
ENGLISH slope, R1	0.32067	0.10283	250	382.22802	0.000
CORF slope, R2	0.00248	0.00001	222	379.60172	0.000
Level 1, E	0.80824	0.65325			
INTRCPT1/INTRCPT2, U00	0.18059	0.03261	28	93.80670	0.000
CORF/INTRCPT2, U20	0.00220	0.00000	28	89.60996	0.000

Level 2 Analysis of Variability Among Teachers

An exploratory analysis was conducted to test if any teacher variables could account for the variance among students in MA. The teacher variables in this analysis included gender, ethnicity (Caucasian, Hispanic, Other), age, and degree. The model from Research Question 1 above was modified to include the teacher variables. Each Level 2 variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model are the same as those used in the language arts analysis of variability among teachers. The only exception is as follows:

u_{20k} = difference between the mean slope for mathematics score for school k and the grand mean was added to the model

For this analysis, X_{0ijk} represented a teacher variable. In other words, each teacher variable was substituted for X_{0ijk} and individually analyzed. Results showed that none of the Level 2 predictors explained differences among teachers in the Mathematics Achievement of students. Table 17 shows the results of this model with robust standard errors.

Table 17

Question 1: Effects of Level 2 Teacher Variables on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
T_GENDER	0.0856	0.063	1.344	328	0.180	-----
T_CAUCAS	-0.1000	0.094	-1.057	328	0.292	-----
T_HISPAN	0.0553	0.142	0.389	328	0.697	-----
T_OTHER	0.1460	0.117	1.239	328	0.217	-----
T_AGE	0.0009	0.001	0.578	328	0.563	-----
T_DEGREE	-0.0330	0.036	-0.913	328	0.362	-----

Level 3 Analysis of Variability Among Schools

An exploratory analysis was conducted to test if any school variables could account for the variance among students in MA. The school variables in this analysis included number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, percent paid lunch, teachers' average years of teaching, and number of teachers. The model from Research Question 1 above was modified to include the school variables. Each variable was individually analyzed and represented by W_{01jk} . The new model was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{ENGLISH})_{1jk} + \pi_{2jk}(\text{CORF})_{2jk} + \pi_{3jk}(\text{INTERACTION})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + \gamma_{01k}W_{01jk} + u_{00k}$$

$$\beta_{10k} = \gamma_{100}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model are the same as those used in the language arts analysis of variability among schools. The only exception is as follows:

u_{20k} = difference between the mean effect of oral reading fluency on mathematics achievement for school k and the grand mean was added to the model

For this analysis, W_{01jk} represented a school variable. In other words, W_{01jk} each school variable was substituted for W_{01jk} and individually analyzed. Results showed that none of the Level 3 predictors explained differences among schools in the Mathematics Achievement of students. Table 18 shows the results of this model with robust standard errors.

Table 18

Question 1: Effects of Level 3 School Variables on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
N_STUDEN	-0.0001	0.000	-0.496	27	0.623	-----
PCT_MINORITY	-0.0904	0.084	-1.066	27	0.296	-----
PCT_ELL	-0.1645	0.112	-1.460	27	0.156	-----
PCT_FREE	-0.1321	0.082	-1.611	27	0.119	-----
PCT_REDUCED	0.2742	0.485	0.565	27	0.577	-----
PCT_PAID	0.1008	0.074	1.357	27	0.186	-----
T_EXP	-0.0017	0.006	-0.249	27	0.805	-----
N_TEACHERS	-0.0013	0.007	-0.173	27	0.864	-----

Summary

ENGLISH and CORF, and INTERACTION were significant predictors of CRT Mathematics Achievement. Results showed that none of the Level 2 and Level 3 predictors explained differences in the Mathematics Achievement of students.

Interpretation of Findings

- 1) Oral Reading Fluency was a significant predictor of language arts achievement and mathematics achievement for English-Speaking students and English Language Learners.
- 2) There was a stronger relationship for English Language Learners between Oral Reading Fluency and language arts than English-Speaking students. In addition, there was more variability in Oral Reading Fluency for English Speaking students than English Language Learners.
- 3) English-Speaking students outperformed English Language Learners in language arts achievement and mathematics achievement.
- 4) Students who had a female teacher outperformed those who had a male teacher in language arts achievement. However, the results of the analyses need to be interpreted with caution as there were 301 female teachers and 29 male teachers and the variance accounted by this variable was small.
- 5) School variables indicted that schools with a relatively higher percentage of minority, ELL, and free lunch students performed worse on language arts achievement, whereas schools with a relatively higher percentage of paid lunch

students performed better. However, the variance accounted by these variables was very small.

Research Question 2

To what extent do gender, socio-economic status, oral language proficiency level, educational placement of English-Speaking students and English Language Learners predict DIBELS Oral Reading Fluency Measure scores?

Level 1 Analysis of Variability Within Students

For Research Question 2, four student variables were used to predict oral reading fluency scores. The model for Research Question 2 was as follows:

$$\begin{aligned} \text{Level 1:} \quad (\text{ORF})_{ijk} &= \pi_{0jk} + \pi_{1jk}(\text{EDSP})_{1jk} + \pi_{2jk}(\text{LPL})_{2jk} + \pi_{3jk}(\text{S_GENDER})_{3jk} \\ &+ \pi_{4jk}(\text{SES})_{4jk} + e_{ijk} \end{aligned}$$

$$\text{Level 2:} \quad \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\pi_{4jk} = \beta_{40k}$$

$$\text{Level 3:} \quad \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

$$\beta_{40k} = \gamma_{400}$$

where $(ORF)_{ijk}$ was the student's end of year Oral Reading Fluency score. Each π represented the effect of the associated independent variable and r and u represented the associated random effects. For this analysis, $(EDSP)_{1jk}$ identified students' education service pattern as special or regular education; $(LPL)_{2jk}$ indicated a student's level of language proficiency; $(S_GENDER)_{3jk}$ identified students as male or female; and $(SES)_{4jk}$ identified the students as having free/reduced or paid lunch.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictors and the outcome variable for the sample of 6,484 students. The results are summarized in Table 19. EDSP, LPL, S_GENDER, and SES were significant predictors of Oral Reading Fluency of students. The results indicated that Regular Education students outperformed Special Education students by 28.111 words per minute on the Oral Reading Fluency measure. The results showed that female students outperformed male students by 3.992 words per minute on the Oral Reading Fluency Measure. The results indicated a significant effect of between students' oral language proficiency level on Oral Reading Fluency. Students' SES was also significantly correlated with their Oral Reading Fluency measure. The results of this model were obtained using robust standard errors.

Table 19

Question 2: Fixed Effects of EDSP, LPL, S_GENDER, and SES on Oral Reading Fluency Measure and Variance of the Effects Across Students

Variable	Coefficient	se	t ratio	df	p value
EDSP	-28.038	1.979	-14.163	28	0.000
LPL	10.451	0.683	15.289	28	0.000
S_GENDER	3.996	0.756	5.282	6479	0.000
SES	11.534	1.299	8.879	6479	0.000

Variance analyses indicated 52% of the variance in oral reading fluency scores was unexplained by Level 1 predictors, 48% was due to Level 2 effects, and 5.3% due to Level 3 effects. The final estimation of Level 3 variance components also indicated that school effects, $t(28), p < .004$, EDSP, $t(28), p < .001$, and LPL, $t(28), p < .004$ were significant. Table 20 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Table 20

Question 2: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	28.97428	839.50909	204	2229.12033	0.000
EDSP slope, R1	6.81773	46.48142	204	252.75973	0.011
LPL slope, R2	4.27897	18.30962	204	281.20800	0.000
Level 1, E	33.22375	1103.81784			
INTRCPT1/INTRCPT2, U00	7.42402	55.11613	28	53.19672	0.003
EDSP/INTRCPT2, U10	7.44999	55.50241	28	59.29573	0.001
LPL/INTRCPT2, U20	1.60965	2.59097	28	51.75428	0.004

Level 2 Analysis of Variability Among Teachers

An exploratory analysis was conducted to test if any teacher variables could account for the variance among students in Oral Reading Fluency. The teacher variables in this analysis included gender, ethnicity (Caucasian, Hispanic, Other), age, and degree. The model from Research Question 2 above was modified to include the teacher variables. Each Level 2 predictor variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\begin{aligned} \text{Level 1:} \quad (\text{ORF})_{ijk} &= \pi_{0jk} + \pi_{1jk}(\text{EDSP})_{1jk} + \pi_{2jk}(\text{LPL})_{2jk} + \pi_{3jk}(\text{S_GENDER})_{3jk} \\ &+ \pi_{4jk}(\text{SES})_{4jk} + e_{ijk} \end{aligned}$$

$$\text{Level 2:} \quad \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\pi_{4jk} = \beta_{40k}$$

$$\text{Level 3:} \quad \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

$$\beta_{40k} = \gamma_{400}$$

The parameters used in this model were the same as those used in Research Question 2 Analysis of Variance within Students. The only exceptions were as follows:

β_{01k} = mean effect of X on oral reading fluency for all teachers in school k ,

X_{01jk} = Centered teacher variable,

γ_{010} = grand mean effect of X on oral reading fluency for all teachers in all schools,

For this analysis, X_{01jk} represented a teacher variable. In other words, X_{01jk} was substituted by each of the teacher variables and individually analyzed. Teacher gender and teacher degree were significant. Table 21 shows the results of this model with robust standard errors.

Table 21

Question 2: Effects of Level 2 Teacher Variables on Oral Reading Fluency

Variable	Coefficient	se	t ratio	df	p value	Effect Size
T_GENDER	-11.406	5.352	-2.131	328	0.034	0.024
T_CAUCAS	4.772	4.870	0.980	328	0.328	-----
T_HISPAN	-6.849	4.885	-1.402	328	0.162	-----
T_OTHER	-1.305	8.085	-0.162	328	0.872	-----
T_AGE	-0.069	0.132	-0.522	328	0.602	-----
T_DEGREE	7.149	3.576	1.999	328	0.046	0.021

The proportion of variance accounted by T_GENDER and T_DEGREE variables were small, 2.4% and 2.1%, respectively.

Level 3 Analysis of Variability Among Schools

An exploratory analysis was conducted to test if any school variables could account for the variance among students in ORF. The school variables in this analysis included number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, percent paid lunch, teachers' average years of teaching, and number of teachers. The model from Research Question 2 above was modified to include the school variables. Each variable was individually analyzed and represented by W_{01jk} . The new model was as follows:

$$\begin{aligned} \text{Level 1:} \quad (\text{ORF})_{ijk} &= \pi_{0jk} + \pi_{1jk}(\text{EDSP})_{1jk} + \pi_{2jk}(\text{LPL})_{2jk} + \pi_{3jk}(\text{S_GENDER})_{3jk} \\ &+ \pi_{4jk}(\text{SES})_{4jk} + e_{ijk} \end{aligned}$$

$$\text{Level 2:} \quad \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k}$$

$$\pi_{4jk} = \beta_{40k}$$

$$\text{Level 3:} \quad \beta_{00k} = \gamma_{000} + \gamma_{01k}W_{01jk} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200} + u_{20k}$$

$$\beta_{30k} = \gamma_{300}$$

$$\beta_{40k} = \gamma_{400}$$

the parameters used in this model were the same as those used in Research Question 2.

The only exceptions were as follows:

γ_{01k} = effect of W_{01jk} on school mean oral fluency reading scores,

W_{01jk} = Centered school variable

For this analysis, W_{01jk} represented a school variable. Results showed that a number of school variables were statistically significant. More specifically, the number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, and percent paid lunch were statistically significant. Table 22 shows the results of this model obtained using robust standard errors. The proportion of variance explained by N_STUDEN, PCT_MINORITY, PCT_ELL, PCT_FREE, PCT_REDUCED, and PCT_PAID variables were small; effect sizes were less than 4%.

Summary

EDSP, LPL, S_GENDER, and SES were significant predictors of Oral Reading Fluency. Results showed that Level 2 predictor variables T_GENDER and T_DEGREE accounted for a small portion of variance in ORF; effect sizes were less than 2.5%. Results also showed that N_STUDEN, PCT_MINORITY, PCT_ELL, PCT_FREE,

Table 22

Question 2: Effects of Level 3 School Variables on Oral Reading Fluency

Variable	Coefficient	<i>se</i>	<i>t</i> ratio	<i>df</i>	<i>p</i> value	Effect Size
N_STUDEN	-0.0247	0.011	-2.211	27	0.036	0.000
PCT_MINORITY	-30.5891	5.387	-5.678	27	0.000	0.027
PCT_ELL	-34.5847	6.467	-5.347	27	0.000	0.015
PCT_FREE	-33.4089	5.535	-6.036	27	0.000	0.036
PCT_REDUCED	-116.7781	50.589	-2.308	27	0.029	0.000
PCT_PAID	32.0322	5.368	5.967	27	0.000	0.037
T_EXP	0.7636	0.390	1.958	27	0.060	-----
N_TEACHERS	-0.5422	0.332	-1.629	27	0.114	-----

PCT_REDUCED, and PCT_PAID Level 3 school variables explained a small portion of the variance; effect sizes were less than 4%.

Interpretation of Findings

- 1) Educational placement, oral language proficiency level, student gender, and socio-economic status were significant predictors of Oral Reading Fluency.
- 2) Regular education students outperformed special education students.
- 3) Female students outperformed male students.
- 4) Students with higher oral language proficiency levels or higher socio-economic status outperformed other students.
- 5) Students with female teachers and students with teachers with advanced degrees outperformed those who had a male teacher or teachers who only had

a bachelor's degree. However, the variance accounted by these two variables was very small.

- 6) School variables indicted that minority, ELL, free lunch, and reduced lunch students performed worse on oral reading fluency, whereas non-minority, non-ELL, and paid lunch students performed better. However, the variance accounted by these variables was very small.
- 7) Number of students at a school had a negative impact on oral reading fluency. However, the variance accounted by this variable was very small.

Research Question 3

To what extent does teacher experience and endorsements account for the variance between teachers within schools?

Language Arts Achievement

Level 1 Analysis of Variability Within Students

For Research Question 3, five teacher variables were used in a 3 Level model to account for the variance between teachers within schools. The model for Research Question 3 was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

where $(LA)_{ijk}$ was the student's standardized Language Arts Criterion Reference Test achievement score. Each π represented the effect of the associated independent variable and r and u represented the associated random effects. For this analysis $(CORF)_{ijk}$ signified centered Oral Reading Fluency scores.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictor and the outcome variable for the sample of 6,484 students. The results are summarized in Table 23. CORF was a significant predictor of language arts achievement of students. The results indicated that a one unit change in Oral Reading Fluency was associated with an increase of 0.015 units on Language Arts Criterion Reference Test. The results of this model were obtained using robust standard errors.

Variance analyses indicated that 69% of the variance in language arts scores was unexplained by Level 1 predictors, 39% was due to Level 2 effects, and 6% due to Level 3 effects. The final estimation of Level 3 variance components also indicated that school effects, $t(28), p < .000$; and CORF, $t(28), p < .000$, were significant. Table 24 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Table 23

Question 3: Fixed Effect of CORF on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value
CORF	0.015	0.000	20.971	28	0.000

Table 24

Question 3: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.39148	0.15325	297	1121.58188	0.000
CORF slope, R1	0.00287	0.00001	297	506.03344	0.000
Level 1, E	0.66246	0.43885			
INTRCPT1/INTRCPT2, U00	0.19673	0.03870	28	95.66244	0.000
CORF/INTRCPT2, U10	0.00357	0.00001	28	193.51117	0.000

Level 2 Analysis of Variability Among Teachers

An analysis was conducted to test if teacher experience and teacher endorsements account for the variance in LA. The teacher variables in this analysis included teacher experience, reading endorsement, mild endorsement, ESL endorsement, and other endorsement. The model from Research Question 3 above was modified to include the teacher variables. Each Level 2 variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

The parameters used in this model were the same as those used in Research Question 3.

The only exceptions were as follows:

β_{01k} = mean effect of X on classroom mean language arts achievement for all teachers in school k ,

X_{01jk} = Centered teacher variable,

γ_{010} = grand mean effect of X on oral reading fluency for all teachers in all schools,

For this analysis, X_{01jk} represented a teacher variable. The results showed that none of the teacher variables were significant. Table 25 shows the results of this model with robust standard errors.

Summary

CORF was significant in the model predicting CRT language arts achievement of students. The results indicated that none of the teacher variables accounted for the variance in the Language Arts achievement of students.

Table 25

Question 3: Effects of Level 2 Teacher Variables on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
TOTALYEA	0.003	0.002	1.492	328	0.137	-----
TEND_REA	-0.077	0.102	-0.764	328	0.446	-----
TEND_MIL	0.028	0.229	0.126	328	0.900	-----
TEND_ESL	0.094	0.048	1.946	328	0.052	-----
TEND_OTH	-0.021	0.085	-0.247	328	0.805	-----

Mathematics Achievement

Level 1 Analysis of Variability Within Students

For Research Question 3, five teacher variables were used in a 3 Level model to account for the variance between teachers within schools in mathematics achievement.

The model for Research Question 3 was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

where $(MA)_{ijk}$ was the student's standardized Mathematics Criterion Reference Test achievement score. Each π represented the effect of the associated independent variable

and r and u represented the associated random effects. For this analysis $(CORF)_{ijk}$ signified centered Oral Reading Fluency scores.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictor and the outcome variable for the sample of 6,484 students. The results are summarized in Table 26. CORF was a significant predictor of mathematics achievement of students. The results indicated that a one-unit change in Oral Reading Fluency was associated with an increase of 0.012 units on the Mathematics Criterion Reference Test. The results of this model were obtained using robust standard errors.

Variance analyses indicated that 79.6% of the variance in mathematics scores was unexplained by Level 1 predictors, 20.3% was due to Level 2 effects, and 5.7% due to Level 3 effects. Table 27 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Level 2 Analysis of Variability Among Teachers

An analysis was conducted to test if teacher experience and teacher endorsements account for the variance among classrooms in mathematics achievement. The teacher variables in this analysis included teacher experience, reading endorsement, mild endorsement, ESL endorsement, and other endorsement. The model from Research Question 3 above was modified to include the teacher variables. Each Level 2 variable was individually analyzed and represented by X_{0ijk} . The new model was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(CORF)_{ijk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{0ijk} + r_{0jk}$$

Table 26

Question 3: Fixed Effect of CORF on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value
CORF	0.012	0.000	19.039	28	0.000

Table 27

Question 3: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.35214	0.12401	297	772.68659	0.000
CORF slope, R1	0.00222	0.00000	297	404.93274	0.000
Level 1, E	0.82252	0.67654			
INTRCPT1/INTRCPT2, U00	0.22076	0.4874	28	123.89660	0.000
CORF/INTRCPT2, U10	0.00301	0.00001	28	139.33047	0.000

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

The parameters used in this model were the same as those used in Research Question 3.

The only exceptions were as follows:

β_{01k} = mean effect of X on classroom mean language arts achievement for all teachers in school k ,

X_{01jk} = Centered teacher variable,

γ_{010} = grand mean effect of X on oral reading fluency for all teachers in all schools,

For this analysis, X_{01jk} represented a teacher variable. The results showed that teachers with reading endorsements were significant. Table 28 shows the results of this model with robust standard errors. The proportion of variance explained by TEND_REA was small; effect size was less than 2%.

Summary

CORF was significant in the model predicting CRT mathematics achievement of students. The results indicated that TEND_REA teacher variable accounted for a small portion of the variance in the mathematics achievement of students.

Table 28

Question 3: Effects of Level 2 Teacher Variables on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
TOTALYEA	0.000	0.001	0.182	328	0.856	-----
TEND_REA	-0.246	0.063	-3.878	328	0.000	0.013
TEND_MIL	-0.011	0.201	-0.056	328	0.956	-----
TEND_ESL	0.075	0.040	1.880	328	0.060	-----
TEND_OTH	0.025	0.058	0.437	328	0.662	-----

Interpretation of Findings

- 1) Teacher endorsements and teacher experience were not able to account for variance in the language arts achievement of students.
- 2) Reading endorsement was the only teacher variable that was able to account for variance in the mathematics achievement of students. However, this variable accounted for a small portion of the variance.

Research Question 4

Does the predictive power of DIBELS Oral Reading Fluency Measure differ between the grades?

Language Arts Achievement

For Research Question 4, a 3 Level model was used to assess the predictive power of Oral Reading Fluency Measure in each grade. Predictive power was defined as the

steeper the slope, the better the prediction. The model for Research Question 4 was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + \beta_{11k}(\text{GRADE})_{1jk} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{11k} = \gamma_{110}$$

where $(LA)_{ijk}$ was the student's standardized Language Arts Criterion Reference Test achievement score. Each π represented the effect of the associated independent variable and r and u represented the associated random effects. For this analysis $(\text{CORF})_{1jk}$ signified centered Oral Reading Fluency scores and $(\text{GRADE})_{1jk}$ identified the grade of the students as first, second, third, or fourth.

The conditional model allowed for the analysis of the relationship between the Level 1 predictor and the outcome variables for the sample of 6,484 students. The results are summarized in Table 29. CORF and GRADE were significant in the model in predicting language arts achievement of students. The results of this model were obtained using robust standard errors.

Table 29

Question 4: Effects of CORF and GRADE on Language Arts Achievement

Fixed Effect	Coefficient	<i>se</i>	<i>t</i> ratio	<i>df</i>	<i>p</i> value
CORF slope	0.0150	0.0007	20.912	28	0.000
GRADE	-0.0023	0.0002	-9.219	328	0.000

The results indicated that the predictive power of the Oral Reading Fluency Measure decreased by -0.0023 as grades increased, $t(328) = -9.219$, $p < .000$. For example, a one standard deviation ORF change is associated with 0.635 units in Language Arts Criterion Reference achievement score for first grade. Table 30 shows the results of the predictive power of ORF by grade.

Variance analyses indicated that 70% of the variance in language arts scores was unexplained by Level 1 effects, 29.6% was due to Level 2 effects, and 6.3% was due to Level 3 effects. Table 31 shows the final estimation of variance components.

Summary

CORF and GRADE were significant predictors of CRT Language Arts Achievement. Results showed that the predictive power of Oral Reading Fluency decreased as grades increased

Table 30

Question 4: Predictive Power of Oral Reading Fluency

Grade	Predictive Power of ORF	Standard Deviation (ORF <i>SD</i> = 50)
0	0.0015	0.075
1	0.0127	0.635
2	0.0104	0.520
3	0.0081	0.405
4	0.0058	0.290

Table 31

Question 4: Final Estimation of Variance Components

Random Effect	Standard Deviation	Variance Component	<i>df</i>	Chi-Square	<i>p</i> value
INTRCPT1, U0	0.38128	0.14537	297	1098.85745	0.000
CORF slope, U1	0.00334	0.00001	296	512.82044	0.000
Level 1, R	0.66307	0.43966			
INTRCPT1/ INTRCPT2, U00	0.19965	0.03986	28	104.11111	0.000
CORF/ INTRCPT2, U10	0.00336	0.00001	28	168.96234	0.000

Mathematics Achievement

For Research Question 4, a 3 Level model was used to assess the predictive power of Oral Reading Fluency Measure in each grade. The model for Research Question 4 was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{ijk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + \beta_{11k}(\text{GRADE})_{ijk} + r_{1jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{11k} = \gamma_{110}$$

where $(MA)_{ijk}$ was the student's standardized Mathematics Criterion Reference Test achievement score. Each π represented the effect of the associated independent variable and r and u represented the associated random effects. For this analysis $(\text{CORF})_{ijk}$ signified centered Oral Reading Fluency scores and $(\text{GRADE})_{ijk}$ identified the grade of the students as first, second, third, or fourth.

The conditional model allowed for the analysis of the relationship between the Level 1 predictor and the outcome variables for the sample of 6,484 students. The results are summarized in Table 32. CORF and GRADE were significant in the model in predicting mathematics achievement of students. The results of this model were obtained using robust standard errors.

Table 32

Question 4: Effects of CORF and GRADE on Mathematics Achievement

Fixed Effect	Coefficient	se	t ratio	df	p value
CORF slope	0.0123	0.0006	20.264	28	0.000
GRADE	-0.0015	0.0002	-6.119	328	0.000

The results indicated that the predictive power of the Oral Reading Fluency Measure decreased by -0.0015 as grades increased, $t(328) = -6.119, p < .000$. For example, a one standard deviation ORF change is associated with 0.540 units in Mathematics Criterion Reference achievement score for first grade. Table 33 shows the results of the predictive power of ORF by grade.

Variance analyses indicated that 79% of the variance in mathematics scores was unexplained by Level 1 effects, 21 % was due to Level 2 effects, and 5% was due to Level 3 effects. The final estimation of Level 3 variance components also indicated that the school effects and CORF were significant. Table 34 shows the final estimation of variance components.

Summary

CORF and GRADE were significant predictors of CRT Mathematics Achievement. Results showed that the predictive power of Oral Reading Fluency decreased as grades increased.

Table 33

Question 4: Predictive Power of Oral Reading Fluency

Grade	Predictive Power of ORF	Standard Deviation (ORF <i>SD</i> = 50)
0	0.0123	0.615
1	0.0108	0.540
2	0.0093	0.465
3	0.0079	0.395
4	0.0063	0.315

Table 34

Question 4: Final Estimation of Variance Components

Random Effect	Standard Deviation	Variance Component	<i>df</i>	Chi-Square	<i>p</i> value
INTRCPT1, U0	0.36169	0.13082	297	793.24093	0.000
CORF slope, U1	0.00273	0.00001	296	407.10172	0.000
Level 1, R	0.81961	0.67176			
INTRCPT1/ INTRCPT2, U00	0.21447	0.04600	28	116.13204	0.000
CORF/ INTRCPT2, U10	0.00278	0.00001	28	119.24666	0.000

Interpretation of Findings

- 1) Oral reading fluency and grade levels were significant predictors of language arts achievement and mathematics achievement.
- 2) The predictive power of Oral Reading Fluency decreased as grades increased for both language arts achievement and mathematics achievement.

Research Question 5

Are there any significant differences in the Oral Reading Fluency Measure between the three ethnic groups used in this investigation?

Language Arts Achievement

Level 1 Analysis of Variability Within Students

For Research Question 5, a 3 Level model was used to assess significant differences between the three student ethnic groups that comprised this investigation.

The model for Research Question 5 was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} + \pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

where $(LA)_{ijk}$ was the student's standardized Language Arts achievement score. Each π represented the effect of the associated independent variable and r and u represented the associated random effects. For this analysis, $(CORF)_{ijk}$ signified centered Oral Reading Fluency scores; $(HISPANIC)_{2jk}$ identified the ethnicity of a student as Hispanic; and $(OTHER)_{3jk}$ identified the student as having another ethnicity other than Caucasian or Hispanic.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictors and the outcome variable for the sample of 6,484 students. The results are summarized in Table 35. CORF, HISPANIC, and OTHER were significant predictors of language arts achievement of students. The results indicated that a one unit change in Oral Reading Fluency was associated with an increase of 0.014 units on Language Arts Criterion Reference Test. The results also indicated a significant difference between Hispanic and Caucasian students on language arts. In addition, there was a significant difference between the ethnicity of students in the OTHER variable and Caucasian students. The results of this model were obtained using robust standard errors.

Variance analyses indicated that 63% of the variance in language arts scores was unexplained by Level 1 predictors, 37% was due to Level 2 effects, and 2.8% due to Level 3 effects. The final estimation of Level 3 variance components also indicated that

school effects and CORF were significant. Table 36 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Level 2 Analysis of Variability Among Teachers

An exploratory analysis was conducted to test if any teacher variables could account for the variance in the ethnicity of students in LA. The teacher variables in this analysis included gender, ethnicity (Caucasian, Hispanic, Other), age, and degree. The model from Research Question 5 above was modified to include the teacher variables. Each Level 2 variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} +$$

$$\pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

Table 35

Question 5: Effects of CORF, HISPANIC, and OTHER Interaction on Language Arts Achievement and Variance of the Effects Across Students

Variable	Coefficient	se	t ratio	df	p value
CORF	0.014	0.000	20.699	28	0.000
HISPANIC	-0.229	0.023	-9.772	329	0.000
OTHER	-0.150	0.035	-4.245	329	0.000

Table 36

Question 5: Final Estimation of Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.37681	0.14198	218	1172.28520	0.000
CORF slope, R1	0.00316	0.00001	218	622.49972	0.000
HISPANIC slope, R2	0.21539	0.04639	245	315.26834	0.002
OTHER slope, R3	0.19877	0.03951	245	311.36172	0.003
Level 1, E	0.65175	0.42477			
INTRCPT1/INTRCPT2, U00	0.13662	0.01867	28	63.59215	0.000
CORF/INTRCPT2, U10	0.00351	0.00001	28	187.34951	0.000

The parameters used in this model were the same as those used in Research Question 5.

The only exceptions were as follows:

β_{01k} = mean weight of pretest scores for all teachers in school k ,

X_{01jk} = Centered teacher variable,

γ_{010} = grand mean effect of X on oral reading fluency for all teachers in all schools,

For this analysis, X_{01jk} represented a teacher variable. In other words, each teacher variable was substituted for X_{01jk} and individually analyzed. Only teacher gender was significant. Table 37 shows the results of this model with robust standard errors.

Table 37

Question 5: Effects of Level 2 Teacher Variables on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
T_GENDER	0.191	0.087	2.188	328	0.029	0.015
T_CAUCAS	-0.135	0.080	-1.698	328	0.090	-----
T_HISPAN	0.145	0.094	1.545	328	0.123	-----
T_OTHER	0.114	0.123	0.925	328	0.356	-----
T_AGE	0.004	0.002	1.769	328	0.077	-----
T_DEGREE	-0.050	0.046	-1.088	328	0.278	-----

Although teacher gender was significant, the proportion of variance explained by this variable was small; the effect size was less than 0.015.

Level 3 Analysis of Variability Among Schools

An exploratory analysis was conducted to test if any school variables could account for the variance in the ethnicity of students in LA. The school variables in this analysis included number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, percent paid lunch, teachers' average years of teaching, and number of teachers. The model from Research Question 5 above was modified to include the school variables. Each variable was individually analyzed and represented by W_{01jk} . The new model was as follows:

$$\text{Level 1: } (LA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} + \pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + \gamma_{01k}W_{01jk} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model were the same as those used in Research Question 5.

The only exceptions were as follows:

γ_{01k} = effect of W_{01jk} on school mean oral fluency reading scores,

W_{01jk} = Centered school variable

For this analysis, W_{01jk} represented a school variable. In other words, each school variable was substituted for W_{01jk} and individually analyzed. PCT_REDUCED was significant. Table 38 shows the results of this model with robust standard errors. The proportion of variance explained by PCT_REDUCED was small; effect size was <0.001.

Table 38

Question 5: Effects of Level 3 School Variables on Language Arts Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
N_STUDEN	-0.0001	0.000	-0.739	27	0.466	-----
PCT_MINORITY	-0.0270	0.087	-0.309	27	0.760	-----
PCT_ELL	-0.1256	0.124	-1.013	27	0.321	-----
PCT_FREE	-0.0729	0.086	-0.844	27	0.406	-----
PCT_REDUCED	0.9929	0.443	2.240	27	0.033	0.000
PCT_PAID	0.0043	0.079	-0.055	27	0.957	-----
T_EXP	0.0002	0.006	0.035	27	0.972	-----
N_TEACHERS	-0.0041	0.008	-0.519	27	0.607	-----

Summary

CORF, HISPANIC, and OTHER were significant in the model predicting CRT language arts achievement of students. The results indicated that there was a significant difference between Hispanic and Caucasian students and there was also a significant difference between the ethnicity of students in the OTHER category and Caucasian students. Exploratory analyses revealed that Level 2 T_GENDER teacher variable and Level 3 PCT_REDUCED school variable were statistically significant. However, the proportion of variance accounted by each variable was small, under .02.

Mathematics Achievement

Level 1 Analysis of Variability Within Students

For Research Question 5, a 3 Level model was used to assess significant differences between the three student ethnic groups that comprised this investigation.

The model for Research Question 5 was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} + \pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200} +$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model are the same as those used in the language arts analyses. The only exception is as follows:

$(MA)_{ijk}$ = Mathematics achievement score of individual student i of teacher j in school k ,

For this analysis, $(MA)_{ijk}$ was the student's standardized Mathematics Criterion Reference Test achievement score; $(CORF)_{1jk}$ signified centered Oral Reading Fluency scores; $(HISPANIC)_{2jk}$ identified the ethnicity of a student as Hispanic; and $(OTHER)_{3jk}$ identified the student as having another ethnicity other than Caucasian or Hispanic.

The unconditional model allowed for the analysis of the relationship between the Level 1 predictors and the outcome variable for the sample of 6,484 students. The results are summarized in Table 39. CORF, HISPANIC, and OTHER were significant predictors of mathematics achievement of students. The results indicated that a one unit change in Oral Reading Fluency was associated with an increase of 0.011 on Mathematics Criterion Reference Test. The results also indicated a significant difference between Hispanic and Caucasian. In addition, there was a significant difference between the ethnicity of students in the OTHER variable and Caucasian students. The results of this model were obtained with robust standard errors.

Variance analyses indicated that 74% of the variance in mathematics scores was unexplained by Level 1 predictors, 26% was due to Level 2 effects, and 2.8% due to Level 3 effects. The final estimation of Level 3 variance components also indicated that school effects and CORF were significant. Table 40 shows the final estimation Level 1, Level 2, and Level 3 variance components.

Level 2 Analysis of Variability Among Teachers

An exploratory analysis was conducted to test if any teacher variables could account for the variance among students in mathematics achievement. The teacher variables in this analysis included gender, ethnicity (Caucasian, Hispanic, Other), age, and degree. The model from Research Question 5 above was modified to include the teacher variables. Each Level 2 variable was individually analyzed and represented by X_{01jk} . The new model was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} + \pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + \beta_{01k}X_{01jk} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + X_{01jk} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

Table 39

Question 5: Effects of CORF, HISPANIC, and OTHER Interaction on Mathematics Achievement and Variance of the Effects Across Students

Variable	Coefficient	se	t ratio	df	p value
CORF	0.011	0.000	17.931	28	0.000
HISPANIC	-0.300	0.027	-10.836	329	0.000
OTHER	-0.254	0.042	-5.959	329	0.000

Table 40

Question 5: Final Estimation Level 1, Level 2, and Level 3 Variance Components

Random Effect	Standard Deviation	Variance Component	df	Chi-Square	p value
INTRCPT1, R0	0.34820	0.12124	218	752.89407	0.000
CORF slope, R1	0.00262	0.00001	218	355.62003	0.000
HISPANIC slope, R2	0.23393	0.05472	245	304.37461	0.006
OTHER slope, R3	0.18298	0.03348	245	293.46618	0.018
Level 1, E	0.80784	0.65261			
INTRCPT1/INTRCPT2, U00	0.15627	0.02442	28	77.88552	0.000
CORF/INTRCPT2, U10	0.00296	0.00001	28	128.98421	0.000

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + u_{00k}$$

$$\beta_{01k} = \gamma_{010}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model were the same as those used in the language arts analysis of variability among teachers.

For this analysis, X_{01jk} represented a teacher variable. In other words, each teacher variable was substituted for X_{01jk} was substituted and individually analyzed. Results showed that none of the Level 2 predictors were significant. Table 41 shows the results of this model with robust standard errors.

Table 41

Question 5: Effects of Level 2 Teacher Variables on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
T_GENDER	0.1008	0.058	1.713	328	0.087	-----
T_CAUCAS	-0.0949	0.094	-1.005	328	0.316	-----
T_HISPAN	0.0486	0.143	0.339	328	0.735	-----
T_OTHER	0.1417	0.124	1.143	328	0.254	-----
T_AGE	0.0014	0.001	0.860	328	0.391	-----
T_DEGREE	-0.0292	0.037	-0.785	328	0.433	-----

Level 3 Analysis of Variability Among Schools

An exploratory analysis was conducted to test if any school variables could account for the variance among students in mathematics achievement. The school variables in this analysis included number of students in each school, percent minority, percent ELL, percent free lunch, percent reduced lunch, percent paid lunch, teachers' average years of teaching, and number of teachers. The model from Research Question 5 above was modified to include the school variables. Each variable was individually analyzed and represented by W_{01jk} . The new model was as follows:

$$\text{Level 1: } (MA)_{ijk} = \pi_{0jk} + \pi_{1jk}(\text{CORF})_{1jk} + \pi_{2jk}(\text{HISPANIC})_{2jk} + \pi_{3jk}(\text{OTHER})_{3jk} + e_{ijk}$$

$$\text{Level 2: } \pi_{0jk} = \beta_{00k} + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{2jk} = \beta_{20k} + r_{2jk}$$

$$\pi_{3jk} = \beta_{30k} + r_{3jk}$$

$$\text{Level 3: } \beta_{00k} = \gamma_{000} + \gamma_{01k}W_{01jk} + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + u_{10k}$$

$$\beta_{20k} = \gamma_{200}$$

$$\beta_{30k} = \gamma_{300}$$

The parameters used in this model are the same as those used in the language arts analysis of variability among schools.

For this analysis, W_{0ijk} represented a school variable. In other words, each school variable was substituted for W_{0ijk} and individually analyzed. Results showed that none of the Level 3 predictors were significant. Table 42 shows the results of this model with robust standard errors.

Summary

CORF, HISPANIC, and OTHER were significant in the model predicting CRT mathematics achievement of students. The results indicated that there was a significant difference between Hispanic and Caucasian students and there was also a significant difference between the ethnicity of students in the OTHER category and Caucasian students. Exploratory analyses showed that none of the Level 2 and Level 3 predictors explained differences in the Mathematics Achievement of students.

Table 42

Question 5: Effects of Level 3 School Variables on Mathematics Achievement

Variable	Coefficient	se	t ratio	df	p value	Effect Size
N_STUDEN	-0.0000	0.000	-0.264	27	0.794	-----
PCT_MINORITY	0.0883	0.106	0.833	27	0.412	-----
PCT_ELL	0.0213	0.142	0.149	27	0.883	-----
PCT_FREE	0.0006	0.098	0.006	27	0.995	-----
PCT_REDUCED	0.6117	0.558	1.095	27	0.284	-----
PCT_PAID	-0.0254	0.091	-0.278	27	0.783	-----
T_EXP	-0.0051	0.007	-0.662	27	0.514	-----
N_TEACHERS	0.0005	0.007	0.073	27	0.943	-----

Interpretation of Findings

- 1) Caucasian students outperformed Hispanic students in language arts achievement and mathematics achievement.
- 2) Caucasian students outperformed other ethnic students (Non-Caucasian, Non-Hispanic) in language arts achievement and mathematics achievement.

CHAPTER IV

DISCUSSION

In the current era of high stakes assessment and accountability, the education field has seen an increase of empirical research that focuses on prevention and early identification of problems area in at-risk students. Many school districts across the nation are using assessment systems throughout the school year that provide feedback on whether or not students are making progress towards curriculum standards that will be evaluated by end of year statewide tests. One of the tools utilized in these assessment systems is oral reading fluency. School districts use it as a tool to help in the decision making process but also to help plan interventions for at-risk students who may perform poorly on statewide assessment tests.

The efficacy of oral reading fluency as a valid and reliable predictor of statewide assessment tests has been established in the research literature. However, most of the research studies that have used ORF to predict academic performance on statewide reading assessment tests have focused on certain grades, most notably Third and Fourth grades. In addition, research is needed to investigate the relationship between Oral Reading Fluency and performance on statewide assessment tests for different grade levels. While the research studies on language arts achievement are extensive, there is a lack of empirical studies investigating the interplay between mathematics achievement

and oral reading fluency. The present study was designed to investigate some of the issues raised above and also to contribute to the growing body of knowledge on Oral Reading Fluency.

Major Findings

The purpose of the present investigation was to evaluate whether DIBELS Oral Reading Fluency scores predict the academic achievement of culturally and linguistically diverse students in the areas of language arts and mathematics. Results from the sample population of 6,484 students indicated that Oral Reading Fluency was a significant predictor of language arts achievement and mathematics achievement for English-Speaking students and English Language Learners. However, English-Speaking students outperformed English Language Learners on both language arts achievement and mathematics achievement. Findings indicated that student's gender, socio-economic status, oral language proficiency level, and educational placement were significant predictors of Oral Reading Fluency. Results of analysis of teacher experience and teacher endorsement variables for language arts indicated that none of the variables accounted for a significant amount of variance between teachers within schools. For mathematics, having a reading endorsement accounted for a small portion of the variance. Results also indicated that the predictive power of Oral Reading Fluency decreased as grades increased for language arts achievement and mathematics achievement. Finally, there was a significant difference between Hispanic and Caucasian students and also a significant difference between the other ethnicities and Caucasian students for language arts achievement and mathematics achievement.

The present investigation employed Hierarchical Linear Models (HLM) to analyze the data nested in a three-level model. HLM uses a nested design to determine the effects at each level. For this investigation, students (Level 1) were nested in teachers (Level 2), and teachers were nested in schools (Level 3). Since individual subjects are nested in groups, HLM can test the effects of students, teachers, and school variables on the dependent variable. HLM was also utilized to conduct exploratory analyses on the effects of teacher and school variables on language arts achievement and mathematics achievement.

The following sections provide a more detailed discussion of the results of the present investigation. The research questions, hypothesis, and relevant research literature are discussed. Finally, implications and limitations for practice and further research are also discussed.

Ability of Oral Reading Fluency Scores to Predict Criterion Referenced Test

Academic Outcomes of English-Speaking Students

and English Language Learners

The hypothesis that Oral Reading Fluency scores would predict CRT academic outcomes of English-Speaking students and English Language Learners was supported. Three potential predictors of language arts and mathematics achievement were identified: the primary language of the students, centered ORF scores, and the interaction of home language and ORF scores. The results of the analyses showed that all three were significant predictors of language arts achievement and mathematics achievement. The

results indicated that English-Speaking students outperformed English Language Learners on language arts achievement and mathematics achievement.

The finding that scores on Oral Reading Fluency tests would predict scores on Criterion Referenced Tests used in the state of Utah is consistent with the results found by a few studies in other states that utilized scores on ORF to predict scores on statewide achievement tests in language arts (Buck & Torgesen, 2003; Crawford, Tindal, & Stieber, 2001; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Good, Simmons, & Kame'enui, 2001; McGlinchey & Hixson, 2004; Stage & Jacobsen, 2001). Thus, the result of this investigation lends support to the use of Oral Reading Fluency as a measure to predict performance on statewide assessment tests. The finding also suggests that ORF can be used as a tool to measure student progress on Utah's core curriculum standards. ORF will also assist in identifying at-risk students in Utah's schools and it allows schools to allocate resources to the lowest-performing group of students.

An exploratory analysis on teacher variables was conducted to determine if they contributed to language arts achievement and mathematics achievement. Teacher variables such as gender, ethnicity, age, and degree were used in the analyses. Results indicated that teacher gender in the language arts analysis was the only variable that was statistically significant. Female teachers had a significant impact on language arts, but it must be noted that the sample consisted of 301 female teachers and only 29 male teachers. The gender discrepancy created an unbalanced design which may have underestimated the results of the effects of gender. The effects may have been larger with equal number of female and male teachers.

Studies on teacher characteristics using conceptualized models of factors that may affect school learning indicate that teacher characteristics influence learning only as they affect teacher performance (Centra & Potter, 1980; McDonald & Elias, 1976). In other words, student learning and behavior are affected by student characteristics, teaching performance, and within-school conditions such as quality of schooling, class size, environment, and administrative and instructional organization. In addition, these models have focused on teacher characteristics that include more pertinent variables such as knowledge of subject, knowledge of teaching, expectations, social class, aptitudes, and values and attitudes. Although teacher gender was statistically significant, the lack of other significant results in the exploratory analyses in the present investigation was probably due to the narrow and limited nature of the teacher predictor variables.

An exploratory analysis on school variables was also conducted to determine if they contributed to language arts achievement and mathematics achievement. School variables such as number of students, percent minority, percent ELL, percent free/reduced/paid lunch, teacher experience, and number of teachers were used in the analyses. Results indicated that percent minority, percent ELL, percent free and paid lunch in the language arts analyses were statistically significant. The proportion of variance accounted by these school variables was small. However, previous research studies on school-level variables indicated that these variables influence student learning and achievement (Odden, Borman, & Fermanich 2004; Tajalli & Opheim, 2005; Yang & Gustafsson, 2004).

The few studies mentioned above that have supported ORF as a predictor of statewide tests has concentrated in language arts achievement and usually only third or

fourth grade. This study extended the research literature by investigating language arts achievement and mathematics at different grade levels. While it may be surprising that Oral Reading Fluency predicted mathematics achievement, the findings from this investigation are consistent with previous studies that investigated the relationship between mathematics and reading (Crawford, Tindal, & Stieber, 2001; Gersten, Jordan, Flojo, 2005; Vilenius-Tuohimaa, Aunola, & Nurmi, 2008). The results of the present investigation indicated that a one-unit change in Oral Reading Fluency was associated with an increase of 0.017 units on the Language Arts Criterion Reference Test. A one-unit change in ORF was associated with an increase of 0.012 units on the Mathematics Criterion Reference Test. The result of this investigation lends support to the idea that having good language skills will help with the literacy demands encountered in mathematics achievement. Therefore, greater emphasis must be placed on the English language skills of ELL students because they must be proficient enough to meet the language demands of mathematics.

Student Variables' Ability to Predict Oral Reading Fluency

The hypothesis that socio-economic status, oral language proficiency level, and educational placement would predict ORF scores was supported. Four student variables were used to predict ORF scores: socio-economic status, oral language proficiency level, educational placement, and gender. The results from the analyses indicated that all four variables were significant predictors of Oral Reading Fluency scores. The results showed that regular education students outperformed special education students. Female students outperformed male students on Oral Reading Fluency. The results also indicated that

there was a significant effect of oral language proficiency level on Oral Reading Fluency. Finally, the results indicated that socio-economic status was significantly correlated with Oral Reading Fluency. These findings continue to emphasize the importance of identifying students who are at a particular risk.

An exploratory analyses on Level 2 teacher variables revealed that teacher gender and teacher degree were statistically significant. Research studies have shown that teacher degrees and education beyond a bachelor's degree has minimal impact on student learning (Goldhaber & Brewer, 1997; Hanushek, 1992; Murnane, 1983). The results of the present investigation contradict these findings.

The exploratory analyses on Level 3 school variables indicated that number of students, percent minority, percent ELL, percent free/reduced/ and paid lunch were statistically significant. The findings indicate that the characteristics of the student population affect achievement. Research on the impact of school size indicates that the optimum size for elementary schools is between 300 to 500 students (Lee & Smith, 1997; Raywid, 1997). Research from a sociological point of view indicates that ethnicity and socio-economic status affect student educational trajectories (Jencks & Phillips, 1998).

Variance Among Teachers Within Schools

The hypothesis that Reading and ESL endorsements would account for variance between teachers within schools for language arts was not supported. However, the hypothesis for mathematics was partially supported by Reading endorsement. For these analyses, teacher variables such as experience, reading endorsement, mild endorsement, ESL endorsement, and other endorsements were used. Results indicated that none of the

teacher variables could account for variance within schools for language arts. The analyses for mathematics achievement revealed that only Reading endorsement accounted for a small portion of the variance.

While research on teacher certification is extensive, research on teacher endorsements is lacking. A literature search under “teacher endorsements” did not provide any viable studies for review or comparative purposes. Only one study attempted to investigate teachers with ESL endorsements and its impact on student performance (Durham, 2008). However, the Durham study was limited to seven ESL teachers and there were difficulties in obtaining student test scores. The literature review also produced studies which addressed endorsement policies, requirements, or training (Markowitz & Linehan, 2001; Council of State Directors of Programs for the Gifted, 1996, Virginia State Department for the Deaf and Hard of Hearing, 1995). Future research is needed to investigate teacher endorsements and their impact on the academic achievement of students.

The Relationship Between Oral Reading Fluency and Grade level

The hypothesis that the predictive power of Oral Reading Fluency would decrease as grades level increased was supported. For this investigation, predictive power was defined as the steeper the slope, the better the prediction between Oral Reading Fluency and grade level. The results from the analyses indicated that Oral Reading Fluency and grade level were significant in predicting language arts achievement and mathematics achievement. The pertinent findings were that the predictive power of Oral Reading Fluency decreased as grade levels increased for both language arts achievement and

mathematics. A recent study by Richardson (2009) on 719 fourth, fifth, and sixth grade students extends the trend that the predictive power of Oral Reading Fluency decreased as grade levels increased for language arts achievement. Thus, the present investigation addressed the limitation of information on the relationship between Oral Reading Fluency and grade levels in the research literature that has been identified by researchers as a central area needing further investigation (Fuchs, et al., 2001; Good, Simmons, et al., 2001; Wolf & Katzir-Cohen, 2001). Fuchs et al. suggested that there is a stronger relationship in younger children and it weakens in older children because the complexity of reading increases.

Chall's (1996) developmental characteristics of reading indicate that children in first through third grade "learn to read" whereas children in fourth grade and above "read to learn." In other words, children in first through third grade move from learning simple concepts to acquiring reading fluency. Children in fourth grade are expected to use reading as a tool for learning and the complexity of the material increases. Therefore, it is assumed that if children do not have the necessary basic alphabetic principles of reading, then they will have a difficult time acquiring reading fluency which in turn will make it difficult for them as their academic demands increase. The findings of this investigation appear to support the idea that as the complexity of reading increases in grade level the ability of Oral Reading Fluency to predict academic achievement decreases. The findings imply that it is imperative for educators to intervene with at-risk children as early as possible.

The Relationship Between Oral Reading Fluency and Ethnicity

The hypothesis that there would be significant differences between Oral Reading Fluency scores and the three ethnic student groups for language arts and mathematics was supported. The results of the analyses indicated a difference between Hispanic and Caucasian students for language arts and mathematics achievement. The results also indicated a difference between the ethnicity of other students (Non-Caucasian, Non-Hispanic) and Caucasian students for language arts and mathematics achievement.

Exploratory analyses on teacher and school variables showed that teacher gender and percentage of reduced lunch were statistically significant for language arts. However, the proportion of variance accounted by these two variables was small. For mathematics achievement, none of the variables were significant. The results in this sample demonstrated that there were differences due to ethnicity. It may be beneficial for educators to also consider the impact of ethnic differences when interpreting Oral Reading Fluency scores.

Implications for Practice

The findings in the present investigation support the use of Oral Reading Fluency as a tool which can be used by educators to predict performance on statewide assessment tests. It provides educators with several opportunities. First, Oral Reading Fluency can be used as a tool to identify at-risk students. Second, ORF can aid in the decision making process as a component to determine student's needs. Finally, ORF can help schools predict scores for the student population which can then be used to implement interventions.

Educators can identify at-risk students using Oral Reading Fluency measures. The advantages of ORF probes are that they are brief, easy to administer and score. In addition, educators are able to quickly ascertain if students are making adequate progress towards their yearly goal. ORF benchmarks have been established to measure student progress three or four times a year depending on a school's preference. These benchmarks have been empirically established at each grade level in order to assist educators compare the progress of a student against national norms (Good, Wallin, Simmons, Kame'enui, & Kaminski, 2002; Good, Simmons, Kame'enui, Kaminski, & Wallin, 2002).

Oral Reading Fluency can be used by educators as a part of a multi-dimensional approach to student assessment. Alone, Oral reading fluency will not provide all of the answers but it can be used with other measures to identify and narrow problem areas in students. In turn, these areas can then be evaluated with specific assessments that are sensitive to the problem area.

School personnel need to work with teachers to identify students who are at-risk of not achieving appropriate proficiency levels. School personnel can implement the use of Oral Reading Fluency to predict scores for the student population. Targeting at-risk students will allow a school to implement programs that could improve their outcome scores. Additional services or specific interventions could also be implemented to support the at-risk population in the school. If school personnel know how students might perform on end of year statewide assessment tests, then there is enough time in a school year to try to improve upon those results.

Implications for Future Research

The results of this investigation continue to expand the research on Oral Reading Fluency beyond its initial extent as a screening device. However, future research is needed to validate the results of this investigation. In particular, research is needed to examine the relationship between Oral Reading Fluency and grade levels. Replication studies in districts around the nation would be a first step in determining how well the results of this investigation generalize to other parts of the country.

Future research is needed to continue to analyze data collected in this investigation. Due to the vast amount of information, some analyses which may be of interest were not performed. For example, analyses on the ethnicity of the students and the ethnicity of the teachers were not conducted. Are language arts and mathematics moderated by teacher ethnicity? In addition, new models could be created using English Language Learners as a factor to control for variables such as language.

Future research is also needed to investigate the relationship between teacher and school level variables and their impact on academic achievement. The variables used in this investigation may have been too narrow to produce any significant effects. Perhaps investigating pertinent teacher variables such as knowledge of subject, aptitudes, and expectations may predict academic success. The impact of school variables such as quality of schooling, ambiance, and instructional organization on academic performance should also be explored.

Future research is needed to investigate teachers who are ESL endorsed. The teacher sample from the present study indicated that 167 out of 330 teachers were ESL endorsed. The findings from the current investigation showed that teachers who were

ESL endorsed did not account for variance within schools. School districts around the nation allocate time and resources for ESL endorsement trainings. Although research is needed to help school districts make informed decisions, the results of the current study appear to indicate that an ESL endorsement does not impact the language arts achievement and mathematics achievement of students. Thus, future research is needed to investigate ESL endorsement and its impact on the academic achievement of students.

Future research is needed to investigate the predictability of Oral Reading fluency over a period of time because the present study investigated this at only one point in time. Longitudinal studies need to investigate the accuracy of ORF predictions. Student populations could serve as their own controls and changes in individual academic performance could be studied. The results of these studies could provide greater insight on Oral Reading Fluency as a valid and reliable predictor of language arts and mathematics statewide achievement tests.

Finally, previous studies have investigated the relationship between cognitive skills, language, and mathematics (Augustyniak, Murphy, & Phillips, 2005; Geary, 2004; Ramussen & Bisanz, 2005; Sarama & Clements, 2005). But future research is needed to investigate the relationship between mathematics and Oral Reading Fluency. The results of the present investigation were consistent with two previous studies indicating that there is a relationship between mathematics and reading. However, more research is needed in the area in order to support the idea that good reading skills are important in the achievement of mathematics.

Limitations

The present investigation was a retrospective designed study utilizing data from the 2006-2007 academic school year from a local district. Data collected were limited to the student, teacher, and school variables found in the Salt Lake City School District databases. Thus, other variables that may have accounted for some of the variance could not be studied. Wayne and Youngs (2003) found that certain teacher characteristics impacted student learning. Some of these characteristics included verbal ability and general measures of academic talent such as an ACT score. While it may be challenging to collect this type of information, such data on these types of variables were not available in the databases utilized for this investigation. In addition to the limitation on teacher variables, the databases did not have information on characteristics of English Language Learners such as how long a student had been in the United States or acculturation level. A formal measure of acculturation could provide information on the experiences of English Language Learners that could impact their educational achievement.

A second limitation of the present investigation was the lack of generalizability of students across the State of Utah, or even local school districts. The sample of students utilized in this study was obtained from one district. In addition, the student sample included a large proportion of Caucasian and Hispanic students. Due to the low numbers of other ethnic groups, one category was created to include all other ethnicities. However, the sample was diverse and highly representative of the overall general population growth in Salt Lake City. It should be noted that there was a loss of subjects due to missing data points from the various samples. This was due to the fact that the

statistical method used to analyze the information, Hierarchical Linear Modeling, could tolerate missing data at Level 1 but not at Level 2 or Level 3. The original sample of 9,164 students, 602 teachers, and 30 schools was reduced because of missing data points. Thus, the student sample lost approximately 29% of the original cases while the teacher sample lost approximately 45% of the original cases. It is not known how these students or teachers would have impacted the final analyses. However, even after eliminating these cases due to missing data, the samples in the present investigation were sufficient and analyses were performed on 6,484 students, 330 teachers, and 29 schools.

A third limitation of the present study was that the Criterion Reference Tests that assessed language arts achievement and mathematics achievement are specific to the State of Utah. This inhibits the generalizability of results in the present investigation because direct comparisons cannot be made with statewide assessments utilized by other states.

A fourth limitation was the use of IDEA Oral Language Proficiency Test (IPT II) scores to indicate speaking and listening proficiency levels of English Language Learners. The IPT assigns English Language Learners as: 1= Non-English speaker, 2= Limited English speaker, 3= Fluent English speaker. But for this investigation, a fourth level was created: 4= English Only speaker; assigning English Speaking students to this category with the assumption that they know their native English language. Thus, the results are limited by the use of only one measure to classify the language level of each student.

A final limitation was that only the year end Oral Reading Score was used in the analyses. Typically, ORF scores are assessed three times a year in the elementary grades.

The beginning of the year assessment is done in the first three months of school. The middle assessment is done between the fourth and sixth month. The end of the year assessment is done between the seventh and tenth month of the academic school year. The only exception is first grade. Their ORF scores are measured on two occasions, at the middle of the year and at the end of the year. Investigating the other assessment occasions could have yielded prediction scores throughout the academic year. Comparison between these assessment occasions could have shown trends of the ORF prediction model.

Conclusion

The present study investigated Oral Reading Fluency and its ability to predict academic achievement in language arts and mathematics on culturally and linguistically diverse population of students in first through fourth grades. Student, teacher, and school information from the 2006-2007 academic school year was gathered from databases maintained by Salt Lake City School District. The information indicated that the student sample was 45.3% Caucasian, 39.0% Hispanic, and 15.6% Other (Non-Caucasian, Non-Hispanic). Data were collected on a variety of variables on the total samples of 29 schools, 330 teachers, and 6,484 students.

Hierarchical linear modeling was used in this study to analyze the data at various levels. The present investigation was able to examine the impact student, teacher, and school variables on Oral Reading Fluency, language arts achievement, and mathematics achievement.

Major findings from the present investigation demonstrated that there were significant differences between Oral Reading Fluency scores and the three ethnic student groups for language arts achievement and mathematics achievement. In addition, the result of the present investigation indicated that the predictive power of Oral Reading Fluency decreased as grade levels increased. DIBELS Oral Reading Fluency predicted academic achievement in language arts and mathematics equally well for both English-Speaking students and English Language Learners. However, English-Speaking students outperformed English Language Learners in both language arts achievement and mathematics achievement. In conclusion, the results of the present investigation support the use of Oral Reading Fluency as a valid and reliable tool that can be used by educators to predict academic achievement outcomes of culturally and linguistically diverse students.

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