AN ANALYSIS OF THE READING ACHIEVEMENT GAP BETWEEN NON-ENGLISH LANGUAGE LEARNERS AND ENGLISH LANGUAGE LEARNERS IN KANSAS PUBLIC SCHOOLS

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ABSTRACT

The rapid increase of ESOL students and the slow increase of qualified ESOL teachers in the public schools of the State of Kansas directed the researcher's attention to investigate how the reading achievement gap between the non-ESOL and ESOL groups changed over the time of the study. This study examined how the reading achievement gap between the two groups changed over the five years of data collected and how the gap between the groups was expected to differ at the elementary, middle and high school levels. In addition, this study investigated how the number of teachers with ESOL endorsement and the number of ESOL students who received ESOL services influenced the non-ESOL and ESOL groups' reading achievement. The effects of time, three school levels (i.e. elementary, middle and high school) and two time-varying predictors (i.e. ESOL teacher and ESOL student predictors) were analyzed using a multilevel model of growth. The study found that the effects of the ESOL teacher and ESOL student predictors showed a more significant influence on the outcome of different levels (i.e. class, school, and district) and different school levels of the non-ESOL group rather than the ESOL group. The ESOL student predictor was negatively correlated with the non-ESOL group's outcome at all levels (between-district of all school levels, within-class high school and within-district middle school). Examination of the policy for teachers to become qualified to teach ESOL students suggested that having more teachers who are endorsed in teaching ESOL students would positively impact both the non-ESOL and ESOL groups' reading growth. Finally, the results of the study confirmed the urgent need for the development of high school ESOL students' academic literacy because the gap in reading outcomes between the elementary and high school ESOL groups was not

expected to narrow as fast as the gap in outcomes between the elementary and high school non-ESOL groups.

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Chapter One: Introduction

Statement of the Problem

English Language Learners (ESOLs) spend a great deal of time at school. According to the report from the Education Commission of the States (Bush, Ryan et al. 2011), students in grades 1st to 11th spend 186 days in school and receive 1116 hours of instructional time in Kansas. In particular, the School and Staffing Survey (SASS) reports that such students in 1st to 4th grades spend 66.7% of their instructional hours (21.8 hours out of 29.6 hours of school each week) on learning English, mathematics, social studies and science (Morton and Dalton 2007). At the elementary level, almost 74 percent of ESOL students' time at school is dominated by learning content knowledge and interacting with instructors in the classroom, a task made more challenging because English is the primary language being used at the classroom.

Indeed, Kansas is the state with the largest ESOL percentage-point increase in the country between 2002–03 and 2012–13 (Kena, Musu-Gillette et al. 2015). In 2002-2003 the number of ESOLs was 17,942 or 3.8% of the total student population whereas, in 2011-2012, the number of ESOLs had increased to 41,052 or 8.5% of the total student population. In other words, the overall number of students increased only 2 % while the population of ESOLs increased by 229%. Kansas City Kansas Public Schools (KCKPS), for example, the largest school district in Kansas situated within an urban setting, comprises 47 schools that serve 22,344 students. Among the students 39.9% are identified ESOL students which represents a 70% increase over the past ten years. This is significantly higher than the state-wide average (8.7%) and the national average (9.2%) (National Center for Educational Statistics).

In the past ESOLs used to be pulled out to work with teachers who were endorsed in teaching English to ESOLs. Given the rapid change of classroom demographics including ESOLs and students from backgrounds with diverse cultures, it has become necessary for teachers of all types of content knowledge to be trained to teach ESOLs their particular subject matter more effectively. In fact, compared to the fast increase in the numbers of ESOLs, the number of teachers endorsed in teaching students of other languages has not kept pace. Data collected from the Kansas State Department of Education (KSDE) shows that the percentage of teachers with ESOL endorsement has remained very low. For example, the data for the Topeka public school district (D0501) shows that while the percentage of ESOLs increased from 6.2% to 13.2% between 2010 and 2013, the percentage of teachers with ESOL endorsement increased only from 2.4% to 2.7%.

In an attempt to accommodate the needs of the rapidly growing ESOL student body, the Kansas City public school district (D0500) has focused on increasing the number of licensed teachers who hold a Kansas State Department of Education (KSDE) English to Speakers of Other Languages (ESOL) endorsement over the last few years. This was a desperate effort and by no means anything more than a quick fix. Indeed, in spite of the increased number of ESOL-endorsed teachers, the annual district assessment data still shows a significant outcome gap between non-ESOL students and ESOL students in the district. For instance, the average reading assessment outcomes of KCKPS (USD 500) over five years (from 2009 to 2013) between non-ESOLs and ESOLs are 70.02 and 67.63 whereas those of Lawrence public schools (USD 497) are 83.07 and 77.02.

Providing substantive professional development opportunities for teachers of all content areas is crucial. Through these opportunities, educators, administrators and pre-service and in-

service teachers have full insight into how ESOL students' learning environments— including the proportion of teachers with ESOL certification and variations of ESOL student populations— has changed in recent years. According to the report of the Pew Hispanic Center, Fry (2008) reports that a recent analysis of standardized testing from data around the country evidenced that English Language Learners are the group who lag farthest behind (Fry 2008). Abedi and Dietel (2004) analyzed several states' assessment data and found that ESOL students' reading performance oftentimes is 20 to 30 percentage points lower than non-ESOLs. For example, the results of the 10th grade English language arts assessment in Massachusetts in 2003 showed that the gap between ESOLs and non-ESOLs overall had increased to 49 percentage point: 61% of non-ESOLs reached the level of proficient and above statewide standards whereas only 12% of ESOLs reached those levels (Abedi and Dietal 2004).

This study was designed to focus on students' reading achievement in Kansas public schools. The study examined whether the reading outcome gap between non-ESOL students and ESOL students became narrower or broader across the five years of data collected. The study examined class-level reading assessment outcomes using the multilevel longitudinal model. By using a multilevel model of growth, it was possible to examine the effect of reading outcomes on school and districts levels separately. The study also examined the effects of predictors−the annual percentage of ESOL endorsed teachers and the annual percentage of ESOL students−on students' reading outcome. Lastly, the study examined the trend of the outcome gap between non-ESOLs and ESOLs across five years. In addition, analyzing the outcome gap data by different school levels (elementary, middle, and high schools) allowed me to examine whether elementary or secondary schools are in a more critical situation with regard to reducing the gap in reading between non-ESOL and ESOL groups.

Purpose of the Study

This study has multiple purposes. The first is to examine the longitudinal relationship of the reading outcomes between the group who receives ESOL services and the group who does not receive ESOL services and whether it differs significantly between schools and districts or not. Second, this study seeks to determine if the outcome gap between the non-ESOL and ESOL groups differs across elementary, middle, and high schools. Its third purpose is to see if the gap in reading outcomes between the non-ESOLs and ESOLs groups changed significantly over the five years of the study after being moderated by the annual percentage of ESOL endorsed teachers and the annual percentage of ESOL students at a school.

Significance of the Study

In the current educational climate of increasing demand for professional teacher training of instructors teaching English language learners, results of the current study may be of significant interest to parents, teachers, policy makers, and school administrators, including school districts that are considering changes to raise the standard of reading outcome for English Language Learners. This study attempts to determine whether ESOL teacher training and an increase of ESOL students in Kansas impact the non-ESOL and ESOL students' reading outcome significantly or whether they do not. By examining the trend in the outcome gap between non-ESOLs and ESOLs, this study may provide direction regarding the way to focus teacher professional training for ESOL endorsement.

Research Questions

The researcher asked the following questions in an attempt to better understand the reading outcome gap between ESOLs and non-ESOLs in Kansas public schools and the

relationships between teachers with ESOL endorsement and students' reading outcomes. The questions are as follows:

1. How much of the total reading achievement outcome variance depends on classes, schools and districts?
2. What is the overall pattern of the gap in reading achievement from 2009 to 2013 between non-ESOL students and ESOL students as nested in schools and districts?
3. How is the gap between the non-ESOL and ESOL groups' reading achievement across five years moderated by school levels (elementary, middle, and high-school)?
4. How is the gap between the non-ESOL group's and the ESOL group's reading outcomes moderated by the percentage of highly qualified ESOL teachers and ESOL students in each class?

Hypothesis

1. The gap in reading outcomes between the non-ESOL and ESOL groups is significant and has changed significantly over time.
2. The reading outcomes of each group are more similar if it is nested within the same school and district as opposed to the reading outcomes of that group in different schools and districts.
3. The reading outcome gap between the non-ESOL and ESOL groups is significantly different and has changed significantly depending on school levels (elementary, middle, and high school) across five years.

4. The reading outcome of the non-ESOL and ESOL groups is positively moderated by the percentage of ESOL endorsed teachers and negatively moderated by the percentage of ESOL students at each school level.

Limitations

Several problems and limitations have been associated with this study. First, one of the biggest shortcomings of the study was the group level data collection and its analysis. Even if analyzing the state-wide data using class-level average reading outcomes allowed me to provide valuable understanding of the gap between two group's reading achievement, the estimate based on the average scores of a group may be over- or under-estimating the gap between two groups' outcomes. Due to FERPA(Family Educational Rights and Privacy Act) limitations, data available for the current study included only class level information.

Second, the scores of the Kansas English Language Proficiency Assessment have not been included in this study. Some research found that information concerning student language proficiency levels did not help teachers effectively in identifying student's individual language strengths and weaknesses (Edvantia 2007). Abedi and Dietel (2004) found that there is not a significant relationship between ESOL classification codes and ESOL scores on both language proficiency tests and outcome tests (Abedi and Dietal 2004). In order to assess all areas of ESOLs English proficiency levels more accurately, the KSDE (Kansas State Department of Education) will launch a new digitalized assessment system, the English Language Proficiency Assessment for the 21st Century (ELPA21) beginning in 2016. Therefore, a follow-up study using the new database of ESOL students who are taking ELPA21 would be more accurate in examining the reading outcome gap between the non-ESOL and ESOL groups.

Third, no doubt many other plausible variables could help explain variations in students' reading outcome levels besides the one of teacher professional development. For example, information on whether students receive free or reduced cost lunches, how many years of teaching experience the teachers have, the principles' and teachers' perceptions of teaching ESOLs, and the socio-economic status of the school could be critical variables in explaining the reading outcome gap between non-ESOLs and ESOL.

Definition of Terms

AMOOs = Annual Measurable Outcome Objectives

FERFA = Family Educational Rights and Privacy Act

ESOL = English Language Learner. A student age 3-21 not proficient in spoken and/or written English, as determined by an English language proficiency assessment.

ELD = English Language Development

ESL/ESOL = English as a Second Language/ English for Speakers of Other Languages.

ELPA 21 = English Language Proficiency Assessment for the 21st Century.

ICC = Intraclass Correlation Coefficient

KELPA = Kansas English Language Proficiency Assessment

KSDE = Kansas State Department of Education

LEP = Limited English Proficiency

NCLB ACT = No Child Left Behind Act

Chapter Summary

This chapter clarified why the present study was undertaken. The rapid increase of ESOLs in both primary and secondary schools directed the researcher's attention to investigate how the non-ESOL group's and ESOL group's reading outcome gap had changed over the time of study. In addition, the importance of teacher preparation to teach subject contents to ESOL students was emphasized because research has demonstrated the effectiveness of ESOLs learning in the mainstream classroom with classmates who speak English as their primary language. Yet most teachers have not been trained properly regarding how to work with ESOLs and have limited knowledge about second language acquisition, the exception being the small number of teachers who were endorsed in teaching English to students of other languages. This study was conducted to see how the trend of the reading outcome gap between the non-ESOL and ESOL groups have changed over the five years of data collected and how the percentage of ESOL endorsed teachers influenced the non-ESOL and ESOL group outcome.

In Chapter 2: Review of the Literature, I take a closer look at what is currently known about the reading outcome gap between non-ESOL and ESOL groups, assess the effectiveness of teacher professional training, and review the literature as it relates to this study. Chapter 3: Methods describes the study's design and data analysis. Results of the models for the study are summarized in Chapter 4: Results, and Chapter 5: Conclusions offers a discussion of the findings and limitations of the study along with providing directions for future research.

Chapter Two: Review of the Literature

This chapter reviews the current literature on the reading development of English language learners. It begins with an overview of research exploring general misconceptions about second language acquisition, then discusses research on the reading outcome gap between non-ESOL and ESOL groups. It also continues to discuss special instructional strategies focused on ESOLs and assessment issues, legal and legislative mandates concerning language education policy in the U.S. and in Kansas, and finally teacher professional training to teach ESOLs, including discussion of long-term English language learners.

From a sociocultural perspective, learning and teaching are viewed as meanings and understandings which are not constructed individually, but rather as students, teachers, and peers engage in specific, situated social interactions, predominantly in the classroom. English language learners' successful language and literacy development is enhanced when curriculum and instruction are designed to create a learning environment in the classroom facilitated without any disjuncture between policy makers' anticipations and ESOLs' current learning circumstances. Hawkins (2004) presents seven guiding concepts which give a better understanding of learners' language and literacy development and its processes (Hawkins 2004). Among Hawkins' seven core concepts, viewing learning as an ongoing process of co-constructing meanings and understanding through interaction is first and foremost. It views the classroom as an environment that promotes interactions where knowledge is constructed through negotiations during diverse activities and practices between teachers and students. Such negotiated learning processes help ESOLs become fully participating members of communities rather than peripheral participants as newcomers or non-mainstream learners.

Five Misconceptions about Second Language Learning

Even though there are many possible advantages to U.S. schools where students could bring their diverse cultures and languages, teachers and administrators have struggled to match their expectations of students learning a second language with the actual outcomes of reading achievement. These difficulties come partially from misconceptions regarding the process of children's or adolescents' second language acquisition. Teachers and administrators often make mistakes in teaching ESOLs content knowledge as English language. McLaughlin (1992) attempted to clarify the most important issues that people misunderstand in regard to second language learning. These include the assertion that children can learn the second language with ease and quickly (e.g. Lennenberg, 1967); the belief that the younger children learn a second language, the better their acquired language skills will be (only pronunciation has research-based validity in this regard); the belief that time on task in a second language setting leads to better learning of the target language (a misconception which leads to putting ESOLs into English immersion classes before they are ready); the assumption that once children speak the second language comfortably, they are in full control of the language; and, finally, the belief that all students learn a language in the same way (McLauglin 1992).

The critical period hypothesis has been questioned by many researchers and remains controversial. The argument that children's brain flexibility allows them to learn a foreign language faster than adolescents or adults has been challenged by research under controlled conditions. Researchers argued that psychological and social factors are reflected more accurately in acquiring a second language than are biological factors that people believe to be most effective in learning a foreign language (Genesee 1981, Harley 1989, Newport 1990, Cited in McLaugln 1992). The assumption that children will learn the second language quickly and

that discomfort or difficulty in learning the second language will pass quickly has not been proven by comprehensive research (Snow and Hoefnagel-Höhle 1978).

A second misconception concerns the optimal time to start learning a foreign language. Certainly, it is ideal that a child begins to learn the second language from birth and learns both his native language and the second language simultaneously. However, in most cases a second language learner starts learning the second language only after becoming fluent in speaking and listening to a first language in addition to developing reading and writing skills. The question then arises: When is the optimal time for learning a second language? This question is related to Cummin (1979, 1981a)'s notion of the differing development of Basic Interpersonal Communicative Skills (BICS) and Cognitive Reading Language Proficiency (CALP) in second language learners. In order to learn a foreign language for the purpose of interpersonal communication, there is convincing evidence that the earlier children begin to learn a second language, the better they will speak it (e.g., Krashen, Long, & Scarca, 1979). However, with regard to school settings, the research literature does not support such a supposition (Stem, Burstall & Harley 1975, Buehler 1972, Genesee 1981 Cited in McLaugln 1992). It may be that these findings are in the context of a formal classroom setting where students learn a foreign language with emphasis on grammatical analysis. Research on the same topic in U.S. school settings is rare and more needs to be done.

Considering younger learners' cognitive and experiential limitations, they are at a disadvantage in regard to how quickly they learn vocabulary, reading, and writing skills in the second language when compared to older learners with more background knowledge and experience in learning. Although the learner's development of interpersonal communication language skills and cognitive language proficient skills cannot be discussed separately,

instruction of children with limited English proficiency in the classroom involves a careful and special consideration as opposed to other learning environments. Learning a second language while simultaneously focusing on content area learning requires teachers and school administrators to consider different factors in order to support students' learning (e.g. by supporting the use of the first language). Early and more intense exposure to second language speaking does not in itself predict language acquisition.

The third misconception about second language learning is the belief that the most effective instructional strategy is to create a structured, immersed environment where English learners can receive all of their instructions in English with the additional support of classes involving English language learning. The rationale behind such measures as time on task strategy is that the more students are exposed to the target language speaking environment, the better they will acquire both language and content knowledge. The research, however, shows that children in bilingual classes, where there is exposure to both the home language and to English, have achieved language skills equivalent to those of children who have been in English- immersion programs (Cummins 1981, Ramirez, Yuen, & Ramey, 1991 cited in McLaugln 1992). The conclusions of this research should caution educators against withdrawing the support of a child's home language too soon. In fact, the use of home language enables students to participate in classroom activities more actively and to reinforce the bond between the home and the school. The support of the home language is not a matter of whether to allow students to use their first language or not; rather, it is a matter of how that first language can be used as an instructional strategy (Genesee, 1987 cited inMcLaugln 1992).

A fourth misconception about English language learning is that once English learners converse in English comfortably, they are considered to be in full control of the language. In

fact, teachers need to understand the complicated process of language learning. Researchers argue that learners need more time and additional efforts to be proficient in reading and writing language skills as opposed to being proficient in oral language skills. Many of the problems that long term English language learners have do not surface until the middle and high-school years where high levels of reading and writing language skills are required. Their linguistic need to learn a higher level of vocabulary and acquire syntactic knowledge for the future was ignored when they were able to communicate fluently in English at the elementary level (Menken and Kleyn 2010). Based on their oral communication skills, they were regarded as proficient and exited into all-English classrooms. Teachers and educators need to be cautious in assessing English learners' proficiency levels with well- prepared assessment instruments which tap not only oral communication skills but all language skills. Issues concerning long-term English language learners will be discussed in more detail later.

The fifth and final misconception involves the multiplicity of learning styles in students from different cultures and social classes. If a teacher grew up in a mono-cultural family and community, it might be challenging to understand students from different cultural backgrounds. In addition, students from different cultures have different learning attitudes ranging from quiet and shy (but active) listeners to those who are highly sociable but have low motivation. Teachers need to be aware of not only students' language proficiency but also of their learning styles arising from cultural and family background information (e.g. cognitive and social norms that differ from those of the mainstream classroom). If the school environment is different from the reading and social norms and expectations students are accustomed to, then students who are from linguistic minority communities are likely to struggle more in adopting school culture than mainstream students will. With an awareness of students' differences, many aspects of teachers'

instruction can be combined with effective instructional strategies without lowering expectations for reading outcomes. This, in turn, will lead English learners to succeed in school activities. Effective instruction for students from culturally diverse backgrounds coincides with the strategies that SDAIE introduces. Teacher professional training and SDAIE strategies will be discussed shortly.

Research on the Academic Achievement Gap between Non-ESOLs and ESOLs

Overcoming the academic achievement gap between the non-ESOL and ESOL groups has been a significant challenge to educators over the last decades. According to the U.S. Department of Education, ESOL student enrollment is expected to reach nearly 25 percent of the population in the U.S. public schools by 2015. The percentage of ESOLs in Kansas public schools alone increased from 3.8 percent to 8.5 percent between 2004 and 2012. While the total number of students enrolled in public schools increased by only 12,460 (a 2.7% increase), the number of ESOL students increased by 16,118 (a 68% increase). In fact, as Table 2.1 shows, the number of students who are not ESOLs actually decreased by 3,658 in 2012 (KSDE 2014). The changes of student numbers and percentages in the Kansas public schools from 2004 to 2012 are shown in Table 2.1.

Table 2.1.

Changes of Student Numbers and Percentage in Kansas Schools

	2003-2004		2011-2012		Change of Number
	Number	Percentage	Number	Percentage	
Non-ESOLs	441,662	94.90	438,004	89.70	-3,658
ESOLs	23,735	5.10	39,853	10.30	16,118
Total	465,397	100.00	477,857	100.00	12,460

Historically, the reading performance of ESOLs has been lower than that of non-ESOLs, and the outcome gap has hardly narrowed over the past years. The data from the National Assessment of Educational Progress (NAEP) demonstrates that there are consistent and significant gaps in both reading and math across grade levels (Edvantia 2007). Many studies using nationally representative assessment data confirm a large outcome gap between ESOL and non-ESOL students in all subject areas (O'Conner, Abedi et al. 2012). Abedi and Dietel (2004) analyzed several states' assessment data and found that ESOL students' reading performance oftentimes is 20 to 30 percentage points lower than non-ESOLs. For example, the results of the 10th grade English language arts assessment in Massachusetts in 2003 showed that the gap between ESOLs and non-ESOLs overall had increased to 49 percentage points: 61% of non-ESOLs reached the level of proficient and above in statewide standards whereas only 12% of ESOLs reached those levels (Abedi and Dietal 2004). In Kansas public schools, little research has been conducted to investigate the outcome gap between non-ESOL and ESOL groups using statewide assessment data. This study was conducted for the purpose of examining the outcome gap between ESOL and non-ESOL groups using the reading assessment data from 2009 to 2013.

The No Child Left Behind Act of 2001 has emphasized the importance of accountability for reading outcomes among ESOL students. NCLB established the high expectation that all ESOL students seek to reduce the outcome gap between ESOL and non-ESOL groups and continue progress to reach proficiency in English language arts and mathematics. English language learners as a subgroup confront more challenges than other groups: differences in cultural background, less experience in taking standardized tests in English, and frequent changes of eligibility for services within the ESOL group (Abedi and Dietal 2004). Therefore, more attention has been directed to the need of ESOL students to "perform well on reading measures" instead of helping them "learn English" because recent research has identified proficiency in reading language as a key to reading success.

Research on Reading Language Proficiency

According to Lindholm-Leary and Borsato (2006), reading outcome refers to those comprehensive skills and competencies gained through learning content knowledge that enable students to be successful in school and society (Genesee, Lindholm-Leary et al. 2006). Gottlieb (2006) defines reading language proficiency as the language patterns and concepts needed in order to process, understand, and communicate curriculum-based content. Reading language proficiency stimulates reading outcome both by developing vocabulary and by acquiring both linguistic complexity and linguistic knowledge (Gottlieb 2006). Francis and his team (2006) emphasize the importance of reading proficiency in learning mathematics from kindergarten to college. For instance, mastery of math concepts presupposes mastery of the reading language of mathematics in order to characterize, express, and apply concepts. This includes an understanding of American culture plus reading comprehensive skills in order to solve word

problems. If ESOL students fail to understand the abstract and advanced language used in the math classroom, achieving high performance in math becomes harder (Francis, Rivera et al. 2006).

The report conducted by the National Literacy Panel on Language-Minority Children and Youth indicated that a large portion of the research regarding English Language Learners' performance focused on reaching English language proficiency. Research on mastery of reading content is still limited (August & Shanahan, 2006, cited in Edvantia 2007). In particular, there is little research on how to make the instruction of math and science more accessible and meaningful to ESOLs in areas considered challenging by native English speakers (Genesee, Lindholm-Leary et al. 2006). Research focused on reading performance among ESOLs as opposed to that focused on basic language proficiency has sparked an interest by educators and school administrators in research on reading English and content mastery (i.e. the ability to understand and perform reading English as well as the ability to demonstrate mastery of content knowledge on reading measures) (Edvantia 2007). Researchers at Edvantia, who participated in a research review regarding preparing ESOLs for reading success, claimed that helping individual ESOLs master reading language is a long-term process with multiple goals. It is not simply a language program with only a set of language proficiency objectives. (Edvantia 2007).

School and Classroom Effectiveness

Local education agencies (for example, school districts) need to be examined regarding what they are doing to improve reading performance for ESOLs even though many factors (e.g. families' values, priorities, and socio-economic status) lie outside the environment of a school and a district. For example, the Center for Public Education (2007) reports that state content

standards may not emphasize ESOL's outcome of reading language equally across all subject areas (Edvantia 2007). Bailey et al (2005) found that fifth grade English Language Development (ELD) standards and science standards in California demonstrate a high degree of connection, but the same is not true of vocabulary requirements, meaning that the ELD standard does not require vocabulary acquisition for the sciences (Bailey, Butler, & Sato, 2005 cited in Edvantia 2007). Having a lower standard for subject content areas for ESOL students at the elementary school level would lead to the low academic achievement the long-term English language learners confront in high schools a few years later (Menken and Kleyn 2010).

The National Research Council, according to 1997 reports, identified 13 attributes of effective schools and classrooms that benefit ESOLs' reading success (August and Hakuta 1997). Among these, four attributes are related to school leadership and the learning environment. According to August and Hakuta, these attributes include "a supportive but challenging school- wide climate, strong instructional leadership at the school level, a learning environment customized to meet the identified instructional needs of students, articulation and coordination that balances basic and higher order skills" (August and Hakuta 1997). Research suggests that a systematic approach to school improvement is particularly beneficial to ESOLs (August and Shanahan, 2006). In a report that examines the issues of adolescent ESOL literacy and recommends ways to improve ESOL adolescents' reading literacy, Short and Fitzsimons (2007) strongly suggest that school administrators support a school-wide commitment to ESOL outcome by providing high-quality staff development and opportunities for collaboration among subject content teachers, teachers of English to Speakers of Other Languages, and other specialized teachers (Neugebauer 2008).

Implementing appropriate instruction for ESOLs involves many factors depending on the ESOL population size and the amount of resources a school has. The data of 2012/13 collected by the School and Staffing Survey found that 70 % of elementary schools in the U.S. have approximately 10 % ESOLs in their schools (NCES 2013). One of the variables involves structural differences between available resources and ESOL population at schools because each school district has different sizes and characteristics regarding their ESOL population along with various or limited resources. Examining the students who took the annual Kansas state assessment in 2012, it is true that the percentage of ESOL students varies depending on the district. Some schools in the same districts have more than 10 percent ESOLs. Some, in fact, have more than 50 percent ESOLs. The Kansas school data demonstrates that the population of ESOLs concentrates in a certain district so ESOL students in the schools where the ESOL population is low tend to receive more limited ESOL service due to a lack of resources.

While schools with a large number of newly arrived immigrants need to address the increased demand for transitional programs and services (Olsen, 2006), schools which serve an ESOL population that speaks the same first language also need to take special care to increase these students' opportunities to acquire reading English. Research has found that the school level homogeneity of California students' first language was negatively correlated to a school rate of reclassifying ESOLs as proficient in English (Jepsen and Alth 2005). One of the speculations about the research outcomes is that such students might be less motivated or have less opportunities to achieve reading English proficiency.

In fact, teachers are the ones who make daily decisions about instruction that affects educational outcomes for their students. Nationwide, Kindler reported that there was on average one certified English as a Second Language teacher for every 44 students in 2000, but that ratio

varies by state, ranging from one teacher for every 9 students to one teacher for every 688 students (Kindle 2002). The need for teacher professional development to achieve the educational goals of ESOLs is complicated and seemingly never-ending. As mentioned above, teachers in content subjects need to understand the importance of increasing ESOLs' opportunities to learn reading English. Furthermore, teachers need the ability to differentiate reading instruction in order to promote the success of ESOLs. Aguirre-Munoz and colleagues (2006) found that ESOLs who received more explicit instruction in the "functional grammar" of reading English outperformed students who did not. In other words, in their quasi-experimental study, students who have teachers with specific training, such as giving direct instruction in reading English, achieved higher scores on the Language Arts Performance Assignment than students who did not. (Aguirre-Muñoz, Boscardin et al. 2006). A more detailed discussion of differentiated instruction for English Language Learners follows.

Specially Designed Reading Instruction in English (SDAIE)

In response to changing U.S. demographics and the challenge of educating ESOLs more efficiently in content area knowledge, Specially Designed Reading Instruction in English (SDAIE) has been introduced as an effective instructional process. It includes teaching content knowledge and English language proficiency simultaneously to a class where non-ESOLs and ESOLs learn together. It also provides an opportunity to develop innovative practices for incorporating ESOLs in mainstream classrooms. These practices originated from a transitional instructional approach used to help ESOLs who have reached the intermediate level of English proficiency move to English-only instruction. The explosive increase in the number of ESOLs in schools necessitates having teachers who are not specialized in teaching ESOLs gain the ability

to incorporate SDAIE strategies into their repertoire of instructional approaches (Cline and Necochea 2003).

SDAIE and second language teaching. Research supports the premise that second language learning and reading knowledge development takes place most efficiently when teachers provide meaningful context and communicative activities through repeated instruction and peer group interaction (Nation & Newton, 1997; Oller, 1983 as cited in Mora 2006). Communicative language teaching (CLT) and content-based instruction (CBI) are the two major approaches for teaching ESOLs in the mainstream classroom where SDAIE is adopted. Krashen and Tarrell claim that language is best learned when it is used for meaningful communication in a specific context of authentic purpose (Krashen and Terrell 1983). The core principle of this approach is that when the teacher and other native speaking students model oral skills along with other reading and writing skills as part of authentic language-learning activities, second language learning occurs most efficiently.

Content-based instruction (CBI) as an approach to second language teaching arises logically from the theoretical base of the communicative language teaching (CLT) approach. The basic assumption underlying CBI is that, in many reading contexts, the content of instruction is not the language itself; rather, the content is derived from the subject matter of the school curriculum. This is the situation for the majority of ESOLs who are required to learn English as they are also being taught content subjects and expected to meet grade-level content standards (Gibbons, 2003 as cited in Mora 2006).

SDAIE and development of second language learning. Research in second language literacy argues that students who are learning to read in a language in which they are not yet proficient face a number of challenges that native speakers do not. ESOL students follow a

different progression through the component skills of language learning. Cummins claims that although ESOL students make rapid gains in listening and speaking abilities, they might lag in their development of reading and writing proficiency as compared to their native English-speaking peers (Shoebottom 2013).

Hakuta, Butler and Witt (2000) analyzed data from two school districts in California which were regarded as teaching Limited English Proficiency (LEP) students most successfully and reported that oral language proficiency takes three to five years to develop whereas reading language proficiency can take four to seven years (Hakuta, Butler et al. 2000). The required language skills necessary to perform school tasks, such as those in language arts and other content subjects, are a more abstract and complex type of language which takes more time to acquire than basic interpersonal communication skills (Cummin, 2000 as cited in Short, Vogt et al. 2008). Language, as a medium of communication, is essential for learning activities. By emphasizing the learning of content subjects, students can apply the language they have learned to authentic content. Chamot and O'Malley claim that optimal language learning, just like learning other subjects, occurs when language learners know how to use it rather than just gaining information about it (Chamot and O'Malley 1996).

Features and challenges of SDAIE methodology. Since the demographic of students in U.S schools is rapidly changing and the population of students whose first language is not English is growing fast, instructional programs based on the assumption that students come to school with the same cultural linguistic background and have the same reading preparation no longer meet the needs of today's students. For a long time, schools in the U.S. have focused on designing ways to educate students whose first language is English. Students who came to school from different home languages were expected to understand the regular English curriculum at the

same pace and with the same ease as the native speakers of English (Genzuk, 1988, as cited in Genzuk 2011). Due to a lack of understanding of the role of language in learning as well as the language acquisition process, this "sink or swim" approach caused many minority students, parents, and educators to be frustrated and fail in both learning and teaching.

After experiencing difficulties in teaching students from culturally and linguistically diverse backgrounds who were in the same class with mainstream students, the English as a Second Language (ESL) program was introduced as a remedial curriculum (Genzuk 2011). Schools with ESL programs emphasized teaching English grammar, spelling, and pronunciation before allowing students to explore the reading curriculum. The goal of this program was to help students master the English language before learning more challenging reading curriculum. Unfortunately, ESL programs in secondary schools with a large number of students has not been helpful in enabling language minority students to graduate from high school or seek higher education (Genzuk 2011). Despite learning English for more than five years, many students are still not English proficient and face major reading deficits as they work to get a high school diploma. According to Olson (2010), the majority of secondary school English learners are this type of "long term English learners."

Olsen and Jaramillo (1999) and Y. Freeman et al (2002) put English Language Learners at the secondary level into three groups: newly arrived with adequate schooling; newly arrived with limited/interrupted formal schooling; and long term English language learners. Since more research has been focused on the first and second group of ESOLs, a long term ESOL group has not been a target for research until recent days. Long Term English Learners are defined as "English Learners who have been in United States schools for seven or more years, are orally fluent in English but have a low level of reading literacy in both English and their native

language (Freeman and Freeman 2002). According to the 2010 report about long term English Learners in California (Olsen 2010), 59 % of secondary school English Learners in 40 school districts are Long Term English Learners. Approximately 33% of ESOLs at the secondary schools in Chicago, 23% in Colorado and 75 % of all ESOLs are long term English learners (Menken, Kleyn et al. 2012).

Considering the research findings that five to ten years are necessary for ESOL students to reach English proficiency, long-term ESOL students have been considered "normal" for many years. However, research (i.e., Menken et al's research at the New York Public schools and Olsen's report about long term ESOLs in 40 school districts in California) found that there are several factors which contribute to becoming a Long Term English Learner (Olsen 2010, Menken, Kleyn et al. 2012). These factors include receiving inconsistent language development programs; dealing with inconsistent school-based language policies; and attending multiple schools in and outside of the U.S (Menken, Kleyn et al. 2012). Through receiving many years of inefficient ESOL services, these students have developed habits of non-engagement, passive learning, and invisibility in school. Olsen's report (2010) found that few districts have programs designed for these long-term English learners in secondary schools. Instead, the typical ESOL programs can be characterized by inappropriate placement in mainstream classes; being placed and kept in classes with newcomer English Learners; being taught by largely unprepared teachers; being overassigned and inadequately served in intervention and support classes; and having limited access to the full curriculum. Olsen's report (2010) and Menken et al's research (2012) recommends that a high school with high percentage of long term ESOLs should be prepared to teach literacy in explicit ways. That is, reading language and literacy instruction must be infused into all subject areas, including math, science, and social science in addition to

English. Menken et al's research implemented biliteracy development programs in English and Spanish and focused on implementation of explicit reading language and literacy instruction across all subject areas. It found such programs promising in meeting the reading and linguistic needs of long term ESOLs (Menken, Kleyn et al. 2012). This comprehensive instructional program matches well with the objectives for which the SDAIE strategy aims.

Whether Long Term English Learners are placed in mainstream classes or in designated English Learner SDAIE content classes, often they are taught by teachers without the preparation, support, or strategies necessary to address their needs. Secondary teachers are generally not prepared to teach reading and writing skills. They do not have training in language development. Their focus has been on the reading content to be taught in the class. They are challenged by how to teach grade-level, advanced secondary school reading content to students without the English foundational or literacy skills needed to access that content. Few teachers feel that they have the tools, skills or preparation to meet the needs of their English Learner students – and, few have received professional development to do so (Gándara, Maxwell-Jolly et al. 2005). This is made even more problematic because these classes are disproportionately assigned to the least prepared teachers in the school. In too many settings, as teachers become more veteran, they earn the right to "move up" to the honors classes (Dabach 2009).

Issues of assessing English language learners in the mainstream classroom. English Language Learners participate in a variety of language and subject area assessments. According to the No Child Left Behind Act (NCLB 2001), ESOL students who have been in U.S. schools for more than 12 months and who are in grades 3-8 must take the annual reading/ language arts assessment to show their yearly progress and attainment of reading and language arts (Garcia and DeNicolo 2009). The majority of these types of assessments are part of a wide-scale assessment

in which tests are administered to large groups of students and do not allow any variation in the individual test's format or the administrative and scoring procedures (Garcia and DeNicolo 2009).

Teachers who actually teach and assess ESOL students' development face many challenges. One of most commonly cited ones is related to the textbooks with many teachers singling out the lack of texts prepared for ESOLs or the lack of supplemental resources to use with the textbooks. When ESOLs use the same textbooks as English speaking students, it is challenging for students who have to deal with both unfamiliar language and content. When ESOL students are not provided textbooks with proper language development and assessment materials, those students are in trouble when they take an exam for subject matter they are supposed to have mastered. Gandara et al (2005) noted that assessment materials are ideally considered as teaching tools. Therefore, the lack of appropriate instructional and assessment materials for determining ESOLs' understanding of reading subjects would put both ESOLs and teachers in a bind.

The importance of appropriately assessing ESOL students' performance is normally acknowledged when ESOL students are misdiagnosed and placed into a classroom where the content or the English language curriculum is too difficult or too easy for them. One of the teachers in the Gandara (2005) research focus group mentioned the importance of diagnostic testing for ESOLs. She said, *"It would be really helpful for brand-new students to our district (that) we have some kind of preliminary assessment to give us some real information about whether this child is really below grade level, on grade level, anywhere – that could be used to get them into intervention early in the year* (Gandara, Maxwell-Jolly et al. 2005)." Other teachers in the focus group mentioned that the state language development test, which is used to assess

the English language proficiency of all ESOL students, sometimes does not provide teachers a great deal of useful information of a diagnostic nature, a problem compounded by a reporting timeline that does not allow teachers to plan effectively for instruction.

The next common issue of assessing ESOLs is one related to face validity. Face validity (in other words, fairness) refers to "the degree to which a test looks right, and appears to measure the knowledge or abilities it claims to measure, based on the subjective judgment of the examinees who take it" (Brown and Abeywickrama 2010). Oftentimes the current state testing system uses instruments that cannot adequately assess ESOL students' reading outcome. ESOL students are only tested as to whether they understand the language of the test or not; thus, it is often impossible to know if students' low scores are due to language problems, to lack of reading skill, or to the fact that they failed to understand the questions correctly due to the cultural differences (Gandara, Maxwell-Jolly et al. 2005).

Implications of assessing English language learners. According to Rivera and her colleagues (Garcia and DeNicolo 2009), "testing accommodations involve changes to a test or to its testing context that do not make the test context or construct invalid." Testing accommodations are supposed to provide ESOLs with help only in processing the language of the test; they cannot provide help on the test's content. The majority of accommodation types include the following: simplification of linguistic structure, dictionaries (lists of definitions about non-content words in English or in the native language), bilingual glossaries, dual-language tests, oral reading of the instructions or test items in English or in the native language, allowing students to take an exam in their native language, and allowing students additional time to take the test (Garcia and DeNicolo 2009).

The NCLB Act (2002) allows ESOL students to take a test in language arts and reading with reasonable accommodations including assessment in the native language. Providing ESOL students with instructions in their native languages or with glossaries or dictionaries for unknown vocabularies will certainly help. These types of accommodations match well with SDAIE strategies particularly in promoting the use of students' primary language. Teachers and administrators need to acknowledge that the standards should be based on the instruction and performance of native English-speaking students. Such wide scale assessments, however, do not tell teachers how to teach the materials in a way comprehensible for ESOL students. Because these tests cannot differentiate between students' developing proficiency in English and their reading performance, it is important for teachers and administrators to consider using other sources for assessment. Although NCLB (2002) requires states to use wide scale assessments in order to assess students' annual attainment of English, educators need to consider other types of assessment, such as parental reports, grades on assignments and in-class tests, anecdotal records, and language samples of students' reading and writing performance. Using such data in combination with students' test results will establish high validity in determining an ESOL student's language proficiency and content outcome.

English Language Learner Education Policies and Legal Mandates in U.S.

The year 2014 marked 60 years since the Brown *v.* Board of Education ruling struck down the racial segregation of public school students and 40 years since Lau v. Nichols which rejected the notion that merely providing students with the same facilities, textbooks, teachers, and curriculum provides equal educational opportunities for English speaking and non-English speaking students alike. Even though Lau v. Nicholas did not specify what types of ELD

program a school must offer, it is considered a landmark civil rights case that was initiated by Chinese-American students whose English proficiency was mostly limited. From the early 1950s to the 1970s, new discourses concerning language tolerance and language rights have emerged which led the U.S. Congress to endorse the Equal Educational Opportunity Act (EEOA) in 1974.

As implied in the EEOA of 1974, English language services for English language learners became more specific and practical due to the Florida Consent Decree (1990). This court decision required the Florida State Board of Education to identify and provide appropriate levels of services depending on students' English proficiency levels (Diaz-Rico 2012). The decree also required basic ESOL teachers or primary and secondary English and Language Arts instructors to obtain an ESOL endorsement.

There are various ways to obtain such an endorsement depending on states or districts. For example, the Florida Department of Education requires teachers to complete 300 in-service points or 15 college semester hours, and teachers of mathematics, social studies, science, computer literacy, administrators, and guidance counselors to take an ESOL endorsement course called Empowerment. In Kansas, on the other hand, in order to make it possible for more teachers to become ESOL endorsed, the Kansas State Department of Education (KSDE) offers two methods: taking ESOL courses plus taking the Educational Testing Service's PRAXIS II ESOL subject Exam©, or taking the PRAXIS II ESOL subject Exam© only. Teachers are strongly encouraged to take college coursework so they can acquire the knowledge, skills, and abilities required for the education of students who speak languages other than English. It would benefit teacher professional training for ESOL endorsement if further research was conducted regarding the relationship between the method by which ESOL teachers received ESOL endorsement and ESOL students' reading outcomes.

Under the No Child Left Behind Act of 2002, all ESOL students must be tested for English proficiency, and districts are held accountable for demonstrating "annual growth" in their ESOLs' English proficiency levels. In addition, all ESOLs must take all state assessments, and their scores count (Hawkins 2004). If a district does not make progress toward meeting the annual measurable outcome objectives (AMAOs) for two consecutive years, that district must submit an improvement plan to KSDE. If a district fails to meet the AMAOs for four consecutive years, KSDE must require that district "modify its curriculum, program, and method of instruction, or determine whether to continue to fund that district with Title III or replace relevant educational personnel (KSDE)." Due to the pressure on educators to be accountable for ESOLs attainment of English language proficiency, the enactment of NCLB is likely to promote English-only approaches (Hornberger 2006).

Part A of Title III funding of the No Child Left Behind Act (2002) is specifically targeted to benefit English language learners and immigrant youth. The Act (2002) states that the funding must be used for English language learners to attain not only English proficiency but simultaneously meet the same reading standards as their English-speaking peers in all content areas. First, the programs for ESOL students must be based on research demonstrating the effectiveness of the program in increasing English proficiency and student reading outcomes in the core reading subjects. Second, funds should be used to provide high-quality professional development to teachers, principals, administrators, and other school or community-based organizational personnel (NCLB 2002). As a condition of receiving Title III funds, states and districts should be accountable that English language learners are achieving heightened levels of English language proficiency and reading outcomes. After examining the size and nature of the ESOL population targeted by Title III and having defined annual performance goals, called

Annual Measurable Outcome Objectives (AMOOs), states and districts are mandated under Title III to report how they are implementing the programs with regard to these goals (Boyle, Taylor et al. 2010).

In Kansas schools, the Kansas State Department of Education (KSDE) provides various ESOL programs to ESOL service qualified students under Title III, NCLB Act (Hayes 2014). After completing the home language survey and an assessment of English proficiency, students who are qualified to receive ESOL services will be assigned to one of the ESOL programs: pull-out service; push-in service, where an ESOL teacher comes into the regular classroom to give language assistance to the English Learner; or bilingual, where instruction in the reading areas is provided in the ESOL's first language with the gradual introduction of English throughout the year. Usually the class is comprised of both ESOLs and non-ESOLs, and additional language support may or may not be given depending on the availability of a school's resources. When students' English proficiency level is low, students are pulled out of the regular classroom to focus on English language acquisition. This takes place in districts in which there are limited numbers of ESOL teachers, where there are many schools across the district, and usually in the elementary setting. Additional research is needed to find out what kinds of ESOL services are being provided to ESOLs and how these programs are being implemented. Throughout Kansas even schools in the same district provide different ESOL services due to limited resources or an increasing number of ESOL students.

Teacher Qualification for Teaching ESOLs in Kansas

Having a reasonable number of ESOL teachers per ESOL students is important, but not easy, for a small district which does not have many ESOL students. In middle and high school

classrooms, paraprofessionals assist ESOLs in the regular classroom or in an ESOL class period. Instructional support in an ESOLs' native language is given if the paraprofessional has language proficiency in the students' home language. Instruction is planned by an ESOL endorsed teacher, and an ESOL endorsed teacher and a para-educator work in close and frequent proximity. Even though paraprofessional help for ESOL students is available, having teachers with ESOL endorsement is of greater benefit to more ESOL students. In order for teachers to be endorsed in teaching ESOLs, taking ESOL courses is recommended in order to gain important and useful knowledge about second language acquisition as well as effective methods of instruction and assessment. However, teachers who pass the PRAXIS II ESOL Subject Exam© without taking ESOL endorsement courses are considered to be ESOL endorsed in Kansas.

According to *Highly Qualified Teacher Overview 2008-2009*, Part A, Title III of NCLB Act (2002) ensures that all K-12 students have teachers with subject matter knowledge and the teaching skills necessary to help all students achieve high reading standards regardless of their individual learning styles or needs (KSDE 2008). By the end of the 2006-2007 year, all public elementary and secondary teachers who teach core reading subjects should have been designated "highly qualified". Highly qualified requirements for *New* ESOL teachers include "1. Have a minimum of a bachelor's degree, 2. Hold a valid license to teach in Kansas. (The license must have the appropriate content and grade level endorsement for the teaching assignment.) 3. Have demonstrated subject-matter competency in each of the core reading subjects the teacher is assigned to teach by completion of the appropriate Praxis II licensure examination(s)" (KSDE 2008). Special education or ESOL teachers who provide "direct instruction" in English Language Arts, Science, Social Studies or Math have three different options available when demonstrating subject matter competency: "1. Appropriate content endorsement on teaching

licenses designated “HQ”, 2. Pass the appropriate content test (PRAXIS II), or 3. Document eleven or more checks on the Kansas HOUSSE document for special education and ESOL teachers” (KSDE 2008).

These regulations for ESOL teachers to be qualified to teach ESOLs in the core content areas (English language arts, science, social studies or math) focus more on ensuring that teachers must be highly qualified to teach content knowledge rather than highly qualified to teach ESOLs successfully in a classroom where ESOLs and non-ESOLs are learning together. Teaching ESOLs becomes more complicated because, from a quantitative perspective, the ESOL population is growing rapidly, and from a qualitative perspective, students who need to receive ESOL services bring diverse background information with them. While the requirement for teachers to be qualified to teach content subjects maintains high standards, the requirement for teachers to be ESOL endorsed seems to be very flexible.

The Roles of Schools and Districts in Helping ESOL Students Succeed in Schools

According to Olsen (2010)’s report which analyzed the responses of a survey of teachers at 40 districts in California, the role of the district is crucial in order to ensure high quality implementation of research-based programs for ESOL students. These roles of the district include clearly defined pathways and clear descriptions of program models in English Learner Master Plans including providing professional development for teachers and administrators and curriculum materials that facilitate differentiation for varying levels of needs (Olsen 2010).

First, language development does not occur only through an explicit Language Arts curriculum but also through the use of language as a vehicle for learning reading content and learning about the world. Providing appropriate curriculum materials and resources to ESOL

students is as important as training teachers to teach ESOLs. It seems like common sense that if students are not doing well in English, you should increase the time spent in teaching them English. In fact, more time does not translate to better outcomes, but the result of those beliefs has unintentionally resulted in a narrowing of curriculum options for students attending underperforming schools. Expanding the hours of the day spent on English language arts and math may results in reduced access to science, social studies, arts and music as well as less interaction with native English speakers in school activities. Where ESOL students are socially segregated or linguistically isolated, they are less motivated and received less effective language instruction.

Types of English language instruction for ESOL students. In 2004*, Listening to Teachers of English Language Learners*, A Survey of California Teachers' Challenges, Experiences, and Professional Development Needs was conducted with instructors who teach ESOL students in a variety of programs in twenty-two school districts in the state of California. Its aim was to discern what special skills and training teachers of English language learners needed (Gandara, Maxwell-Jolly et al. 2005). One of the survey's discoveries related to out of class and in-class assistance for English learners, showing that pull-out instruction was more prevalent among teachers in smaller districts and/or those with fewer ESOL students.

The survey found that pull-out instruction as a strategy for providing reading support was among the least successful strategies for teaching ESOLs. Reasons included students' lost opportunities to learn what their classmates are exposed to, inconsistencies in the instruction of pull-out assistance compared with what students who remain in the classroom are learning, and loss of time in transitions (Gandara, Maxwell-Jolly et al. 2005). These findings support use of the SDAIE methodology, particularly for ESOLs in secondary schools because the depth of content

knowledge becomes more complicated and abstract. Thus, receiving language and content instruction in the same classroom with the same teacher would result in more positive progress in terms of both language and content knowledge.

Challenges for teachers who teach ESOL students. In searching for the best quality instructional methodology for teaching ESOLs, most of the discussion has focused on the challenges ESOL students have in school. Yet it is also necessary to include in the discussion what kinds of challenges teachers are facing in their classroom. According to the findings of a survey conducted by four joint research institutes in California (Gandara, Maxwell-Jolly et al. 2005), the challenge most often cited by K-6 teachers centered on their struggles to communicate with students' families and communities due to their inability to speak the parents' language or the parents' inability to speak English. This difficulty in communication hindered teachers in helping students with doing homework and limited families' ability to support their children's education.

For secondary teachers, however, the most commonly mentioned challenge in teaching ESOL students was the language and cultural barrier and the difficulty of motivating students that followed. Secondary school teachers noted the difficulty of challenging their ESOLs to develop English language skills without discouraging them. In other words, it is difficult for teachers to help ESOLs feel comfortable in class while at the same time presenting challenging reading content appropriate to their English language skills.

The next most significant challenge teachers reported was insufficient time. Teachers are frustrated as much as students when they lack sufficient time to teach ESOL students both the regular curriculum and English language skills. Both elementary and secondary teachers need more time to observe and collaborate with other teachers and to make lesson plans. The fourth

most reported challenge, both elementary and secondary school teachers agreed, was that the wide range of English language and reading levels in their classrooms frustrated them. Since most state policy has changed to place the majority of ESOLs in mainstream classes rather than clustering ESOLs by language needs, such huge differences in students' reading and language levels can create daunting challenges for teachers who have never experienced this before. In order to support teachers properly who have such a wide range of students−not only those with different levels of English language skills but also mainstream students who have different reading needs in the same class−providing classroom teachers with appropriate resources by school becomes more vital as well as supplying appropriate teaching and instructional materials and instruments (Gandara, Maxwell-Jolly et al. 2005).

According to the National Literacy Panel on Language Minority Children and Youth, instructional strategies effective with native English speakers do not have as positive a learning impact on language minority students. The instructional strategies used to teach reading to native English-speaking students are not the same as the strategies which should be used to teach reading and writing in English to language minority students (August, Shanahan et al. 2009). Thus, the programs and approaches used in literacy intervention programs designed for native English speakers may help English Learners to some degree, but the gap in outcomes will continue to grow – and the specific needs of Long Term ESOL students will not be adequately addressed. State and school districts have a legal responsibility to ensure educational access through programs that speak to the needs of all English Learners by developing their proficiency to the level required for participation in an English-taught curriculum and providing access to the core curriculum (Olsen 2006).

Contributions of Current Study and Limitation of Research

Hawkins (2004) claims that every social interaction English Language Learners encounter in specific local contexts is always situated in larger social, institutional, and community contexts that have embedded ideologies, beliefs, and values which, in turn, are carried out and reproduced through unfolding social interactions. Learners whose identity or community background is different from the dominant society will attempt to conform to or resist following the mainstream norms, beliefs, and practices of the environment. Students who come from different cultural and linguistic backgrounds spend most of their time at schools with teachers and classmates who do not share that background.

I believe that most teachers do their best to meet the needs of all their students. However, the wide range of student language proficiencies and reading abilities often leaves teachers challenged and unprepared. The main focus of this literature review has been on three attributes of a classroom where ESOLs are present: theoretical and political background information regarding the English language development of ESOL students, current issues in the classroom where ESOLs learn with non-ESOLs, and issues related to teacher development programs for teaching ESOLs. It is reasonable to anticipate that teachers who know their students and are highly qualified in content knowledge will be successful in the classroom. Many researchers found, however, that the reading outcome gap between English Language Learners and non-English Language Learners has not changed for many years. Little research on public schools in Kansas has been conducted to examine the reading outcome gap between the non-ESOL and ESOL groups and what effect teacher's ESOL training and the increase of ESOL students in the classroom has on both group's academic achievement and the gap between them. In addition, research regarding ESOL students' learning consistently focuses on elementary schools, not middle or high schools. The emphasis of prior research on elementary schools is not surprising

considering the ease of acquiring information on students and teachers in the elementary schools as compared to gaining similar information concerning ESOL students and teachers at the middle and high school levels. Inconsistencies in the secondary grades' teaching structures could also be at play. For instance, the size of class and school, the funding of schools, and the departmentalized structure where students receive instruction vary. This research puts the data into three categories (elementary, middle, and high school) and tries to analyze the outcome gap between ESOLs and non-ESOLs at each level. However, this research could not use the individual data of students' reading scores. Also, this research only uses the data of percentage of teachers' ESOL endorsements and the percentage of ESOL students. Further research using more specific data−for example, which method a teacher used to become endorsed in ESOL teaching, years of teaching, types of ESOL services ESOL students received, a school or a district's annual budget, percentage of students who received free or reduced lunch program−would be worth examining to find out more about the gap between the non-ESOL and ESOL groups' reading achievement.

Chapter Three: Methods

The goal of this study is to examine the reading outcome gap between the group of students who do not receive ESOL services (non-ESOL) and the group of students who receive ESOL program services (ESOL), first overall and then more specifically by school levels. The effect of two time-varying predictors on groups' reading outcomes will be considered, and the effects of schools and districts where each group is clustered will be examined as well. The assessment and administrative data was collected by the Kansas State Department of Education (KSDE), and all analyses conducted using SAS 9.4 (SAS, 2014).

Sample

Five years of class-level reading outcomes and teacher administrative data were used for this study, from 2009 through 2013. A total of 289 districts and 5734 schools in the state of Kansas were included in the study. Private and specialized schools were not included. All records of the grades that students belonged to and teacher information used in the study were nested within school and district.

Two reading outcomes of a grade's reading assessment were used for the study: one outcome from students who are qualified to receive English for Students of Other Languages (ESOL) services and the other outcome from the students who do not receive ESOL services. Students in grades 3 through 11 take a state assessment test in reading in the spring semester. The study used each grade's average score from the reading assessment. The number of students at each grade in the school varied and the size of schools and districts varied as well. The study used percentages of students who took the test and received ESOL services and that of teachers who are highly qualified in teaching ESOL as predictors that might moderate the outcome

variable. The record of teachers who have either old (ESL: 0591) or new (ESOL: 70591) endorsement codes were included in the study. The old ESL endorsement was effective from 1971 to 2011. Since 2012, Kansas State Department of Education (KSDE) has adopted the new code number for teachers' ESOL endorsement subject number.

Data and Instrumentation

Data. The study used the school level data provided by the Kansas State Department of Education (KSDE). The data includes records of standardized test scores by grade, number of students who received ESOL services, and teacher endorsement records. Additional sources of data were provided by websites such as National Center for Education Statistics (NCES).

Students' assessment records. These records specified students aggregated scores by a grade and categorized by two outcomes: students who received English language service and those who did not. Even though ESOL service records are divided into more than three groups depending on the funding and the student's KELPA scores, the current study combined groups and used the average score. For the elementary school level, the average reading score of grades 3, 4, and 5 was used; for the middle school, the reading scores of grades 6, 7, and 8 were collected; and for the high school, the score of grade 11 was used. Since some schools are operated differently (particularly some middle schools), scores of grade 5 were included at the middle school level instead of the elementary school level.

Teachers' ESOL endorsement records. Information on individual teachers with a pseudo ID who are endorsed in teaching English Language Learners was provided by KSDE. Endorsement includes two subject codes: ESL and ESOL. The subject code ESL was effective from 1971 to 2009 and the code of ESOL has been effective since 2010. These ESOL subject

codes allowed me to estimate the percentage of teachers endorsed to teach ESOL and then to divide this by the total number of students who took the test each year. Because theoretical framework and instructional practice change over time, the profile of students in the classroom also changes. The information received regarding the number of teachers with ESOL endorsement tells only a quantitative aspect with limitations regarding the understanding of whether the teacher with ESOL endorsement teaches ESOL students more effectively or not.

School records. School records consist of district IDs, school IDs, and grades served at a school. In addition to these records, the number of students who took the test along with information on whether they received ESOL services or not are also included. Using this record, the percentage of ESOL students and the percentage of teachers with ESOL endorsement were calculated. For example, in order to find the percentage of teachers with ESOL endorsement at each grade, the number of ESOL endorsed teachers was divided by the total number of students who took the test. The percentage of ESOL students was calculated in the same manner by dividing the number of ESOL students by the total number of students who took the test. Appendix A describes all variables that were used for the study.

Instrumentation. The study utilizes administrative and assessment data to measure the relationship of reading assessment outcomes between non-ESOL students and ESOL students (multivariate dependent variables), teacher training (independent variable), and percentage of ESOL students (independent variables).

Measurement

Kansas state assessment. In spring semester students in Kansas public schools are required to take standardized tests over various subjects developed by Center for Educational

Testing and Evaluation at the University of Kansas. For this research reading test outcomes were selected. Reading test outcomes were measured on a scale from 0 to 100. The Kansas State Assessment, aligned to Kansas' schools' reading content standards, helps students, parents, educators and policymakers evaluate student learning and meet federal and state accountability requirements. The results of students' test scores can be used to identify whether a child or student reached the goal of learning or not and to compare that student's performance to other students in the school, district, and state (Interpretive Guide for Score Reports).

Reading outcomes. Annual state assessment test scores measuring students' reading performance were used. The tests were administered in the spring semester of each year to all students in grades 3 through 11 including ESOLs. This current study used the average scores of grades as the dependent variables. The research model was created to compare ESOL and non-ESOL groups' outcomes respectively by grade level, then to compare the outcome growth of the two groups by school types (elementary, middle, and high school). In order to capture students' performance growth, the scores of the test are scaled vertically; this allows students in higher grades to earn higher scores. The reading test scores have five waves of data from 2009 to 2013.

Teacher training data. In order to identify teachers highly qualified to teach ESOLs, the study used teacher records of ESL and ESOL endorsements. In the state of Kansas, endorsements are issued as part of the certification process to identify whether teachers are highly qualified in teaching certain content areas. ESL and ESOL endorsement identifies the teacher who has had adequate training in teaching ESOL. The subject code was changed from ESL to ESOL in 2010. Teachers can obtain the ESOL endorsement either by completing the appropriate college coursework prior to taking and passing the PRAXIS® test or just by passing the PRAXIS® (KSDE). The general coursework for ESOL endorsement includes Introduction to Linguistics,

Instructional Methods to teach ESOL, Assessment Tools and Consideration for ESOL, Multicultural Education, and ESOL practicum. Endorsement requirements are identical in every district, but the effective time period of ESL and ESOL endorsement is different. Endorsement for ESL (English as a second language) began 1971 and ended in 2009, and after that the subject name and code number was transferred to ESOL (Speakers of Other Languages) 70591. It would be meaningful to research how ESOL teacher training has changed from 10 or 15 years ago to the present time. The study's independent variable is the number of teachers with ESOL endorsement at a given school, which was calculated as a percentage by dividing by the total student number of students who took the test in each year as counted on the school records.

Student characteristics. School records were used to measure relevant student and school characteristics, such as the percentage of students receiving ESOL services and the percentage of teachers with ESOL certification. Due to the limited data I received, the data described above will be used as independent variables. All variables and their level of aggregation are described in Appendix A.

Validity and Reliability of the Dependent Variable

As it is developed as a standardized test, Kansas State Assessment is statistically processed to make sure the test is valid and reliable. It is the only statewide test administered at schools for the purpose of evaluating students' performances (i.e. what they have learned in the classroom as aligned with the reading content standards following KSDE's educational objectives). All schools administering the tests must follow specific procedures to ensure comparable measurements whenever students take the test. Kansas State Assessment also goes through a rigorous statistical procedure to ensure the reliability of the test. Test reliability

indicates the degree to which a test yields consistent results. If a student attempts the test a second time, the test results should be consistent within a certain probability of error. In order to be administered as a state assessment, it should be developed with a proper degree of test validity and reliability.

Sections 6 and 7 of the Technical Manual of Kansas Assessment 2006 provided the reliability and validity evidence for the Kansas General Assessment which is the data used for this research. In order to report the scores reliability, Cronbach alpha coefficients are used. The coefficient values range from a low of .88 to a high of .94 across all the Reading grade level forms. Section 7 of the Technical Manual discusses evidence for the validity of inferences from test scores. It consists of two parts: internal evidence for the validity and criterion-related evidence for the validity. The results of both analyses conducted by test developers at CETE provide evidence to support the validity of the 2006 Kansas assessment scores. The full report is available at the CETE website (Irwin, Poggio et al. 2007). Assuming the test materials have continued to be administered every year, the evidence of reliability and validity of test scores is effective for the test scores used in this research.

Table 3.1.

Kansas Assessment Performance Level Cut Score

Kansas Assessment Performance Level Cut-Scores					
General Reading Assessment (% correct)					
Grade	Reading Warning	Approaches Standard	Meets Standard	Exceeds Standards	Exemplary
3rd	0-54	55-66	67-79	80-88	89-100
4th	0-56	57-67	68-80	81-88	89-100
5th	0-56	57-67	68-79	80-87	88-100
6th	0-51	52-63	64-78	79-87	88-100
7th	0-49	50-62	63-76	77-86	87-100
8th	0-49	50-63	64-78	79-88	89-100
High school	0-53	54-67	68-80	81-88	89-100

Chapter Four: Results

This chapter describes the results of the data analysis. An overview of the research and the sample characteristics is provided first. The categorical predictor and two time-varying predictors are described next. The results section summarizes the findings of both the univariate and the multivariate, multilevel growth models in order to examine the longitudinal relationship between the non-ESOL group and ESOL group reading outcomes. The data analysis is organized according to a series of research questions along with the proposed models to answer the questions.

Overview of the Research

The goal of this study was to examine reading achievement growth in both non-ESOL and ESOL groups in the public schools of the state of Kansas. The data used in this research includes five years of reading achievement outcomes for both groups of students. Because each group of students was nested within the same school and district, a four-level model of level-1 occasions nested within level-2 classes nested within level-3 schools and within level-4 districts was initially used to analyze each group's reading outcomes. The non-ESOL sample included 18,838 occasions from 4,382 classes nested within 1,244 schools and 302 districts which had complete data at a given occasion for all variables to be included. The ESOL sample included 9,619 occasions from 2,689 classes nested within 1,057 schools and 193 districts which had complete data at a given occasion for all variables to be included. Private and specialized schools were not included. All students' records and teacher information in the study were nested within districts, and the size of districts varied.

ESOL students are the group who are qualified to receive English Language Development (ELD) service. All students including ESOL students in grades 3 through 11 take a state assessment test in reading between March and May of each year. State reading achievement test scores from 2009 to 2013 are available from the Kansas State Department of Education. Students' reading proficiencies were assessed on a scale of 0 to 100, with a higher score indicating higher reading achievement. Years in the study was the metric of time, such that time 0 represented the first occasion. Each school had an annual outcome at times 0-4. All variables were created for year-specific classes and then categorized by school level (elementary, middle, and high school). The study used each class' average reading test score. The study also used percentages of qualified ESOL teachers and the percentage of ESOL students in a given class to examine how these two predictors influenced the non-ESOL and ESOL groups' reading outcomes. To facilitate multilevel data analysis, the final dataset was organized using stacked data for the years 2009 through 2013. The final dataset contained a total of 28,457 observations.

Data Analysis

Data were analyzed with a multilevel growth model using SAS® PROC MIXED. The data available for the study fit well within the requirements for a multilevel growth model: there were five waves of data, and each wave was associated with a reliable time metric, in this case, a school year in a hierarchical organized setting. Since the SAS® 9.4 software program can use unbalanced data to analyze outcomes, the expected outcomes can be more accurately predicted by including cases of schools closed between 2009 and 2013. In this data, each grade has five years of outcomes nested in schools and districts, which produced a four-level growth model: level-1: five years of observations; level-2: classes for which reading outcomes were collected;

level 3: school in which a class was nested, and level-4: district to which a school belonged. The dependent variable – class mean scaled reading test scores – was a continuous measure with outcomes comparable over time. Conducting research at any of these levels without consideration of school-level and district-level dependency could lead to inaccurate conclusions.

The time-varying outcome is reading achievement as measured by the class mean of individual students' reading test outcomes scaled from 1 to 100. The effects of time-varying predictors for the percentage of qualified ESOL teachers and the percentage of ESOL students within each class were also examined. Each variable was partitioned into per-level observed variables to convey level-specific variation. That is, the within-class, level-1 variables represented variation of each occasion relative to the level-2 class mean; the within-school, level-2 variables represented variation of each class relative to the level-3 school mean; the within-district, level-3 variables represented variation of each school relative to the level-4 district mean; and the between-district level-4 variables represented variation of each district relative to the sample grand means of each predictor. Descriptive statistics for each variable at each level are provided in Table 4.1

Table 4.1.

Descriptive Statistics for Each Variables at Each Level

Level		*Variables*	*Number*	*Mean*	*SD*	*Min*	*Max*
1	within class (occasion)	Reading outcome	28455	77.97	9.27	7.00	100.00
		ESOL teacher percent	28457	4.31	6.38	0.00	87.50
		ESOL student percent	28457	10.57	16.71	0.00	100.00
2	within school (class)	Reading outcome	28457	78.49	6.18	26.00	93.25
		ESOL teacher percent	28457	4.31	6.30	0.00	67.65
		ESOL student percent	28457	10.57	16.03	0.00	86.05
3	within district (school)	Reading outcome	28457	77.97	5.82	32.16	90.28
		ESOL teacher percent	28457	4.31	6.28	0.00	67.65
		ESOL student percent	28457	10.57	15.92	0.00	84.30
4	between district	Reading outcome	28457	77.97	4.11	66.14	88.22
		ESOL teacher percent	28457	4.31	5.04	0.00	46.30
		ESOL student percent	28457	10.57	12.44	0.00	59.53

Note. Number: number of observation, SD: standard deviation, Min: minimum, Max: maximum.

Model Building Process

Finding the most parsimonious but still well-fitting model started with empty means, random intercept models to see whether significant outcome variation existed at each level. The appropriate fit statistic depends on model estimation [full maximum likelihood (ML) vs. restricted maximum likelihood (REML)] as well as whether the models are nested or not (i.e., models that have been fitted using the same data where one model is a subset of the other). Restricted maximum likelihood estimation was used to estimate univariate models for each outcome in order to examine which fixed and random effects are needed for each. By using REML, I could examine improvement in model fit due to additional random effects using the likelihood ratio test when examining differences in the −2 log likelihood (−2LL) values of nested models, as well as additional fixed effects using the Wald test, a significant test of given fixed effect: a t-statistic formed by the ratio of its estimated slope over Standard Error (SE). If the t-statistic is smaller than -1.96 or greater than 1.96, the slope is deemed significant at the $\alpha = .05$ level (Hoffman 2015). Thus we could determine if a simple slope is significant for any value of the interpreting predictor. In terms of the -2 log likelihood test, when the models become more complex and the model fit improves, the -2 log likelihood values for more complex models will be smaller than the values for the comparison model. For example, if in a level-2 model, allowing the effects of level-1 predictors to vary between level-2 units improves model fit, then the -2LL values will be smaller. It was necessary to start by examining all predictors to see how great a portion of the variation in outcome was represented in between-class level and within-class level outcomes. Therefore, Intraclass Correlation Coefficients (ICCs) were examined using reading outcomes, and two time-varying predictors (qualified ESOL teacher and ESOL student

percentage) as an outcome variable to see if the level-2, level-3, and level-4 variations are significant.

Models for Question 1 (Four-Level Empty Means Random Intercept Model for Reading)

The first model started with a four-level empty means random intercept model (i.e. a model with no predictors) in order to calculate the ICC which estimates how much variation in predictors exists within-class (level-1), within-school (level-2), within-district (level-3), and between-districts (level-4). In order to answer research question *1. How much of the total reading achievement outcome variance depends on classes, schools and districts?* ICCs of each level for reading outcomes were calculated.

Empty model ICC for reading outcomes of the non-ESOL and ESOL groups.

Non-ESOL group. Having obtained a descriptive sense of how much variation existed in each variable, the proportion of variation at each level was estimated by fitting empty means models. First, I examined the non-ESOL group's ICC as estimated within two-level, three-level, and four-level models. A two-level empty means, random intercept model of time nested within classes was initially specified and indicated that 68.2% of the reading outcome variance was at the between-class level (level-2 and above) and 31.8% of the variance was within classes (level-1). The addition of a random intercept for school (level-3) resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 4{,}130.1$, $p < .0001$, and revealed that 97.9% of that 68.2% between-class variance was actually across schools. That is, 69.3% of total variance was between schools (level-3), 1.5% was between classes within the same school (level-2), and 29.2% was within class over time (level-1). When district (level-4) was added to the three level, empty means, random intercept model, it resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) =$

278.1, $p < .0001$. Equation (4.1) for a four-level empty means, random intercept model is shown below.

Equation of Empty Means, 4-Level Random Intercept Model (4.1)

Notation: t = level-1 time (year), c = level-2 class, s = level-3 school, d = level-4 district

Level 1 time (year): $y_{tcsd} = \beta_{0csd} + e_{tcsd}$

Level 2 Class: $\beta_{0csd} = \delta_{00sd} + C_{0csd}$

Level 3 School: $\delta_{00sd} = \eta_{000d} + S_{00sd}$

Level 4 District: $\eta_{000d} = \gamma_{0000} + D_{000d}$

Composite: $y_{tcsd} = \gamma_{0000} + D_{000d} + S_{00sd} + C_{0csd} + e_{tcsd}$

$$\text{ICC L2} = \frac{T^2_{D00}+T^2_{S00}+T^2_{C00}}{T^2_{D00}+T^2_{S00}+T^2_{C00}+\sigma^2_e} \qquad \text{ICC L3} = \frac{T^2_{D00}+T^2_{S00}}{T^2_{D00}+T^2_{S00}+T^2_{C00}} \qquad \text{ICC L4} = \frac{T^2_{D00}}{T^2_{D00}+T^2_{S00}}$$

Thus, out of the school and district variances, 17.7% of the variance in reading outcomes was due to differences across districts whereas 82.2% was due to the difference across schools. This four-level model for reading outcomes provided a fixed intercept of $\gamma_{0000} = 80.49$ (SE = 0.24) for the mean reading scores of the non-ESOL group across the years. The total variance across levels = 59.28, which was calculated as the sum of the level-4 random intercept variance of $T^2_{D00} = 6.95$ (SE = 0.996; 11.7% of the total) for the variance across districts, a level-3 random intercept variance of $T^2_{S00} = 32.23$ (SE = 1.39; 54.3% of the total) for the variance across schools from the same district, a level-2 random intercept variance of $T^2_{C00} = 0.99$ (SE = 0.16; 0.3% of the total) for the variance across classes from the same school, and a level-1 residual variance of $\sigma^2_e = 19.10$ (SE = 0.226; 32.2% of the total) for variation across years from the same class.

Equation (4.1) also provides intraclass correlation coefficients at each level. Using Equation (4.1), $ICC_{L2} = 0.843$, which was significantly > 0, as indicated by a model comparison of a single-level to a two-level model (ignoring school and district). Then, again using Equation (4.1), $ICC_{L3} = 0.975$, which was also significantly > 0, as indicated by a model comparison of a two-level model to a three-level model $-2\Delta LL(\sim 1) = 4{,}130.1$, $p < .0001$. Lastly, $ICC_{L4} = 0.177$, which was also significantly > 0, as indicated by a model comparison of a three-level model to this four-level model, $-2\Delta LL(\sim 1) = 278.1$, $p < .0001$. Together, these ICCs indicate that, of the total variation in reading outcomes over time, 32.2% was the outcome variance within-class over time and 67.8% was across classes, schools, and districts; of that 67.8%, 97.5% was actually across schools and districts, of that 97.5%, 17.7% was actually due to the variation of districts.

ESOL group. The ESOL group's four-level empty means, random intercept model for reading outcomes resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 167.6$, $p < .0001$, relative to the three-model empty means, random intercept model, indicating that 58.1% of the variance was over time, whereas 23.7% of the variance was across schools and 18.2% of the variances was across districts. However, the four-level model showed no class level-2 variance. This four-level model for reading outcomes provided a fixed intercept of $\gamma_{0000} = 72.43$ (SE = 0.44) for the mean reading score for the ESOL group across the years. Together, the ICCs from Equation 4.1 indicate that, of the total variation in reading outcome over time, 41.9% was across classes, schools and districts; of that 41.9%, 100% was actually due to schools and districts (no class-level variance at level 2); of that 100%, 56.6% was due to variation of schools, while 43.4% was due to variation of districts.

Group comparison. Comparing the ICCs between the non-ESOL and ESOL groups, the univariate models for each group shows more variance at the district level for the ESOL group's

outcome (43.4%) than for the non-ESOL group's outcome (17.7%). That means, the outcome of ESOL groups was distributed more widely than the non-ESOL group's outcome. Table 4.2 provides the comparisons of model fit and proportions of variance at each level for the reading outcomes of the non-ESOL and ESOL groups.

From the Intraclass Correlation test, we found that the non-ESOL group's class level variance was 0.99; that is, only 2.4% of the reading outcome variance was between class difference, and the ESOL group's class level variance was 0. Therefore, in order to make a parsimonious baseline model, the class level was removed. The effects of time for reading outcomes of within-class (level-1), within-districts (level-3), and between-districts (level-4) levels were then estimated to address question 2. Parameters in the model for the means and model for the variance were estimated by the best-fit univariate model, and the gap for the effect between the non-ESOL group and ESOL group's reading outcomes was estimated by best-fit multivariate model.

Table 4.2.

Model Fits and Proportion of Variance at Each Level for Reading

Non-ESOL group						
	Level	*-2ΔLL(~1)*	*P value*	*Variance*	*SE*	*Proportion of Variance*
2 level model	within-class			18.73	0.22	18.73/58.87 =.318
	between-class			40.14	0.98	40.15/58.88 =.682
3 level model	within-class	4130.1	< .001	19.09	0.23	19.09/65.33 =.292
	within-school			0.98	0.16	0.976/65.33 =.015
	between- school			45.26	1.80	45.28/65.33 =.693
4 level model	within-class	278.1	< .001	19.10	0.23	19.10/59.27 =.322
	within-school			0.99	0.16	0.99/59.27 =.016
	within-district			32.23	1.39	32.23/59.27 =.544
	between- district			6.95	1.00	6.95/59.27 =.117
ESOL group						
2 level model	within-class			71.45	1.81	71.45/110.42 =.647
	between-class			38.97	1.23	38.97/110.42 =.353
3 level model	within-class	1095.3	< .001	70.30	1.08	70.30/117.90 =.596
	within-school			0	.	0
	between- school			47.59	2.82	47.59/117.90=.403
4 level model	within-class	167.6	< .001	70.46	1.08	70.46/121.30 =.581
	within-school			0	.	0
	within-district			28.78	2.12	28.78/121.30 =.237
	between- district			22.07	4.59	22.07/121.30 =.182

Summary of the results. In this section, I discussed how much reading outcome variances were due to the different levels within which the outcomes were nested. The proportion of the non-ESOL and ESOL groups' outcome variances at each level was compared.

First, in terms of the within-class level outcome variance, the non-ESOL group's variance was 32.22% of the total outcome variances whereas the ESOL group's variance was 58.08% of the total variances. The study's results suggested that the reading outcomes of the ESOL group within the same class across years tended to be more similar to each other's than to the reading outcomes of the non-ESOL group. Second, in terms of the within-district (school) level outcome variances, the non-ESOL group's variance was 54.37% of the total outcome variances whereas the ESOL group's school level outcome variance shared only 23.72% of the total variances. The study's results suggested that the reading outcome of the non-ESOL group within the same district tended to be more similar to each other's than to the reading outcome of the ESOL groups. Last, in terms of the between-district level's outcome variances, the non-ESOL group's outcome variance shared 11.73% of the total outcome variances whereas the ESOL group's outcome variance shared 18.19% of the total variances. The study's results thus suggest that the reading outcomes of the ESOL group between districts tended to be more similar to each other's than to the reading outcomes of the non-ESOL groups.

In sum, the reading outcomes of the ESOL group within the same class tended to be similar to each other (ICC_{L1} =.581) whereas the non-ESOL group's outcomes tended to be more similar to each other at the within-district level (ICC_{L3} =.544). In particular, when the outcome variances within district-levels and between-district levels of the non-ESOL and ESOL groups were compared, it seemed that which school the non-ESOL group attended was a significant

factor in influencing reading outcomes whereas which district the ESOL group belonged to was a significant factor influencing their reading outcomes.

Models for Question 2: The Final Unconditional Model for Change Over Time

The model in this section was constructed to answer question 2. *What is the overall pattern of the gap in reading achievement from 2009 to 2013 between non-ESOL students and ESOL students as nested in schools and districts?* In order to address this question, the best fit expected patterns of reading outcomes for change over time per each group were estimated first by a univariate model.

Univariate model for change over time predicting non-ESOL and ESOL group's reading outcomes.

Non-ESOL group. To find the best-fit model for change over time, an empty means, random intercept four level model was estimated to partition the variation in reading outcome in the previous section. The ICC for level 3 and above, $ICC_{L3} = 0.668$, indicated that 66.8% of the variation in reading outcomes resulted from constant mean differences between level 3 (school) and above. The $ICC_{L4} = 0.177$, indicated that out of 66.8%, 17.7% of the variance was between level-4 (district). It was significantly greater than 0.

Then, the effect of time was added to the within-class, within-district, and between-district level, fixed linear time random intercept model, and indicated that the non-ESOL group's outcome, $\gamma_{000}= 80.64$ significantly decreased by −0.08 across a year ($\gamma_{100}= -0.08$, $p < .0001$). A fixed quadratic, random intercept time model was then estimated in order to examine the potential for nonlinear change via quadratic effect of time. The fixed quadratic time random intercept model indicated that the positive linear time slope rate of 0.93 at year = 0 ($\gamma_{100}= 0.93$, *p*

<.0001) became significantly less positive by twice the quadratic linear rate across the years (γ_{200}= −0.25, p <.0001). Then, school level (level-3) random linear time was added, resulting in a significant improvement in model fit, −2ΔLL(~2) = 191.4 p < .001, indicating that the school level (level 3) linear time slope had its own linear time slope variation. The addition of district level (level 4) random linear time also improved the model fit, −2ΔLL(~2) = 500.4 p < .001 indicating that district level linear time slope also had its own linear time slope variation. Therefore, based on comparison of model fit, the fixed quadratic time, level-3 and level-4 random linear time slope model became the final unconditional model for change over time for the non-ESOL group. The fixed linear and quadratic effects of time model accounted for 0.3 % of the overall variance (as given by total R^2). The total R^2 is calculated as the square of the correlation between the original outcome and the outcome predicted by the model fixed effects. The total R^2 was calculated in order to describe the proportion of outcome variance accounted for by the fixed effects of predictors, which is time in this model for the means (Hoffman, 2015). Final unconditional model parameters for reading outcome were interpreted as follows.

The fixed intercept of 79.97 is the predicted reading outcome at time = 0 (γ_{000} = 79.97, p < .0001). A 95% random effects confidence interval for intercept at the district level is 74.99 to 84.94, whereas the 95% random effects confidence interval for intercept at the school level is from 66.92 to 93.02. The fixed linear slope of 1.01 is the expected linear rate of change at time = 0 (γ_{100} = 1.01, p < .0001). Since the school and district level variance showed significant random differences in linear change, the random linear time slope at district, γ_{100}=1.01, was expected to differ from 0.55 to 1.47 across districts, and the random linear slope at school level was expected to differ from 1.19 to 3.21. The linear rate of time change was predicted to become less positive by twice the fixed quadratic slope of −0.25 per year (γ_{200} = −0.25, p < .0001) without any

random effect across schools and districts. Next, the process of finding the best model fit for the ESOL group's reading outcome is discussed as follows.

ESOL group. As discussed in the previous section, the best fit empty means random intercept model was the within-class, within-district, and between-district level empty means, random intercept model. The ICC for level 3 and above, $ICC_{L3} = 0.419$, indicating that 41.9% of the variation in reading outcomes resulted from constant mean differences between level 3 (within district) and above (between-district). The $ICC_{L4} = 0.434$ indicated that out of 41.9%, 43.4% of the variance was between level-4 (between-district). It was significantly greater than 0.

In order to find the best-fit model for change over time, a fixed linear time, random intercept model was then estimated, indicating that the reading outcome of 71.4 (γ_{000}= 71.4, p <.0001) was expected to become significantly greater by 0.49 across year (γ_{100}= 0.49, p <.0001). Next, the potential for nonlinear change via quadratic effect of time was considered. A fixed quadratic, random intercept time model was then estimated, indicating that the positive linear time slope rate of 2.17 at time = 0 (γ_{100}= 2.17, p <.0001) became significantly less positive by twice the quadratic linear rate across a year (γ_{200}= −0.42, p <.0001). Then school level (level-3) random linear time was added, resulted in a significant improvement in model fit, $-2\Delta LL(\sim 2) = 108.0$ $p < .0001$, indicating that level 3 linear time slope has its own linear time slope variation. The addition of district level (level 4) random linear time also improved the model fit, $-2\Delta LL(\sim 2) = 98.1$ $p < .0001$ indicating that level-4 linear time slope has its own linear time slope variation as well. Therefore, based on comparison of model fit, the fixed quadratic time, level-3 and level-4 random linear time slope model became the final unconditional model for change over time for the ESOL group. The fixed linear and quadratic effects of time model

accounted for 0.9 % of the overall variance (as given by total R^2). Final unconditional model parameters for reading outcomes were interpreted as follows.

The fixed intercept of 70.5 was the predicted reading outcome at time = 0 ($\gamma_{000} = 70.5$, $p < .001$). A 95% random effects confidence interval across districts was 60.99 to 80.01 whereas a 95% confidence interval across schools was 56.89 to 84.11. The fixed linear slope of 2.17 was the expected linear rate of change at time = 0 ($\gamma_{100} = 2.17$, $p < .001$). A 95% random linear slope effects confidence interval of 0.21 to 4.13 was across districts, and a 95% confidence interval of −0.57 to 4.91 was across schools. The linear rate of change was predicted to become less positive by twice the fixed quadratic slope of −0.42 per year ($\gamma_{200} = -0.42$, $p < .001$) with significant fixed and linear random effects across schools and districts.

Group and level comparison of 95% confidence intervals of random effects. Given the different random variances for fixed effects and linear time slope effects of the non-ESOL and ESOL groups and given the different ranges of 95% confidence intervals of random effects at level-3 (school) and level-4 (district), 95% confidence intervals were compared by groups and levels. First, it was found that the 95% confidence intervals of random effects of the intercept for the ESOL group was distributed more widely than the confidence intervals of intercept for the non-ESOL group. The range of 95% CIs for districts were 9.94 for the non-ESOL group and 19.03 for the ESOL group, and the range for schools was 26.09 for the non-ESOL group and 27.22 for the ESOL group. As for the 95% confidence intervals of random effects for linear rate change, the confidence intervals of the ESOL group were also distributed more widely than the non-ESOL group's for both school and district level. The ranges of 95% CIs for the linear rate for the districts was 3.92 for ESOL whereas 0.91 was the 95% CIs for the linear rate for the

district level for the non-ESOL group. The ranges for school level 95% CIs were 4.34 for the ESOL group and 2.02 for the non-ESOL group.

The 95% Confidence Interval values of linear slope rate indicated that the linear time slopes of reading outcomes across schools was more variable than the slopes across districts. In addition, the distribution of the ESOL group's linear time slopes was wider than the non-ESOL group's linear time slopes. Not only the distribution of the fixed intercept of reading outcomes of the ESOL group but also the distribution of their rates change over time was wider than the linear rate of the non-ESOL group. Table 4.3 shows the 95% random effects confidence interval for fixed intercept, and Table 4.4 shows the 95% random effects confidence interval for linear slope. Figures of these tables are shown as well. Equation (4.2) of the final unconditional model for change over time and the results for the non-ESOL and ESOL group's predicted reading outcomes are shown in Table 4.5.

Table 4.3.

Random Effects of Confidence Interval for Intercept by Groups and Levels

Group	*Level*	*Mean of Reading Outcomes by Group*	*95% Random Effect Confidence Interval*	
Non-ESOL	4 (district)	79.97	74.99	84.94
ESOL	4	70.50	60.99	80.01
Non-ESOL	3 (school)	79.97	66.92	93.02
ESOL	3	70.50	56.89	84.11

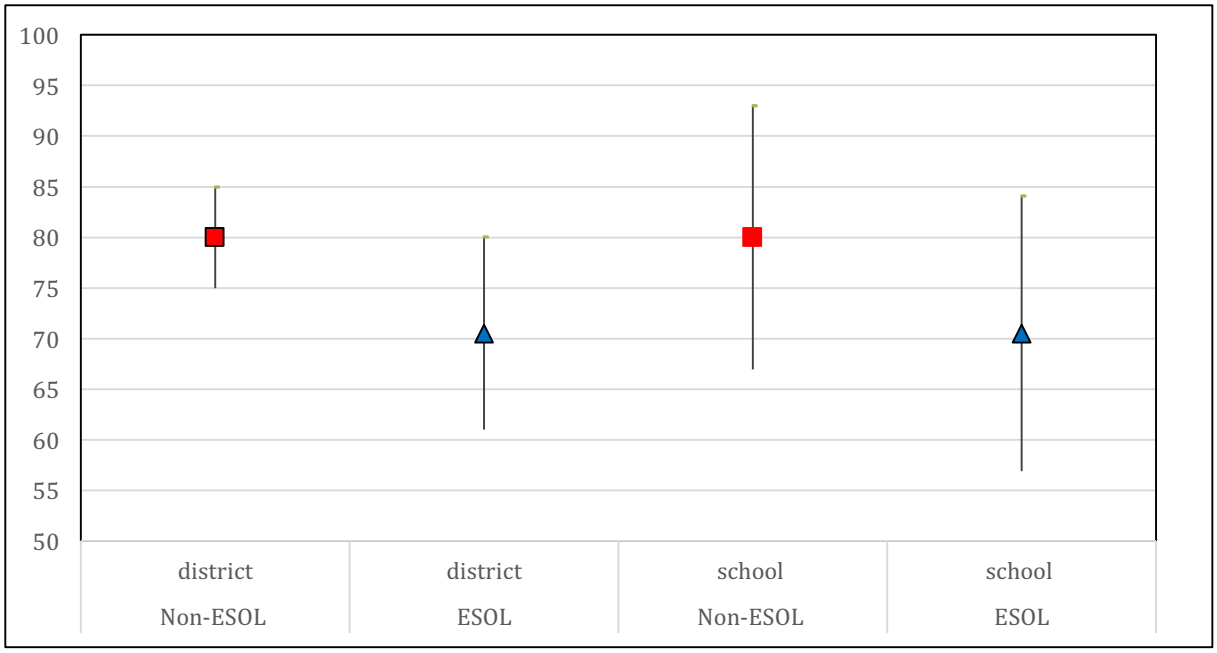

Figure 4.1. 95% Predicted Confidence Interval of intercept for reading means by groups and levels.

Table 4.4.

Random Effects of Confidence Interval for Linear Time Slope by Groups and Levels

Group	*Level*	*Predicted Linear Time Slope for Reading Outcomes*	*95% Random Effect Confidence Interval*	
Non-ESOL	4	1.01	0.55	1.47
ESOL	4	2.17	0.21	4.13
Non-ESOL	3	1.01	1.19	3.21
ESOL	3	2.17	0.57	4.91

The final unconditional time model predicting non-ESOL and ESOL groups' reading achievement outcomes is shown in Equation (4.2):

Equation of Fixed Quadratic Time, Random Linear 3-Level Model (4.2)

Notation: t = level-1 time (year), s = level-3 school, d= level-4 district

Level 1 time (year): $Y_{tsd} = \beta_{0sd} + \beta_{1sd}(time) + \beta_{2sd}(time)^2 + e_{tsd}$

Level 3 School:

Intercept: $\beta_{0sd} = \delta_{00d} + S_{0sd}$

Time: $\beta_{1sd} = \delta_{10d} + S_{1sd}$

Time*Time: $\beta_{2sd} = \delta_{20d}$

Level 4 District:

Intercept: $\delta_{00d} = \gamma_{000} + D_{00d}$

Time: $\delta_{10d} = \gamma_{100}$

Time*Time: $\delta_{20d} = \gamma_{200}$

Composite: $Y_{tsd} = (\gamma_{000} + D_{00d} + S_{0sd}) +$

$(\gamma_{100} + D_{00d} + S_{1sd})(time_{tsd}) +$

$\gamma_{200}(time_{tsd})^2 + e_{tsd}$

Table 4.5.

Model Fit and Results for the Univariate Unconditional Model for Reading

Parameters		non-ESOL (4.2)			ESOL (4.2)		
		Est	SE	p <	Est	SE	p <
Model for the Means							
γ_{000}	Intercept	79.97	0.26	<.0001	70.50	0.54	<.0001
γ_{100}	Linear Time Slope	1.01	0.09	<.0001	2.17	0.25	<.0001
γ_{200}	Quadratic Linear Time Slope	-0.25	0.02	<.0001	-0.42	0.05	<.0001
Model for the Variance							
	District Random Intercept Variance	6.43	1.13	<.001	23.56	6.59	<.001
	District Random Linear Time Slope	0.05	0.04	0.08	1.00	0.35	0.002
	District Intercept-Time Slope Covariance	0.06	0.15	0.69	-1.40	1.26	0.27
	School Random Intercept Variance	44.30	2.07	<.001	48.22	4.06	<.001
	School Random Linear Time Slope	1.26	0.10	<.001	1.96	0.31	<.001
	School Intercept-Time Slope Covariance	-4.05	0.37	<.001	-6.62	0.98	<.001
	Residual Variance	17.42	0.20	<.001	64.40	1.04	<.001
REML Model Fit							
	Number of Parameters	10			10		
	- 2LL	113382			69546		
	AIC	113396			69560		
	BIC	113422			69582.8		

The multivariate model for change over time. In order to discuss question 2. *What is the overall pattern of the gap in reading achievement from 2009 to 2013 between non-ESOL students and ESOL students as nested in schools and districts?* a series of the multivariate models were estimated to address the questions. The "gap" in this study refers to the reading outcome mean difference between the non-ESOL group and the ESOL group who took the annual state reading assessment. The multivariate models were constructed to find the gap of the reading outcomes between groups with the purpose of discussing each research question.

The overall pattern of the gap of effects for change over time. In order to find the best multivariate model, as we did to find the best fit univariate model, a multivariate empty mean random intercept model was first estimated in which the fixed effect for the mean difference, 7.99, was the predicted mean difference between the non-ESOL and ESOL groups specifically across time. Then the quadratic linear effects of time were added to the model, which were significant as indicated by a Wald test ($p < .05$). The gap of between group outcomes of 9.54 at time = 0 was expected to become narrower significantly by the linear rate of −1.14 per year ($\gamma_{10n} - \gamma_{10e} = -1.14$, $p = .05$). Then, the linear rate of the gap of effect was expected to become less narrow by twice the quadratic rate of 0.14 ($\gamma_{20n} - \gamma_{20e} = 0.14$, $p < .009$). All of the effects were significant. Although the random linear time slope effects for level 3, and level 4 were successfully added to the univariate model, in the multivariate model, the random linear time model would not converge in SAS 9.4. Thus, the final unconditional multivariate model became a fixed quadratic time, random intercept model.

Using the multivariate model allowed me to examine the differences in effect size across outcomes – for instance, is the time slope greater in one outcome than in another? Applied to this study, we can see if the non ESOL group's reading outcomes grew faster than the ESOL group's

or vice versa. Given that there were variance components for each outcome – level-4 random intercept, level-3 random intercept, and residual – there were three ways that reading outcomes could relate to each other. By examining the cross-variable covariance, we can predict the relationship between the non-ESOL group and the ESOL group in terms of growth of reading achievement. Now let us interpret each correlation as converted from cross variable covariances.

First, the level-4 random intercept correlation $r = 0.24$ indicated that the random intercepts were moderately and positively related across districts. That is, in districts in which the non-ESOL group's reading achievement became greater, ESOL group's reading achievement was also likely to become greater than other districts across time. Second, the level-3 random intercept correlation $r = 0.29$ indicated that the intercepts were also moderately and positively related across schools. Although relationship among intercepts of level 3 and level 4 told us that these schools are positively and moderately related "over time," the residual correlation from the R matrix described a within-class relationship, level-1 relationship for how time-specific deviation from the predicted trajectories were related across outcomes. In our model, the residual correlation $r = 0.19$ meant that the change of the non-ESOL group's reading outcomes was positively but not strongly related to the change of the non-ESOL group's reading outcomes over time. After controlling for time change in each variable, a positive residual correlation indicated that the time-specific deviations from the predicted trajectory for each variable were likely to go in the same direction over time. The predicted change of gap of outcomes between the non-ESOL and ESOL groups is shown in Figure 4.2.

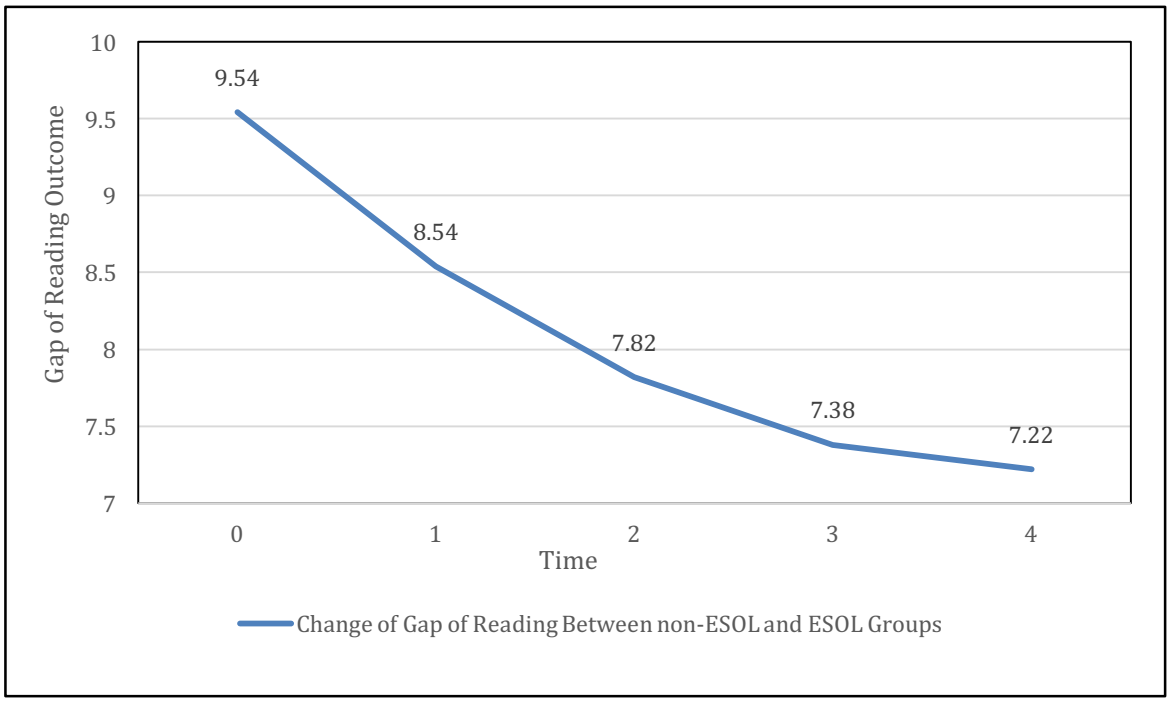

Figure 4.2. Predicted change of gap of reading outcomes over time between the non-ESOL and ESOL groups

Summary of the results.

Gap of effects over time. The results of the univariate model for change over time suggested that the reading outcome of the non-ESOL group was expected to be 79.97 in 2009, and the linear slope was expected to positively increase 1.01 with less positive being twice the quadratic linear rate of –0.25 per year. The ESOL group's predicted reading outcome was 70.5 in 2009 and was expected to grow linearly by 2.17 with twice the quadratic slope of –0.42 per year. Figure 4.3 shows each group's reading outcome change over time.

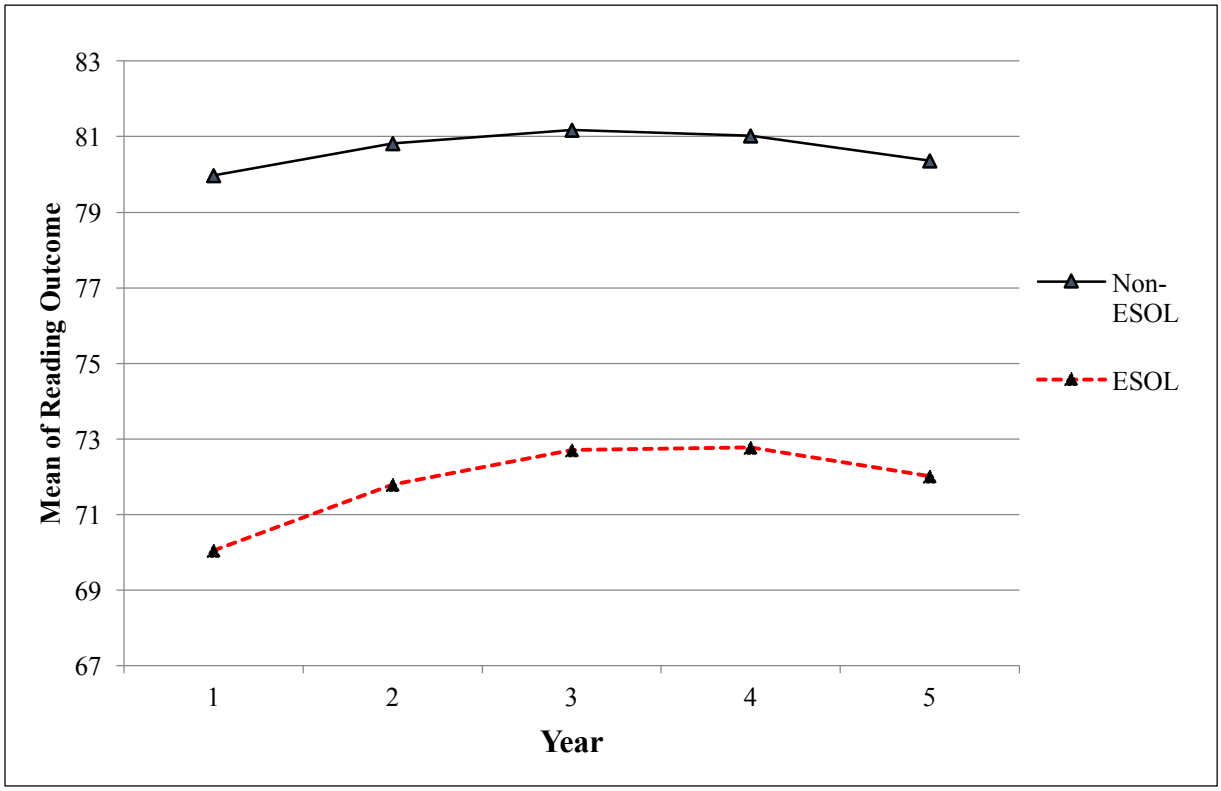

Figure 4.3. Change of reading outcome of the non-ESOL and ESOL groups over time

The results of the multivariate model for change over time indicated that the gap between the two groups' outcomes was significant and has changed significantly over time. The gap was expected to be 9.54 in 2009 ($\gamma_{00n} - \gamma_{00e} = 9.54$, $p < .0001$), then decrease by −1.14 ($\gamma_{10n} - \gamma_{10e} = -1.14$, $p < .0001$) with twice the quadratic linear slope rate of 0.14 ($\gamma_{20n} - \gamma_{20e} = 0.14$, $p <= .009$). As shown in Figure 4.2, the gap of effect was predicted to become significantly narrower over time, but at a decelerating rate.

Models for Question 3 (Adding Categorical Predictors of School Levels to the Models for Change Over Time)

A series of models was constructed to answer question *3. How is the gap between the non-ESOL and ESOL groups' reading achievement across five years moderated by school levels (elementary, middle, and high-school)?* Categorical predictors of school level were added to see how much the reading outcomes differed between the two groups within each school level. The elementary school level consisted of grades 3, 4, and 5; the middle school level consisted of grades 6, 7, and 8; and the high school level consisted of grades 9, 10, and 11. The high school was used as a reference group. In order to address the question about the significance of the gap between the two groups' reading outcomes over time, the gap of effects at each school level between the non-ESOL and ESOL groups' outcomes was examined by a multivariate model after examining each group's growth of outcome over five years using a univariate model.

Univariate model: Effects of school levels on reading outcomes. The addition of school level predictors showed significant fixed effects for each school level and their effects for change over time. The effects of adding categorical predictors of school level to the non-ESOL group's outcome accounted for 1.32% of the total variance (additional 1.0% relative to the model for change over time) whereas the effects of adding categorical predictors to the ESOL group's outcome accounted for 5.88% of the total variance for the ESOL group's outcome (additional 4.98% relative to the model for change over time). Equation (4.3) for the univariate model for the non-ESOL and ESOL groups' outcomes by school levels is provided in composite form below. Results for the non-ESOL and ESOL groups' expected outcomes are given in Table 4.6 and are interpreted as follows.

Equation (4.3):

$$Y_{tsd} = [\gamma_{000} + \gamma_{010}(\text{elementary}_i) + \gamma_{020}(\text{middle}_i) + S_{0sd} + D_{00d}] +$$

$$[\gamma_{100} + \gamma_{110}(\text{elementary}_i) + \gamma_{120}(\text{middle}_i) + S_{1sd} + D_{10d}](\text{time}_{tsi}) +$$

$$[\gamma_{200} + \gamma_{210}(\text{elementary}_i) + \gamma_{220}(\text{middle}_i)](\text{time}_{tsi})^2 + e_{tsd}$$

Table 4.6.

Univariate Model for Change Over Time by School Level

Parameters		*Adding School Types for Non-ESOL Group*			*Adding School Types for ESOL Group*		
		Est	*SE*	*p <*	*Est*	*SE*	*p <*
Model for the Means							
γ_{000}	Intercept	**78.13**	0.36	<.0001	**63.15**	0.98	<.0001
γ_{100}	Linear Time Slope	**1.80**	0.26	<.0001	**2.48**	0.87	0.005
γ_{200}	Quadratic Linear Time Slope	**-0.34**	0.06	<.0001	-0.33	0.20	0.10
γ_{010}	Elementary	**2.65**	0.33	<.0001	**9.50**	0.93	<.0001
γ_{110}	Time*Elementary	**-1.10**	0.28	0.04	-0.15	0.91	0.87
γ_{210}	Time*Time*Elementary	**0.13**	0.06	<.0001	-0.17	0.21	0.43
γ_{020}	Middle	**1.80**	0.32	<.0001	**7.28**	0.96	<.0001
γ_{120}	Time*Middle	**-0.62**	0.29	0.03	-0.86	0.95	0.37
γ_{220}	Time*Time*Middle	0.03	0.07	0.60	0.04	0.22	0.85
Model for the Variance							
	District Random Intercept Variance	**6.89**	1.16	<.0001	**28.90**	7.00	<.0001
	District Random Linear Time Slope	0.07	0.07	0.05	**1.02**	0.35	0.002
	School Intercept-Time Slope Covariance	-0.02	0.17	0.89	-1.78	1.34	0.18
	School Random Intercept Variance	**41.78**	2.00	<.0001	**32.95**	3.13	<.0001
	School Random Linear Time Slope	**1.19**	0.10	<.0001	**1.88**	0.30	<.0001
	School Intercept-Time Slope Covariance	**-3.64**	0.36	<.0001	**-5.46**	0.85	<.0001

Residual Variance	**17.41**	0.20	<.0001	**64.51**	1.04	<.0001
REML Model Fit						
Number of Parameters	19			19		
- 2LL	113323.8			69546		
AIC	113337.8			69314.1		
BIC	113363.8			69336.9		

Note. Bold values are $p < .05$

Non-ESOL group.

Elementary school. The reading outcomes of the non-ESOL group at elementary schools were estimated as 80.78 ($\gamma_{000} + \gamma_{010} = 80.78$, $p < .0001$) at year = 1 and expected to become significantly greater by 0.70 per year ($\gamma_{100} + \gamma_{110} = 0.70$, $p < .0001$) with twice the quadratic effect of time by –0.21 ($\gamma_{200} + \gamma_{210} = -0.21$, $p < .0001$) for an additional year.

Middle school. The reading outcomes of the non-ESOL group at middle schools were estimated as 79.93 ($\gamma_{000} + \gamma_{020} = 79.93$, $p < .0001$) at year = 1 and expected to become significantly greater by 1.18 ($\gamma_{100} + \gamma_{120} = 1.18$, $p < .0001$) with twice the quadratic effect of time by–0.31 ($\gamma_{200} + \gamma_{220} = -0.31$, $p < .0001$) for an additional year. The difference of outcomes between each school level was significant. The difference between the non-ESOL elementary school and the middle school groups' outcomes was expected to become 0.85 at year = 1 ($\gamma_{010} - \gamma_{020} = 0.85$, $p < .0001$) and expected to become less by–0.48 ($\gamma_{110} - \gamma_{120} = -0.48$, $p = .004$) with twice the quadratic linear time effect of 0.10 per year ($\gamma_{210} - \gamma_{220} = 0.10$, $p = .02$).

High school. The reading outcome of the non-ESOL group at high schools was estimated as 78.13 ($\gamma_{000} = 78.13$, $p < .0001$) at year = 1 and expected to become significantly greater by 1.80 ($\gamma_{100} = 1.80$, $p < .0001$) with twice the quadratic effect of time by −0.34 ($\gamma_{200} = -0.34$, $p < .0001$)

for an additional year. The difference between the non-ESOL elementary school and high school groups' outcomes was expected to be 2.65 at year = 0 ($\gamma_{010} - \gamma_{000} = 2.65$, $p < .0001$) and expected to become less by –1.10 ($\gamma_{110} + \gamma_{100} = -1.10$, $p < .0001$) with twice the quadratic effect of time by 0.13 per year ($\gamma_{210} - \gamma_{220} = 0.13$, $p = .04$). The difference between the non-ESOL middle school and high school groups' outcomes was expected to be 1.80 at year = 1 ($\gamma_{020} - \gamma_{000} = 1.80$, $p < .0001$) and expected to become less by–0.62 ($\gamma_{120} + \gamma_{100} = -0.62$, $p = .03$) with twice the quadratic effect of time by 0.03 ($\gamma_{220} + \gamma_{200} = 0.03$, $p = .61$) per year.

ESOL group.

Elementary school. The reading outcomes of the ESOL group at elementary schools was estimated as 72.65 ($\gamma_{000} + \gamma_{010} = 72.65$, $p < .0001$) at year = 1 and expected to become greater by 2.33 per year ($\gamma_{100} + \gamma_{110} = 2.33$, $p < .0001$) with twice the quadratic effect time by –0.5 ($\gamma_{200} + \gamma_{210} = -0.5$, $p < .0001$) for an additional year.

Middle school. The reading outcomes of the non-ESOL group at middle schools was estimated as 70.43 ($\gamma_{000} + \gamma_{020} = 70.43$, $p < .0001$) at year = 1 and expected to become greater by 1.62 ($\gamma_{100} + \gamma_{120} = 1.62$, $p < .0001$) with the twice the quadratic effect of time by –0.29 ($\gamma_{200} + \gamma_{220} = -0.29$, $p = 0.002$) for an additional year. The difference of outcomes between each school level was significant. The difference between the ESOL elementary school and middle school groups' outcomes was expected to be 2.22 ($\gamma_{010} - \gamma_{020} = 2.22$, $p < .0001$) and expected to increase by 0.71 ($\gamma_{110} - \gamma_{120} = 0.71$, $p = .14$) with twice the quadratic effect of time by –0.21 per year ($\gamma_{210} - \gamma_{220} = -0.21$, $p = .06$).

High school. The reading outcomes of the non-ESOL group at high schools was estimated as 63.15 ($\gamma_{000} = 63.15$, $p < .0001$) at year = 1 and expected to become significantly

greater by 2.48 ($\gamma_{100} = 2.48$, $p = 0.005$) with twice the quadratic linear effect of time by –0.33 ($\gamma_{200} = -0.33$, $p = 0.1$) for an additional year. The difference between the ESOL elementary school and high school group's outcomes was expected to become 9.50 at year = 1 ($\gamma_{010} - \gamma_{000} = 9.50$, $p < .0001$) and expected to become less by –0.15 ($\gamma_{110} - \gamma_{100} = -0.15$, $p = .87$) with twice the quadratic effect of time by –0.17 per year ($\gamma_{210} - \gamma_{200} = -0.17$, $p = .43$). The difference between the ESOL middle school and the high school groups' outcomes was expected to be 7.28 at year = 1 ($\gamma_{020} - \gamma_{000} = 7.28$, $p < .0001$) and expected to become less by –0.86 ($\gamma_{120} - \gamma_{100} = -0.86$, $p = .37$) with the quadratic effect of time by 0.04 ($\gamma_{220} - \gamma_{200} = 0.04$, $p = .85$) per year. Figure 4.4 shows the predicted reading outcome change over time by school levels of the non-ESOL and ESOL groups. The results of the multivariate model, constructed to find the gap of outcomes for change over time between the non-ESOL group and ESOL group by school level, was then discussed.

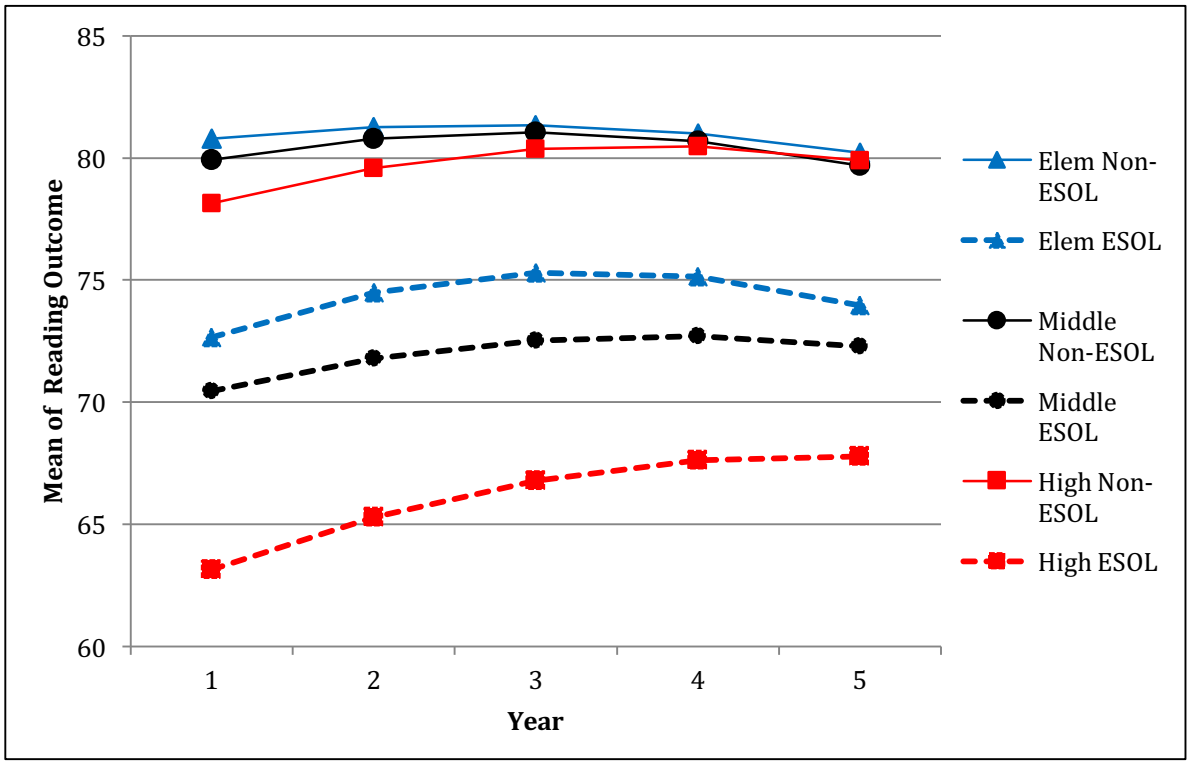

Figure 4.4. Projected outcome change over time by school levels of the non-ESOL and ESOL groups

Multivariate model: Gap of effects between groups by school levels.

Elementary school. The gap of the fixed effects between the elementary school non-ESOL and ESOL groups' outcomes was 8.10 ($\gamma_{01n} - \gamma_{01e} = 8.10$, $p < .0001$) at year = 1. The gap of 8.10 was expected to decrease significantly by the linear rate of –1.51 per year ($\gamma_{11n} - \gamma_{11e} = -1.51$, $p < .0001$) with twice the quadratic effect of time by 0.24 ($\gamma_{21n} - \gamma_{21e} = 0.24$, $p = .0002$). That is, the linear rate of decrease in the gap was expected to accelerate by twice the quadratic linear rate of 0.24.

Middle school. The gap of the fixed effects between the middle school non-ESOL and ESOL groups' outcomes was 9.78 ($\gamma_{02n} - \gamma_{02e} = 9.78$, $p < .0001$) at year = 1. The gap of 9.78 was expected to decrease nonsignificantly by the linear rate of –0.54 per year ($\gamma_{12n} - \gamma_{12e} = -0.54$, $p = 0.18$) with twice the quadratic effect of –0.04 ($\gamma_{22n} - \gamma_{22e} = -0.04$, $p = .65$). That is, the linear rate of decrease in the gap was expected to nonsignificantly decelerate by twice the quadratic linear time rate of –0.04.

High school. The gap of the fixed effects between high school non-ESOL and ESOL groups' outcomes was 14.75 ($\gamma_{00n} - \gamma_{00e} = 14.75$, $p < .0001$) at year = 1. The gap of 14.75 was expected to decrease nonsignificantly by the linear rate of –0.86 per year ($\gamma_{10n} - \gamma_{10e} = -0.86$, $p = 0.33$) with twice the quadratic effect of time by 0.01 ($\gamma_{20n} - \gamma_{20e} = 0.01$, $p = .97$). That is, the linear rate of decrease in the gap was expected to nonsignificantly accelerate by twice the quadratic linear effect of time by 0.01. The predicted gaps of effects for change over time by school levels between groups are shown on Figure 4.5.

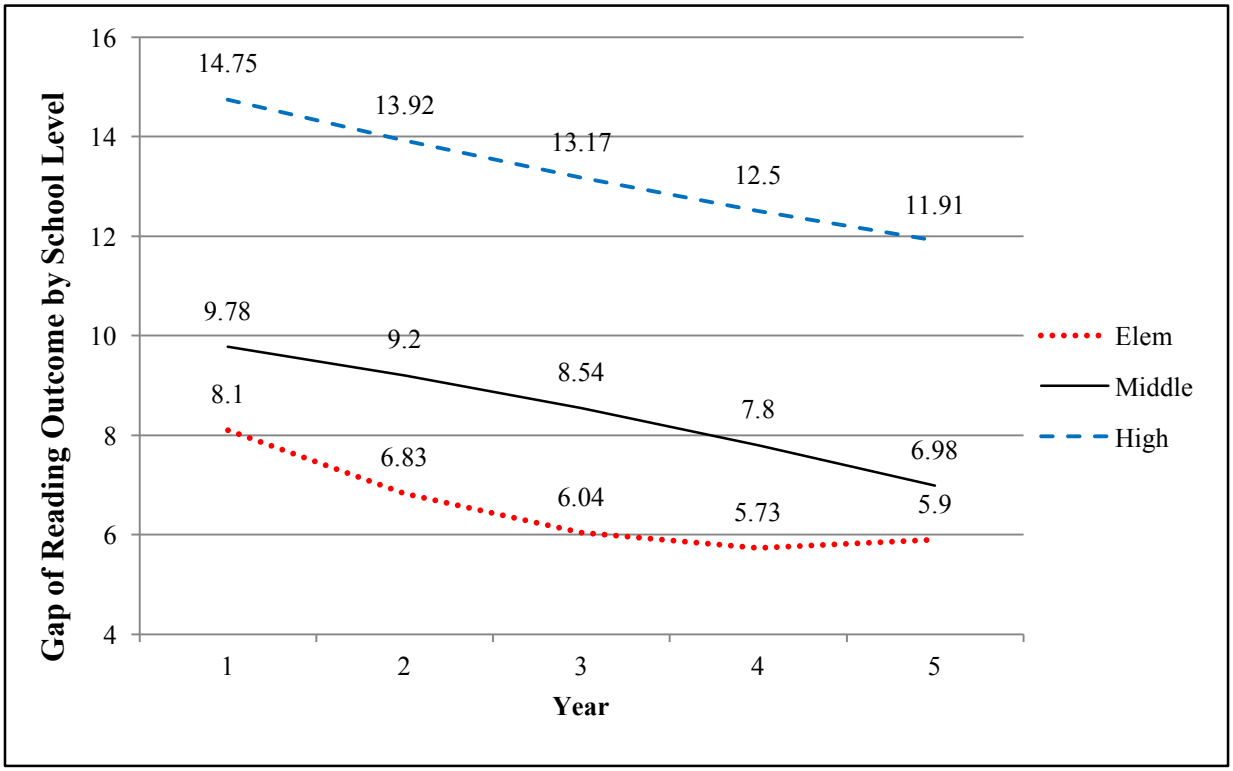

Figure 4.5. The predicted trajectories for the gap of reading outcome by school levels

Unlike the univariate model's random effects, the random effects for time of the multivariate model didn't converge, so the within-district and between-district levels were not expected to have their own linear time variation for the gap of effects on the outcomes. Equation (4.4) for the multivariate model for the non-ESOL and ESOL groups' outcomes by school levels is provided. Results of the multivariate model after adding the categorical predictor of school level are provided in Table 4.7.

Equation of Multivariate Clustered Longitudinal Model (4.4)

Notation: t = level-1 time (year), s = level-3 school, d= level-4 district

dvN = non-ESOL group = 1, dvE = ESOL group = 1

Composite:

$$Y_{tsd} = dvN[\gamma_{00n} + \gamma_{01n}(\text{elementary}) + \gamma_{02n}(\text{middle}) + S_{0dn} + D_{00n} + e_{tin}] +$$

$$dvN[\gamma_{10n} + \gamma_{11n}(\text{elementary}) + \gamma_{12n}(\text{middle})](time_{tsn}) +$$

$$dvN[\gamma_{20} + \gamma_{21n}(\text{elementary}) + \gamma_{22n}(\text{middle})](time_{tsn})^2 +$$

$$dvE[\gamma_{00e} + \gamma_{01e}(\text{elementary}) + \gamma_{02e}(\text{middle}) + S_{0de} + D_{00e} + e_{tie}] +$$

$$dvE[\gamma_{10e} + \gamma_{11e}(\text{elementary}) + \gamma_{12e}(\text{middle})](time_{tse}) +$$

$$dvE[\gamma_{20e} + \gamma_{21e}(\text{elementary}) + \gamma_{22e}(\text{middle})](time_{tse})^2$$

Table 4.7.

Gap of Time Effect on the Outcomes Between Groups by School Levels

Parameters		*Est*	*SE*	*p <*
Model for the Means			*Elementary School*	
$\gamma_{01n} - \gamma_{01e}$	Intercept difference between groups	**8.10**	0.51	<.0001
$\gamma_{11n} - \gamma_{11e}$	Linear time slope difference between groups	**-1.51**	0.28	<.0001
$\gamma_{21n} - \gamma_{21e}$	Quadratic linear slope difference between groups	**0.24**	0.07	0.0002
			Middle School	
$\gamma_{02n} - \gamma_{02e}$	Intercept difference between groups	**9.78**	0.57	<.0001
$\gamma_{12n} - \gamma_{12e}$	Linear time slope difference between groups	-0.54	0.40	0.18
$\gamma_{22n} - \gamma_{22e}$	Quadratic linear slope difference between groups	-0.04	0.09	0.65
			High School	
$\gamma_{00n} - \gamma_{00e}$	Intercept difference between groups	**14.75**	0.93	<.0001
$\gamma_{10n} - \gamma_{10e}$	Linear time slope difference between groups	-0.86	0.88	0.33
$\gamma_{20n} - \gamma_{20e}$	Quadratic linear slope difference between groups	0.04	0.21	0.97
Model for the Variance				
Non-ESOL	District Random Intercept Variance	**7.13**	1.01	<.0001
	School Random Intercept Slope	**31.66**	1.36	<.0001
	Residual Variance	**19.52**	0.21	<.0001
ESOL	District Random Intercept Variance	**23.45**	4.41	<.0001
	School Random Intercept Slope	**18.27**	1.47	<.0001
	Residual Variance	**69.69**	1.07	<.0001
Cross Variable Covariances				
	District Random Intercept	**3.49**	1.43	0.01
	School Random Intercept	**5.76**	1.03	<.0001
	Residuals	**6.95**	0.42	<.0001
REML Model Fit				
	Number of Parameters	27		

-2LL	183131.6
AIC	183149.6
BIC	183183

Note. Bold values are $p < .05$.

Summary of the results. When the categorical predictor of school level was added to the models for question 2, the outcome became more precise. A comparison of the gap of effects between the non-ESOL and ESOL groups' outcomes by school levels suggested that high school non-ESOL and ESOL groups were expected to have the widest gap among the three levels, but the gap between high school groups was expected to decrease most quickly over five years. Figure 4.6 shows that 14.75 was the predicted gap of effects on outcomes between the high school non-ESOL and ESOL groups whereas 8.1 was the predicted gap in reading between the elementary school groups. The gap of outcome between high school groups, 14.75, was expected to decrease to 11.43 in 2013 with a difference of 3.32 from 2009 to 2013, while the gap of reading between elementary school groups was expected to decrease from 8.1 to 5.9 with a difference of 2.2 from 2009 to 2013. This result indicated that the gap between high school groups was widest and did not narrow as much as the gap in elementary school groups. Figure 4.6 shows the predicted trajectories of the gap in outcomes between the non-ESOL and ESOL groups for elementary, middle, and high school respectively.

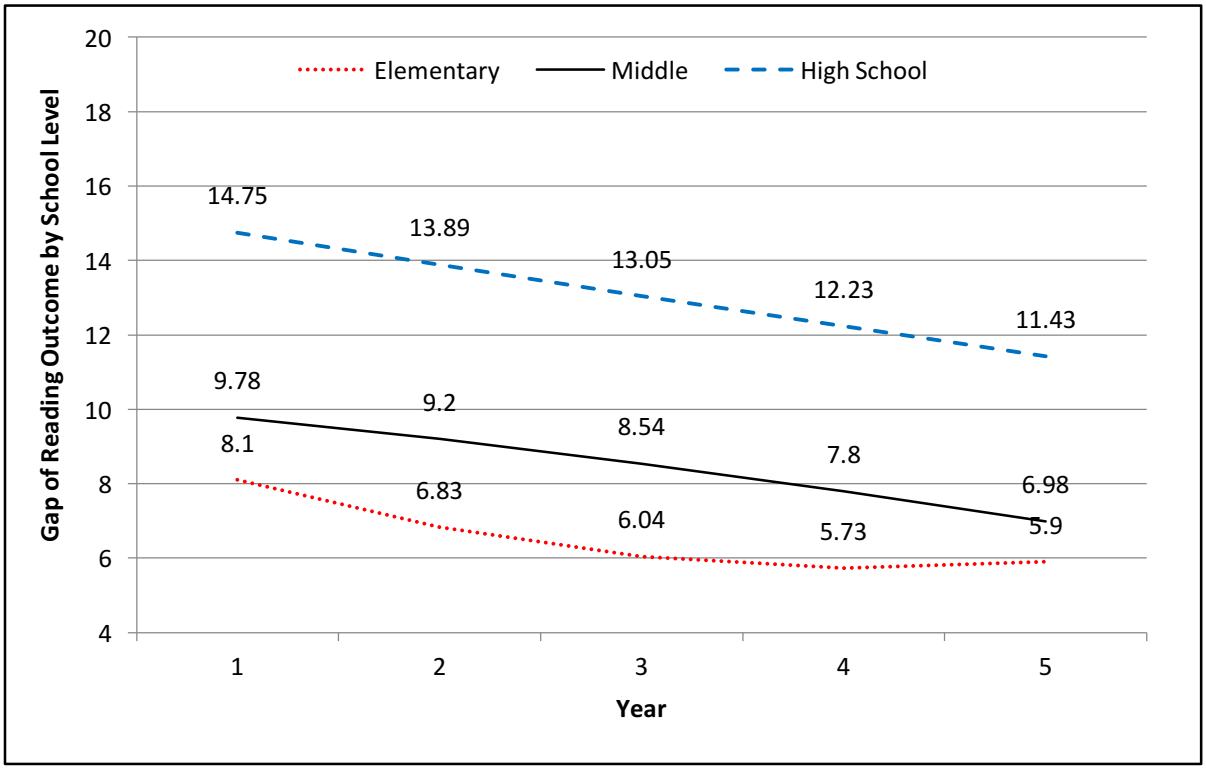

Figure 4.6. Predicted trajectories of the gap in reading outcome by school levels

When the gaps of effects between high school and elementary school ESOL groups and high school and elementary non-ESOL groups were compared, the gap between high school and elementary ESOL groups was significantly wider than the gap between the non-ESOL groups. The gaps in outcomes between high school and elementary school ESOL groups was expected to be 2.95 with a significant linear rate of –1.2 and with twice the quadratic effect of time by 0.14. The gaps in outcomes of ESOL groups between high school and elementary school was expected to be 9.6 with a nonsignificant linear rate of –0.54 and twice the quadratic time rate of –0.1. This finding suggested that elementary ESOL group's reading didn't improve as much as the non-ESOL group's improved in reading achievement. ESOL groups in high schools still lagged behind their peer groups. Figure 4.7 shows the predicted trajectories of the gap in outcomes

between the non-ESOL high school and elementary school groups and the gap between outcomes of the ESOL high school and elementary school groups.

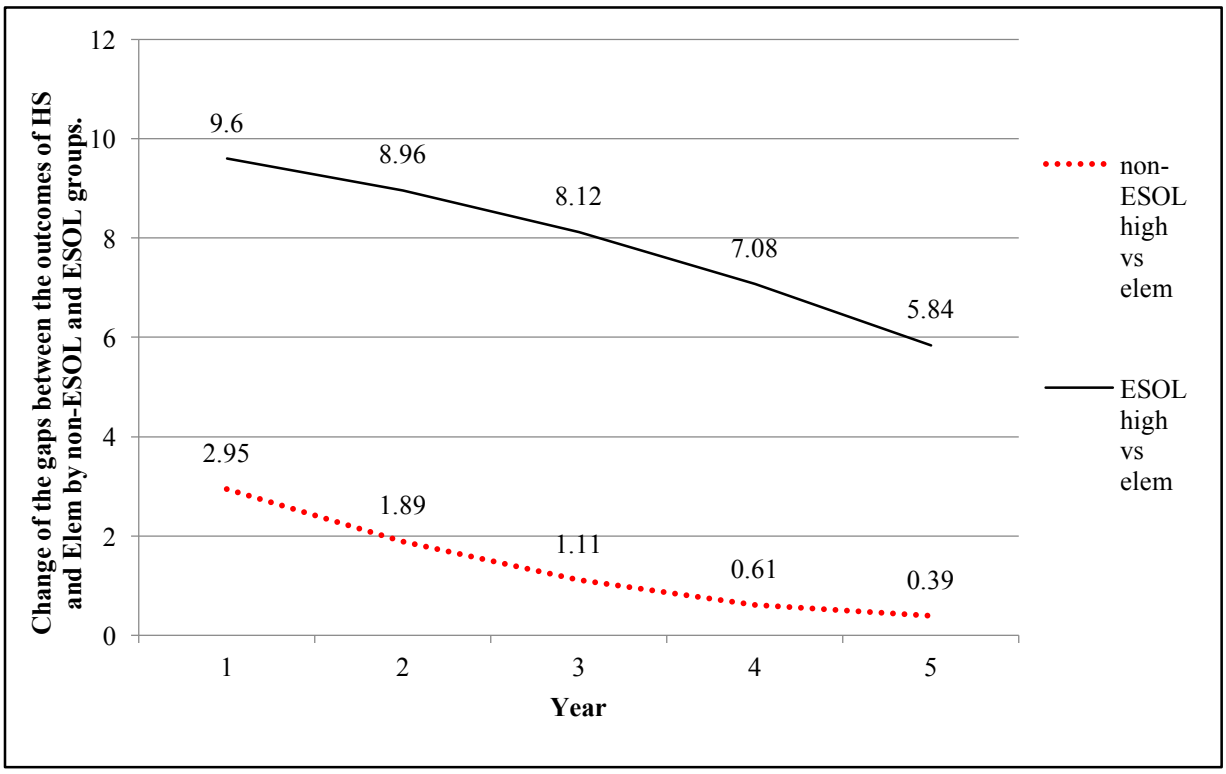

Figure 4.7. Predicted changes of the gap between high school vs elementary school non-ESOL group and high school vs elementary school ESOL groups' reading outcome

Models for Question 4 (Adding Two Time-Varying Predictors)

Models for question 4 were constructed to answer the last question *4. How is the gap between non-ESOL and ESOL groups' reading outcomes moderated by the percentage of highly qualified ESOL teachers and ESOL students in each class?* Two time-varying predictors−qualified ESOL teachers and ESOL students−were added to the model for question 3 (the model for change over time by school levels) in order to see how much reading outcomes of the two groups within each school level were moderated by these effects per year. Because non-ESOL and ESOL groups were nested within a school, and a school nested within a district, a three-level model of level-1 occasions nested within level-3 schools, and then nested within level-4 districts was used for the data analyses of the univariate model.

Two time-varying predictors are the percentage of qualified ESOL teachers, which was divided by the number of students in each class, and the number of ESOL students, which was divided by the total number of students in each class. The proportion of these numbers was then transformed to a percentage to make it easier to understand the effects on non-ESOL and ESOL groups' reading outcomes. As the reading outcomes of non-ESOL and ESOL groups were nested within each of the three levels, the effects of these predictors were expected to differ by levels. Each variable, therefore, was partitioned into per-level observed variables to convey level-specific variations. That is, the within-class, level-1 variables represented the variation of each occasion relative to the level-2 class mean which was constant because there was no variation between the level-2 class mean. The within-district, level-3 variables represented the variation of each school relative to the level-4 district mean; the between-district level-4 variables represented the variation of each district relative to the sample grand means of each predictor. Descriptive statistics for each variable at each level are provided in Table 4.8.

Table 4.8.

Descriptive Statistics per Level for All Variables in the Clustered Longitudinal Data

Level		*Variables*	*# of ob.*	*Mean*	*SD*	*Min.*	*Max.*
1	within class (occasion)	reading mean	28455	77.97	9.27	7.00	100.00
		ESOL teacher percent	28457	4.30	6.38	0.00	87.50
		ESOL student percent	28457	10.56	16.67	0.00	100.00
3	within district (school)	reading mean	28457	77.97	5.82	32.16	90.28
		ESOL teacher percent	28457	4.31	6.28	0.00	67.65
		ESOL student percent	28457	10.57	15.92	0.00	84.30
4	between district	reading mean	28457	77.97	4.11	66.14	88.22
		ESOL teacher percent	28457	4.31	5.04	0.00	46.30
		ESOL student percent	28457	10.57	12.44	0.00	59.53

Note. # of ob: number of observations; SD: Standard Deviation; Min: minimum; Max: maximum

Three models were used to address research question 4. First, the four-level empty means random intercept model for the percentage of ESOL teachers and ESOL students was estimated. Estimating the empty means random intercept model for these predictors as outcomes allowed me to examine how much the variability in the four level predictors was due to the variability in each level (e.g. within-class, within-district, and between-districts) which, in turn, was relevant in predicting the change of reading outcomes. Second, predictors that had significant variability in their level were added to model 3 (four-level model for change over time with school levels) to examine how much the effects of ESOL teacher and ESOL student predictors moderated the reading outcomes of non-ESOL and ESOL groups. Finally, in order to address the question concerning the gap between the two groups' reading outcomes after adding two time-varying

predictors, the multivariate model was used to estimate the gap of effects on the two groups' reading outcomes after moderating for the effects of the two predictors. As the two predictors were added to the univariate model for question 3, the gap of effects of the percentage of ESOL teachers and the percentage of ESOL students between the outcomes will be examined by adding these predictors to the multivariate model for question 3. If the effects are not significant, they are not mentioned.

Empty model Intraclass Correlations Coefficients (ICCs) for the ESOL teacher predictor.

Non-ESOL group. A two-level empty means, random intercept model of time nested within class was initially specified and indicated that 95.2% of the teacher percent variance was between-classes (and above) and 4.8% of the variance was within-class. The addition of a random intercept for level-3 between-school and above resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 11{,}360.4$, $p < .0001$ and revealed that 100% of that 95.2% between-class variance was actually across schools. That is, 96.4% of total variance was between schools (level-3), 0% was between classes (level-2), and 3.6% was within class over time (level-1). The addition of a random intercept for level-4 between districts resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 589.7$, $p < .0001$ and revealed that 96.9% of total variance was between class and above (level-2,3,and 4), and 3.1% was within class over time (level-1). That is, 60.5% of total variance was between-districts (level-4), 36.5% was between schools (level-3), 0% was between classes and 3.1% was within-classes over time (level-1). Fitting this four level qualified ESOL teacher percentage provided a fixed intercept of $\gamma_{0000} = 3.44$ (SE = 0.35), indicating that the non-ESOL group had 3.44 % ESOL teachers on average across a year.

ESOL group. The ESOL group's four-level empty means, random intercept model for ESOL teachers resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 407.3$, $p < .0001$, relative to the three-level empty means, random intercept model, indicating that 0.7% of the variance was over time, whereas 34.9% of the variance was across schools and 64.3% of the variance was across districts (with 0% class level variance). This four-level model for qualified ESOL teacher percent provided a fixed intercept of $\gamma_{0000} = 5.07$ (SE = 0.537) indicating that the ESOL group had the 5.07% ESOL teachers on average across a year. Together, the ICCs from Equation 4.3 indicate that, of the total variation in qualified ESOL teacher percent over time, 99.3% was across schools and districts; of that 99.3%, 64.3% was actually between-districts and 34.9% was between schools (no class-level variance at level 2).

***Group comparison*.** The analysis of the four-level empty model for the teacher predictor variance of districts shows that there was no variance between classes in both non-ESOL and ESOL groups' outcome, and the district showed similar proportions of variance of teacher predictor for ESOL and non-ESOL groups (60.5% of variance of ESOL group vs 64.3% of variance of non ESOL group), and the ESOL group had more ESOL teachers in their classes. Table of model fits and proportion of variance of two-level, three-level, and four-level empty model for non-ESOL and ESOL groups is below.

Table 4.9.

Table of Model Fits and Proportion of Variances at Each Level for Time-Varying Predictors

Non-ESOL group						
	Level	*-2ΔLL (~1)*	*P-value*	*Variance*	*SE*	*Proportion Variance*
2 level model	within-class			1.62	0.02	1.62/33.58 = .048
	between-class			31.96	0.69	31.97/33.57 =.952
3 level	within-class	11360	<.0001	1.57	0.07	1.57/43.07 =.036
	within-school			0	.	0
	between- school			41.48	1.53	41.5/43.07 =.964
4 level	within-class	589.7	<.0001	1.57	0.017	1.57/51.33 =.031
	within-school			0	.	0
	within-district			18.73	0.78	18.73/51.33 =.365
	between- district			31.03	3.14	31.03/51.33 =.605
ESOL Group						
2 level model	within-class			0.62	0.01	0.62/43.31 =.014
	between-class			42.69	1.17	42.69/43.31 =.986
3 level	within-class	9444.4	<.0001	0.53	0.008	0.52/55.33 =.010
	within-school			0	.	0
	between- school			54.81	2.46	54.80/55.33 =.990
4 level	within-class	407.3	<.0001	0.53	0.008	0.53/71.52 =.007
	within-school			0	.	0
	within-district			25.00	1.25	25.00/71.52 =.349
	between- district			45.99	5.77	45.99/71.52 =.643

Empty model Intraclass Correlations Coefficients (ICCs) for ESOL student predictor.

Non-ESOL group. Next, the empty model for the percentage of ESOL students was examined. The model fit of the four level empty means, random intercept model for the non-ESOL group resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 794.2$, $p < .0001$, relative to the three level empty means, random intercept model, indicating that 10.8% of the variance was over time, whereas 45.5% of the variance was across schools and 43.6% of the variance was across districts.

This four-level model for ESOL student percent provided a fixed intercept of $\gamma_{0000} = 4.96$ (SE = 0.62), indicating that the non-ESOL group had 4.96 percent ESOL students on average in their class across a year. Together, the ICCs from Equation 4.3 indicate that, of the total variation in ESOL student percentage over time, 89.2% was across schools and districts. Of that 89.2%, 49.0% was actually between districts and 51.0% was between schools within the same district. No class-level variance was estimated.

ESOL group. The model fit of the four level empty means, random intercept model for the non-ESOL group resulted in a significant improvement in model fit, $-2\Delta LL(\sim 1) = 452.3$, $p < .0001$, relative to the three level empty means, random intercept model, indicating that 13.5% of the variance was over time, whereas 45.4% of the variance was across schools and 41.2% of the variance was across districts. No class-level variance was estimated. This four-level model for ESOL student percentage provided a fixed intercept of $\gamma_{0000} = 10.38$ (SE = 0.92) indicating that the ESOL group had 10.38 percent ESOL students on average in their class across a year Together, the ICCs from Equation 4.3 indicate that, of the total variation in ESOL student

percentage over time, 86.5% was across schools and districts; of that 86.5%, 47.6% was actually between districts, and 52.4% was between schools within the same district.

***Group comparison*.** The analysis of the four-level model for ESOL student predictor showed that the variance of districts for ESOL and non-ESOL groups' outcomes was similar (49% variance of non-ESOL group vs 47.6% variance of ESOL group), and the ESOL group had a greater percentage of ESOL students in their classes. No variance of class level for both groups was estimated. Table of model fits and the proportion of variance of the two level, three level, and four level empty model for non-ESOL and ESOL groups is below.

Table 4.10.

Model Fits and Proportion of Variation at Each Level for ESOL Students

Non-ESOL group						
	Level	*-2ΔLL(~1)*	*P-value*	*Variance*	*SE*	*Proportion Variance*
2 level model	within-class			22.13	0.26	22.13/224.07 =.10
	between-class			201.94	4.44	201.94/224.07 =.90
3 level	within-class	9603.9	<.0001	21.38	0.23	21.38/230.62 =.09
	within-school			0	.	0
	between- school			209.24	7.75	209.34/230.62 =.91
4 level	within-class	794.2	<.0001	21.37	0.23	21.37 /197.01 =.108
	within-school			0	.	0
	within-district			89.63	3.71	89.63 /197.01 =.455
	between- district			86.00	8.89	86.00/197.01 =.436
ESOL Group						
2 level	within-class			39.82	0.67	39.82/303.22 =.13
	between-class			263.36	7.53	263.4/303.22 =.87
3 level	within-class	4884.6	<.0001	37.59	0.57	37.59/301.15 =.12
	within-school			0	.	0
	between- school			263.55	12.04	263.55/301.15 =.88
4 level	within-class	452.3	<.0001	37.57	0.57	37.57/278.46 =.14
	within-school			0	.	0
	within-district			126.30	6.40	126.30/278.46 =.454
	between- district			114.59	15.32	114.59/278.46 =.412

It was found that both non-ESOL and ESOL groups' class level variances of qualified ESOL teacher and ESOL student percentage was 0. The between class level variance of reading outcomes for the ESOL group was also 0, and the variance for the non-ESOL group was only 0.99. (Only 2.4 % was due to class difference out of the total variances.) Therefore, in order to make a parsimonious baseline model, the class level was not retained for the model for question 4. The effects of ESOL teacher and ESOL student predictors were then added to the model for change over time with the school level predictor.

Four-level model for the effects of two time-varying predictors without level-2.

When four level empty means random intercept models for ESOL teacher and ESOL student predictors were examined, there was no level-2 variation across classes. Therefore, the within-class level-1 variable was indicated by the difference at each occasion class mean. The within-district, level-3 variable was indicated by each district mean subtracted from each school mean. Between-district, level-4 variation was indicated by the group mean of each predictor variable subtracted from each district mean. Our new model including level-1(time), level-3 (school), and level-4 (district) effects of qualified ESOL teachers and ESOL student percentage on the non-ESOL and ESOL groups' reading outcome is shown in Equation (4.4). The addition of the effects of two predictors accounted for an additional 5.72% of the reading outcome variance for the non-ESOL group and ~0% of the outcome variance for the ESOL group. This model accounted for 7.04% of the total outcome variance for the non-ESOL group and 5.3% of the total variance for the ESOL group. The four-level model for the effects of two time-varying predictors predicting non-ESOL and ESOL groups' outcomes is shown in composite form in Equation (4.5).

Equation (4.5)

Notation: t = level-1 time (occasion), s = level-3 school, d= level-4 district

teach04 = between-district level 4 ESOL teacher percentage

stud04 = between-district level 4 ESOL student percentage

teach03 = within-district level 3 ESOL teacher percentage

stud03 = within-district level 3 ESOL student percentage

teach01 = within-class level 1 ESOL teacher percentage

stud01= within-class level 1 ESOL student percentage

$$
\begin{aligned}
Y_{tsd} = [&\gamma_{000} + \gamma_{010}(\text{elementary}) + \gamma_{020}(\text{middle}) + \gamma_{001}(\text{teach04}_d) + \gamma_{002}(\text{stud04}_d) + \\
&\gamma_{003}(\text{teach03}_{sd}) + \gamma_{004}(\text{stud03}_{sd}) + \gamma_{005}(\text{teach01}_{tsd}) + \gamma_{006}(\text{stud01}_{tsd}) + \\
&\gamma_{021}(\text{teach04}_d)(\text{middle}) + \gamma_{022}(\text{stud04}_d)(\text{middle}) + \\
&\gamma_{023}(\text{teach03}_{sd})(\text{middle}) + \gamma_{024}(\text{stud03}_{sd})(\text{middle}) + \\
&\gamma_{025}(\text{teach01}_{tsd})(\text{middle}) + \gamma_{026}(\text{stud01}_{tsd})(\text{middle}) + \\
&\gamma_{011}(\text{teach04}_d)(\text{elementary}) + \gamma_{012}(\text{stud04}_d)(\text{elementary}) + \\
&\gamma_{013}(\text{teach03}_{sd})(\text{elementary}) + \gamma_{014}(\text{stud03}_{sd})(\text{elementary}) + \\
&\gamma_{015}(\text{teach01}_{tsd})(\text{elementary}) + \gamma_{016}(\text{stud01}_{tsd})(\text{elementary}_i) + S_{0sd} + D_{00d}] + \\
&[\gamma_{100} + \gamma_{120}(\text{middle}) + \gamma_{110}(\text{elementary}) + S_{1sd} + D_{10d}](\text{time}_{tsi}) + \\
&[\gamma_{200} + \gamma_{220}(\text{middle}) + \gamma_{210}(\text{elementary})](\text{time}_{tsi})^2 + e_{tsd}
\end{aligned}
$$

Elementary School.

Non-ESOL group. The results of the univariate model suggested that when there were 1 percent more ESOL teachers in the district, the elementary non-ESOL group's outcome was expected to become greater by 0.19 (γ_{011}= 0.19, p =.02). The effects of the ESOL student predictor on the non-ESOL group's outcome were expected to be significant or marginally significant for all three levels. When there are 1 percent more ESOL students in the class, the non-ESOL group's outcome was expected to become greater by 0.02 during that year than as compared to outcome of the group with an average percent of ESOL students in the class (γ_{016}= 0.02, p =.05). When there were 1 percent more ESOL students in the school, the non-ESOL group's outcome at that school was expected to become less by–0.13 (γ_{014}=–0.13, p <.0001). When there were 1 percent more ESOL students in the district, the outcome of the non-ESOL group was expected to become less by −0.15 (γ_{012} = –0.15, p<.0001).

ESOL group. Only the interaction effect with the within-district, ESOL student predictor with the elementary school ESOL group was significant. The results of the model suggest that when there are 1 percent more ESOL students in the school, the ESOL group's outcome is expected to become less by −0.15 (γ_{014}= −0.15, p = 0.02) than the outcome of the ESOL group at a school in which there is an average percentage of ESOL students.

Middle School.

Non-ESOL group. Among three different levels of non-ESOL group outcomes in which the ESOL teacher predictor had effects, the ESOL teacher predictor showed significant effects on within-class and between-district level outcomes. The results of the model suggested that when there were 1 percent more ESOL teachers in the class, the non-ESOL group's outcome in that class were expected to become less by –0.10 (γ_{025}= –0.10, p = 0.02) during that year. When the

district had 1 percent more ESOL teachers, the non-ESOL group's outcome was expected to become greater by 0.30 (γ_{021}= 0.30, p =.0004) than the non-ESOL group's outcome for a district in which there were average percent of ESOL teachers.

Regarding the effects of the ESOL student predictor, within district and between district ESOL student predictors had significant effects on middle school non-ESOL group's outcome. When there were 1 percent more ESOL students in the school, the non-ESOL group's outcome in that school was expected to become less by –0.12 (γ_{024}= –0.12, p = .0002) than the outcome of the ESOL group at the school, in which there was an average percentage of ESOL students. When there were 1 percent more ESOL students in the district, the outcome of the ESOL group in that district was also expected to become less by –0.16 (γ_{022}= –0.16, p <.0001) than the outcome of the ESOL group of that district in which there were an average percentage of ESOL students.

ESOL group. Regarding the effects of the ESOL teacher and ESOL student predictors on middle school ESOL group's outcomes, only the within-district, level-3 effect of the ESOL teacher predictor was significant. That is, when there were 1 percent more ESOL teachers in the school, the ESOL group's outcomes in that school were expected to become less by –2.53 (γ_{024}= –2.53, p = 0.03) than the outcome of the ESOL group in the school in which there was an average percentage of ESOL teachers.

High School.

Non-ESOL group. The ESOL teacher predictor had significant effects on the outcome of the non-ESOL group for school and district levels. When the non-ESOL group had 1 percent more ESOL teachers in their school, the outcome of the group was expected to become less

by –1.2 than the outcome of the group in the school in which there was an average percentage of ESOL teachers (γ_{003}= –1.20, p <.0001). When there were 1 percent more ESOL teachers in the district than the average number of ESOL teachers, the outcome of the group was expected to become greater by 0.24 than the outcome of the group in the district in which there was an average percentage of ESOL teachers (γ_{001}= 0.24, p =.01). The ESOL student predictor had significant and negative effects on the level-1 and level-3 outcomes. When there was 1 percent more ESOL students in the class, the non-ESOL group's outcome in that class was expected to become less by −0.06 (γ_{006} = −0.06, p = 0.04) than the group's outcome in the class in which there was an average percentage ESOL students. When the district had 1 percent more ESOL students, the outcome of the non-ESOL group in that district was also expected to become less by −0.20 (γ_{002} = −0.20, p <.0001) than the non-ESOL group's outcome in a district in which there was an average percentage of ESOL students.

ESOL group. None of the ESOL teacher and ESOL student effects was significant except the ESOL student predictor effect on the level-1 outcome. The outcome of the non-ESOL group in the class in which there were 1 percent more ESOL students was expected to become greater by 0.09 than the outcome of the group in the class in which there was average percentage of ESOL students (γ_{006}= 0.09, p =.05). Results of two time-varying predictor's effects on elementary, middle, and high school groups' outcomes are shown in Table 4.11.

Table 4.11.

Results of Two Time-Varying Predictor Effects on School Level Variables Outcome

Parameters		*Predicted Outcomes*					
		non-ESOL			*ESOL*		
		Est	*SE*	*p <*	*Est*	*SE*	*p <*
Model for the Means							
γ_{000}	Intercept (high)	**77.96**	0.38	<.0001	**61.52**	1.07	<.0001
γ_{100}	Linear Time Slope (high)	**1.81**	0.26	<.0001	**2.46**	0.87	0.005
γ_{200}	Quadratic Linear Time Slope (high)	**-0.33**	0.06	<.0001	**-0.33**	0.20	0.10
γ_{005}	within-class ESOL teacher (high)	0.05	0.03	0.13	0.07	0.07	0.33
γ_{006}	within-class ESOL student (high)	**-0.06**	0.03	0.04	**0.09**	0.04	0.05
γ_{003}	within-district ESOL teacher (high)	**-1.20**	0.29	<.0001	0.43	2.13	0.84
γ_{004}	within-district ESOL student (high)	-0.22	0.12	0.08	-0.15	0.24	0.52
γ_{001}	between-district ESOL teacher	**0.24**	0.09	0.01	0.08	0.17	0.64
γ_{002}	between-district ESOL student (high)	**-0.20**	0.05	<.0001	0.01	0.07	0.89
γ_{010}	Intercept (elementary)	**80.97**	0.28	<.0001	**72.67**	0.62	<.0001
γ_{110}	Linear Time (elementary)	**0.69**	0.11	<.0001	**2.35**	0.30	<.0001
γ_{210}	Quadratic Time (elementary)	**-0.21**	0.03	<.0001	**-0.50**	0.06	<.0001
γ_{015}	within-class ESOL teacher (elementary)	-0.03	0.03	0.31	0.01	0.05	0.80
γ_{016}	within-class ESOL student (elementary)	**0.02**	0.01	0.05	**-0.02**	0.01	0.08
γ_{013}	within-district ESOL teacher (elementary)	-0.09	0.18	0.63	0.65	0.66	0.32
γ_{014}	within-district ESOL student (elementary)	**-0.13**	0.03	<.0001	**-0.15**	0.06	0.02
γ_{011}	between-district ESOL teacher (elementary)	**0.19**	0.08	0.02	0.08	0.12	0.50
γ_{012}	between-district ESOL student (elementary)	**-0.15**	0.04	<.0001	0.03	0.06	0.65

γ_{020}	Intercept (middle)	**80.24**	0.28	<.0001	**69.89**	0.69	<.0001
γ_{120}	Linear Time (middle)	**1.17**	0.14	<.0001	**1.60**	0.41	<.0001
γ_{220}	Quadratic Linear Time (middle)	**-0.31**	0.03	<.0001	**-0.30**	0.09	0.002
γ_{025}	within-class ESOL teacher (middle)	**-0.10**	0.04	0.02	0.06	0.09	0.48
γ_{026}	within-class ESOL student (middle)	0.01	0.01	0.31	0.03	0.02	0.23
γ_{023}	within-district ESOL teacher (middle)	0.13	0.10	0.20	**-2.53**	1.16	0.03
γ_{024}	within-district ESOL student (middle)	**-0.12**	0.03	0.0002	0.06	0.07	0.44
γ_{021}	between-district ESOL teacher (middle)	**0.30**	0.08	0.0004	-0.12	0.14	0.38
γ_{022}	between-district ESOL student (middle)	**-0.16**	0.04	<.0001	0.06	0.06	0.34
Model for the Variance							
	District Random Intercept Variance	5.65	1.10	<.0001	26.94	6.64	<.0001
	District Random Linear Time Slope	0.07	0.04	0.04	1.01	0.35	0.002
	District Intercept-Time Slope Covariance	-0.01	0.16	0.95	-1.34	1.30	0.30
	School Random Intercept Variance	41.42	1.99	<.0001	33.24	3.16	<.0001
	School Random Linear Time Slope	1.19	0.10	<.0001	1.86	0.30	<.0001
	School Intercept-Time Slope Covariance	-3.62	0.36	<.0001	-5.48	0.86	<.0001
	Residual Variance	17.37	0.20	<.0001	64.29	1.04	<.0001
REML Model Fit							
	Number of Parameters	34			34		
	- 2LL	113312.7			69306.2		
	AIC	113326.7			69320.2		
	BIC	113352.7			69343.0		

Note. Bold values are $p < .05$

Multivariate model for the gap of effects on outcomes after adding two time-varying predictors.

In this section, the gap of effects on the outcomes (i.e. intercept, linear and quadratic time slope rate) and the significant gap of effects of time-varying predictors between the non-ESOL and ESOL groups' outcomes by school levels will be discussed.

Elementary school. After adding the two time-varying predictors, the gap of the expected intercept outcomes between two groups became 8.20 when both groups had the average percentage of qualified ESOL teacher and ESOL student predictors at year = 1 ($\gamma_{01n} - \gamma_{01e} = 8.20$, $p < .0001$). The gap of effect, 8.20 was expected to become narrower significantly by a linear rate of −1.55 per year ($\gamma_{11n} - \gamma_{11e} = -1.55$, $p < .0001$) with twice the quadratic effect of time, 0.25 ($\gamma_{21n} - \gamma_{21e} = 0.25$, $p = .0002$) per year. That means, the gap was expected to decrease by a linear rate of −1.55, but the linear rate was expected to decelerate by twice the quadratic time rate of 0.25 for every additional year.

*The effects of the ESOL student predictor on the gap***.** Among the gap of effects of the ESOL teacher and ESOL student predictors for three levels, the ESOL student predictor had a significant effect on the gap of within-class level elementary school groups' outcomes. When there were 1 percent more ESOL students in the class, the gap of outcomes between groups was expected to decrease by–0.11 across year ($\gamma_{16n} - \gamma_{16e} = -0.11$, $p = .02$).

Middle school. The gap of fixed effect, 10.02 was the predicted gap of intercept outcome between middle school non-ESOL and ESOL groups, specifically when both groups had the average percentage of qualified ESOL teachers and ESOL students at year = 1 ($\gamma_{02n} - \gamma_{02e} = 10.02$, $p < .0001$). The gap of outcome, 10.02 was expected to decrease by −0.50 ($\gamma_{12n} - \gamma_{12e} =$

−0.50, p =.21) per year with accelerating by twice the quadratic linear time effect of −0.04 for every additional year ($\gamma_{21n} - \gamma_{21e} = -0.04$, p =.65).

The effects of the ESOL teacher predictor on the gap. The results of the multivariate model suggested that the ESOL teacher predictor had a significant effect on the within-district level gap of outcomes between middle school groups. When the school had 1 percent more ESOL teachers, the gap of effects on outcomes was expected to widen by 2.38 across a year than the gap of outcomes between the groups at the school in which there are an average percentage of ESOL teachers ($\gamma_{23n} - \gamma_{23e} = 2.38$, p =.04).

High school. The fixed effect for the mean difference, 16.25, was the predicted gap of intercept outcomes between the high school non-ESOL and ESOL groups, specifically when both groups had the average percentage of qualified ESOL teacher and ESOL student predictors at year = 1 ($\gamma_{00n} - \gamma_{00e}$ =16.25, p <.0001). The gap of outcome, 16.25, was expected to decrease by –0.82 per year ($\gamma_{10n} - \gamma_{20e} = -0.82$, p =.35) with decelerating by twice the quadratic effect of time by 0.02 for every additional year ($\gamma_{20n} - \gamma_{20e} = 0.02$, p =.93) although these linear and quadratic linear time effects were not significant. The predicted changes of the outcome gaps for the models for Question 3 and Question 4 are compared in Figure 4.8.

The effects of the ESOL student predictor on the gap. The ESOL student predictor showed significant effects on the gap of high school within-class and between-district level gap of outcomes. When the class had 1 percent more ESOL students, the gap of outcomes between the high school groups in that class was expected to widen by 0.03 across a year than the gap of effects between the groups in which there was average percentage of ESOL students ($\gamma_{06n} - \gamma_{06e} = 0.03$, p =.05). In addition, when the district had 1 percent more ESOL students, the gap of outcomes between the groups was expected to narrow by–0.15 across a year than the gap of

effect between the groups in the district in which there was an average percentage of ESOL students ($\gamma_{02n} - \gamma_{02e} = -0.15$, $p = .01$). Table 4.12 shows the results of the two models to compare the gaps of effects from the question 3 model and the question 4 model. The Figure 4.8 demonstrates that adding the time-varying predictors does not seem to contribute to a change of the gap of effects on the elementary school group's outcomes whereas the two predictors seemed to contribute to change the gap of outcomes for the middle school groups and high school groups. Furthermore, the gap of outcomes between high school groups was expected to become wider after adding the two time-varying predictors, more than the gap between middle school groups.

Table 4.12.

Model Fit and Results for the Multivariate Model for the Gap of Effects

Parameters		*Model for the Gap of Effects*					
		Q3 Model			*Q4 Model*		
		Est	*SE*	*p <*	*Est*	*SE*	*p <*
Model for the Means				Elementary School			
$\gamma_{01n} - \gamma_{01e}$	Gap of Intercept between groups	**8.10**	0.51	<.0001	**8.20**	0.56	<.0001
$\gamma_{11n} - \gamma_{11e}$	Gap of Linear time slope	**−1.51**	0.28	<.0001	**−1.55**	0.28	<.0001
$\gamma_{21n} - \gamma_{21e}$	Gap of Quadratic linear time slope	**0.24**	0.07	0.0002	**0.25**	0.07	0.0002
$\gamma_{16n} - \gamma_{16e}$	Gap of within-class ESOL student effect				**-0.11**	0.05	0.02
$\gamma_{15n} - \gamma_{15e}$	Gap of within-class ESOL teacher effect				0.04	0.07	0.58
$\gamma_{13n} - \gamma_{13e}$	Gap of within-district ESOL teacher effect				0.37	2.08	0.86
				Middle School			
$\gamma_{02n} - \gamma_{02e}$	Gap of Intercept between groups	**9.78**	0.57	<.0001	**10.02**	0.71	<.0001
$\gamma_{12n} - \gamma_{12e}$	Gap of Linear time slope	−0.54	0.4	0.18	−0.50	0.42	0.21
$\gamma_{22n} - \gamma_{22e}$	Gap of Quadratic linear time slope	–0.04	0.09	0.65	–0.04	0.09	0.64
$\gamma_{26n} - \gamma_{26e}$	Gap of within-class ESOL student effect				0.02	0.02	0.36
$\gamma_{23n} - \gamma_{23e}$	Gap of within-district ESOL teacher effect				**2.38**	1.17	0.04
$\gamma_{25n} - \gamma_{25e}$	Gap of within-class ESOL teacher effect				0.08	0.09	0.35
				High School			
$\gamma_{00n} - \gamma_{00e}$	Gap of Intercept between groups	**14.75**	0.93	<.0001	**16.25**	1.19	<.0001
$\gamma_{10n} - \gamma_{10e}$	Gap of Linear time slope	−0.87	0.88	0.33	−0.82	0.88	0.35
$\gamma_{20n} - \gamma_{20e}$	Gap of Quadratic linear time slope	0.04	0.21	0.97	0.02	0.21	0.93

$\gamma_{06n} - \gamma_{06e}$	Gap of within-class ESOL student effect				0.03	0.01	0.05
$\gamma_{02n} - \gamma_{02e}$	Gap of between-district ESOL student effect				**-0.15**	0.58	0.01
$\gamma_{05n} - \gamma_{05e}$	Gap of within-class ESOL teacher effect				-0.02	0.06	0.7
$\gamma_{03n} - \gamma_{03e}$	Gap of within-district ESOL teacher effect				-0.76	0.68	0.26
$\gamma_{01n} - \gamma_{01e}$	Gap of between-district ESOL teacher effect				0.08	0.13	0.51
Model for the Variance							
Non-ESOL	District Random Intercept Variance	**7.13**	1.01	<.0001	**6.70**	1	<.0001
	School Random Intercept Slope	**31.66**	1.36	<.0001	**23.00**	4.34	<.0001
	Residual Variance	**19.52**	0.21	<.0001	**19.50**	0.21	<.0001
ESOL	District Random Intercept Variance	**23.45**	4.41	<.0001	**23.00**	4.34	<.0001
	School Random Intercept Slope	**18.27**	1.47	<.0001	**18.48**	1.49	<.0001
	Residual Variance	**69.69**	1.07	<.0001	**69.44**	1.07	<.0001
Cross Variable Covariances							
	District Random Intercept	**3.49**	1.43	0.01	**3.42**	1.42	0.02
	School Random Intercept	**5.76**	1.03	<.0001	**6.00**	1.04	<.0001
	Residuals	**6.95**	0.42	<.0001	**6.91**	0.42	<.0001
REML Model Fit							
	Number of Parameters	27			45		
	- 2LL	183132.0			183137.0		
	AIC	183150.0			183155.0		
	BIC	183183.0			183188.0		

Note. Bold values are $p < .05$

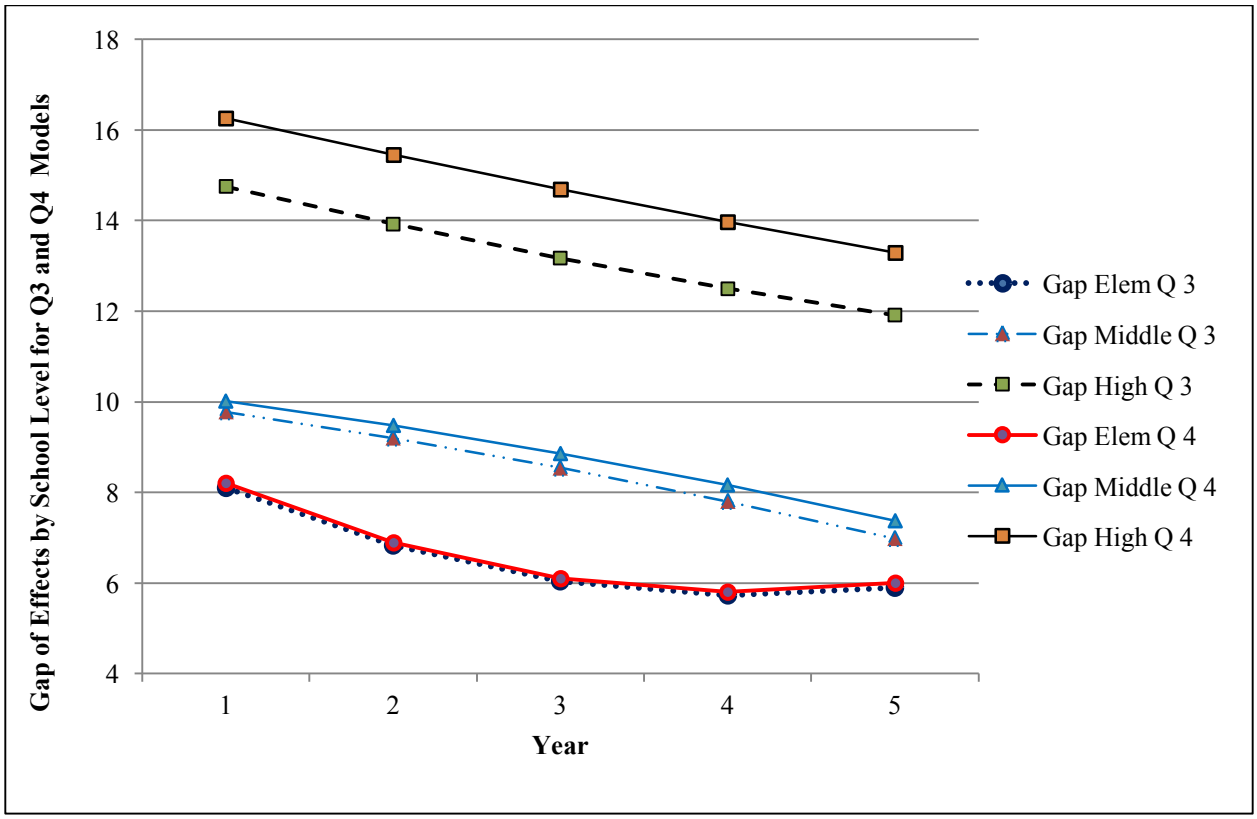

Figure 4.8. The trajectories of change of the gap between the effects of the model for question 3 and the effects of the model for question 4 by school levels

Summary of the results. The addition of the percentage of qualified ESOL teachers and the percentage of ESOL students as time-varying predictors was expected to contribute to change of reading outcomes of the non-ESOL and ESOL groups over time as well as narrowing or widening of the gap in outcomes between the two groups. The results of the multivariate model examining the gap of effects on the outcome suggested that the ESOL student predictor had significant effects on the gap of within-class elementary and high school groups' outcomes and the gap of between-district high school groups' outcome. The ESOL teacher predictor was expected to have a significant effect on the gap of within-district middle school groups' outcomes.

The results of the univariate model suggested that when the ESOL student predictor was examined by within-class, within-district, and between-district levels, the ESOL student predictor had negative effects on within-district and between-district level outcomes of both the non-ESOL and ESOL groups. That means, when the school and district had more ESOL students, the reading outcomes of the groups in that school and district were expected to become less. The effect of the ESOL teacher predictor was expected to have significant effects on the outcome of the non-ESOL group rather than the outcome of the ESOL group. The results of the model suggested that the outcomes of the non-ESOL group were expected to become greater when the district had more ESOL teachers. However, when the school had more ESOL teachers, the outcomes of the high school non-ESOL group and middle school ESOL group were expected to become significantly less. In addition, when the class had more ESOL teachers, the outcome of the middle school non-ESOL group was expected to become less as well. The results of the question 4 models suggest that the outcome of the high school non-ESOL group was expected to

be affected the most by the effects of two time-varying predictors among the outcomes of three school levels' non-ESOL and ESOL groups.

Chapter Five: Conclusions

This study was conducted with the main purpose of examining whether the reading achievement gap between non-ESOL and ESOL groups became narrower or wider across the five years of data collected while considering the moderating effect of qualified ESOL teachers and the impact of ESOL student percentage. The study used data from the annual reading assessment outcome averaged by the number of students who took the exam at public schools in the state of Kansas. Using a multilevel model of growth made it possible to examine the changes in the achievement gap between non-ESOL and ESOL groups across five years as well as the effect of a categorical predictor (elementary, middle, high school level) and the effect of two time-varying predictors. The two time-varying predictors were the annual percentage of highly qualified ESOL teachers and the annual percentage of ESOL students. In addition, using a multilevel model allowed examination of how much the non-ESOL and ESOL groups' outcomes were dependent on the school and the district. This chapter begins with a discussion of the study's implications and limitation along with directions for future research. It also includes a summary of the results of the study.

Study's Implications and Contributions

This multilevel longitudinal study examined the difference in outcomes between non-ESOL and ESOL groups by analyzing the data of student standard reading test scores collected from 2009 to 2013. By assessing the results of a series of models for the reading outcomes of each group along with the gap in outcomes between the non-ESOL and ESOL groups in the previous section, I concluded that the reading outcomes for each group have changed significantly over time along with the gap of the outcomes between the two groups. In addition,

the reading outcomes of each school level (i.e. elementary, middle, and high school) were expected to change significantly over time. Finally, the number of ESOL students and the number of teachers trained to teach ESOL students affected the outcome of each group as well as the gap between groups depending on the levels involved (i.e. within-class, within-district, and between district). When examining the gap of effects of time on each group's outcomes by school levels, the gap between the high school non-ESOL and ESOL groups was significantly wider than elementary and middle school groups. Recent research in other cities and states (i.e. California, New York City) has paid attention to the academic underachievement of long-term English Leaners (Menken, 2014). Follow-up research regarding long term English Language learners in Kansas public schools is needed to determine which factors cause high school ESOL students to be delayed in catching up with their peer group in terms of reading achievement in the Kansas public schools.

Effects of the increase of ESOL students at schools. The rapid increase of ESOL students in schools gave this researcher two motivations to conduct this study. The first interest was to determine if there actually exists a gap in reading achievement between non-ESOL and ESOL groups or not and, if so, how the gap has changed across five years. The second motivation was to find out if the change in ESOL student percentage had an effect on students' reading achievement or not. Since research on this relationship between the number of ESOL students and students' reading achievement is scarce, this study could provide substantial data for future research and academic action.

In recent years, the number of ESOL students has dramatically increased in public schools in every state. In particular, Kansas has had the largest ESOL percentage-point increase in the country during the last ten years. In Kansas public schools, the National Center for

Education Statistics (NCES) reported that 3.8% of students were in the ESOL group in 2003, a figure which increased to 8.5% by 2013. This study was conducted to investigate the impact of the ESOL student increase on students' reading achievement.

In this study, the average percent of ESOL students was calculated to be 10.56%. This percentage is larger than the report of NCES because it was calculated differently. The number of ESOL students who took the reading assessment test was divided by the total number of students who actually took the test instead of the total number of students enrolled in the school. However, according to the data used for this study, the average percentage of ESOL students also increased significantly over those five years across all school levels. At the elementary school level, the average percent of ESOL students in 2009 was 11.23%; it had increased to 14.39% in 2013. In middle schools, ESOL students made up 6.53% of the classes in 2009, a figure that had increased to 9.48% in 2013. In high schools, the 3.85% of ESOL students in the student body had increased to 5.42% by 2013.

This study revealed that the significant increase of ESOL students in the classroom not only influenced the ESOL group's academic achievement but also the outcome of the non-ESOL group by different levels (within-class, within-district, and between-district). In fact, the high school non-ESOL group's outcome was negatively correlated with the percentage of ESOL students at all three levels. That is, when there were more high school ESOL students in the class, in the school, and in the district, the reading outcomes of non-ESOL group were expected to become less. Regarding the reading achievement of the elementary and middle school non-ESOL groups, the increase in ESOL students was negatively correlated with within-district and between-district level outcomes of the non-ESOL group. It might be speculated that the classroom, the school, and the district in which there are large populations of ESOL students

have different learning environments and educational policies than those with a smaller ESOL student population. To find out what other factors influence the relationship between the increase of ESOL students in the classroom and the non-ESOL group's reading outcome, follow-up research needs to include other predictors and focus on a smaller number of schools or districts.

Effects of ESOL teacher training. Data collected from the Kansas State Department of Education (KSDE) showed that the percentage of teachers qualified to teach ESOL students has remained very low. For example, data from the Topeka public school district (D0501) showed that while the percentage of ESOLs increased from 6.2% to 13.2% between 2009 and 2013, the percentage of teachers with ESOL endorsement increased only from 2.4% to 2.7%. From the data used in this study, the average percent of ESOL teachers in elementary schools was 5.13% in 2013, only a 0.1% increase from 5.03% in 2009. At the middle school level, there was a 0.08% increase in ESOL teacher percentage (from 2.58% in 2009 to 2.66% in 2013) and in the high school, there was a 1.57% increase of ESOL teachers (from 3.85% in 2009 to 5.42% in 2013). Before discussing the effects of the percentage of ESOL teachers on the non-ESOL and ESOL group's reading outcomes and the gap in outcomes, it should be noted that there is an urgent need for schools and districts to have more qualified ESOL teachers who are trained to teach ESOL students.

This study showed that the ESOL teacher predictor had significant effects on different levels of the non-ESOL group's outcome rather than the ESOL group. Among the within-class, within-district, and between-district levels, the percentage of ESOL teachers was positively correlated with the between-district non-ESOL group's outcome at all school levels. When the district had more ESOL teachers, the non-ESOL group's outcomes at the elementary, middle, and high schools was expected to become greater. However, the outcomes of the within-class

middle school and within-district high school non-ESOL group were negatively correlated with the percentage of ESOL teachers. When the class had more ESOL teachers, the outcomes of the middle school non-ESOL group were expected to become less, and when the school had more ESOL teachers, the outcomes of the high school non-ESOL group were expected to become less. As these results are not the main focus of this study, it is only speculated that there might be other circumstances of the class and the school in demonstrating this negative correlation between ESOL teacher percentage and the outcome of non-ESOL groups. Since the percentage of ESOL teachers is the only information regarding teacher training available for this study, additional information regarding ESOL teacher training needs to be included in a follow-up study.

Concerning the ESOL teacher effect on the ESOL group's outcomes, only the within-district level ESOL teacher effect was negatively and significantly correlated with the middle school ESOL group's outcomes. That means that when the middle school had more ESOL teachers, the outcomes of the middle school ESOL group was expected to become less than the comparable outcomes of the ESOL group in a school which had only the average percentage of ESOL teachers. In sum, as the percentage of ESOL students was expected to affect the growth of the non-ESOL group's reading outcomes, the percentage of ESOL teachers was also expected to affect the growth of the non-ESOL group's outcomes in this study.

Regardless of other factors which were not considered in this study, providing substantive professional development opportunities for teachers is crucial for both non-ESOL and ESOL students' academic achievement. In addition, with the rapid increase of ESOL students, the learning environment for both the non-ESOL and ESOL groups has changed. Teachers are being urgently pressed to adapt themselves to this new environment. Through these

opportunities, teachers can help not only ESOL students reach their academic goals more effectively but also non-ESOL students who are struggling with reading development. In Kansas, the Kansas State Department of Education (KSDE) offers teachers two methods to become ESOL endorsed: taking ESOL courses plus the Educational Testing Service's PRAXIS II ESOL subject Exam©, or taking the PRAXIS II ESOL subject Exam© only. In order to provide deeper understanding of second language learning and the learning styles of students from linguistically and culturally different backgrounds, teachers are strongly encouraged to take college coursework. In this study data concerning which method individual ESOL teachers used to obtain an ESOL teaching endorsement was not included because this data was not available. In the future, to examine the effectiveness of ESOL teacher endorsement, ESOL teacher data needs to be collected and categorized by how ESOL teachers became endorsed (i.e. whether the teacher took college coursework and passed the PRAXIS II ESOL subject Exam© or passed only the PRAXIS II ESOL exam). Currently, KSDE does not differentiate between the two methods, collecting data only for ESOL teacher training.

Long-Term English Language Learners in Kansas Public Schools. According to the data used in this study, the percentage of ESOL students at the high school level was small (3.85% in 2009; 5.42% in 2013) when compared to the percentage of ESOL students at the elementary and middle schools, but the gap in outcomes between the non-ESOL and ESOL groups at this level was the biggest. Menken et al (2008) conducted research in the New York City district to identify the characteristics of long term English language learners. The first characteristic was that they received inconsistent ESOL services, and the second one was that they moved back and forth between the U.S. and their family's country of origin. Menken (2008) argued that "literacy is, therefore, a major concern in the education of all high school emergent

bilinguals, as academic literacy skills are essential for achievement, particularly within the high-stake testing climates." Short and Fitzsimmons (2007) also highlighted the need for increased attention to what they termed the emergent bilingual "academic literacy crisis." The outcome of this study, conducted for the non-ESOL and ESOL groups in Kansas public schools confirms the urgent need for development of high school ESOL students' academic literacy.

Limitations and Directions for Future Research

This study's findings should be considered with a number of limitations in mind. One of the first shortcomings of this study was the fact that the data was collected by group level and analyzed using the average test scores of the group. Even though this study used data collected from all public schools in Kansas, which in turn allowed it to provide valuable understanding of the gap between the non-ESOL and ESOL groups' reading achievement, any estimation based on the average scores of the groups could over- or underestimate the effects of time and other predictors on the gap. Due to the Family Educational Rights and Privacy Act (FERPA) regulation, data available for the current study could only use class level information.

Second, the scores of the Kansas English Language Proficiency Assessment have not been included in this study as the supplemental predictor for the percentage of ESOL students. If the predictor of ESOL student percentage was calculated using ESOL students' proficiency levels, the results of the ESOL student effect could have more accurately explained the relationship between the ESOL student predictor and students' reading outcome. In 2016, the KSDE (Kansas State Department of Education) launched a new digitalized assessment system, the English Language Proficiency Assessment for the 21st Century (ELPA21) in order to assess all areas of ESOLs' English proficiency levels more accurately. Therefore, a follow-up study

using the new data base of ESOL students taking ELPA21 will be able to examine more accurately the reading outcome gap between the non-ESOL and ESOL groups.

According to the program guidance for 2016-2017 available at the KSDE website, students who are qualified to receive ESOL services must receive those services from a "qualified" teacher. However, as discussed in the previous section, the requirement for teachers to be an ESOL endorsed teacher is relatively easy in Kansas compared to other states. For example, the departments of Education of Colorado and Florida require in-service and pre-service teachers to earn the endorsement through completion of state-approved-programs or meeting the coursework requirements for ESOL endorsement (Colorado Department of Education, Florida Department of Education), whereas in Kansas either taking the course work or passing the Praxis II ESOL subject exam allow the teachers to be endorsed. The difficulties of English language learners in reaching the academic standards of the regular curriculum (i.e. the standard for non-ESOL group's academic achievement) have not been given attention by teachers or administrators in Kansas until recent years.

One of the valuable implications of this study is that the data used in it was a Kansas state reading assessment where non-ESOL and ESOL groups were assessed by the same questions. Therefore, the outcomes of the reading assessment in which the non-ESOL and ESOL students took the same tests can be compared without any problem. As the results of this study show, the gap in reading outcomes between the high school non-ESOL group and the ESOL group is significantly wide, and the gap in outcomes between the elementary ESOL group and the high school ESOL groups became much wider than the comparable gap between elementary non-ESOL and high school non-ESOL groups. The results of this study can be used to provide insight and direction to improve class instruction, curriculums, and teacher training in the future.

If further research using a different subject's outcome (e.g. math) is conducted to compare the gap in reading outcomes between the non-ESOL and ESOL groups as well as within the ESOL group, it would provide more information regarding non-ESOL and ESOL students' academic achievement. In addition, further longitudinal research concerning long-term English language learners at the high schools in Kansas is also needed because the results of this study show that the gap in reading between the two groups at the high school level was the widest among three school levels. Furthermore, the gap in reading between elementary and high school ESOL groups was not expected to narrow as much as the gap in reading between elementary and high school non-ESOL groups.

The final R-squared (explained variance/ total variance) of this study was 7.04% for the non-ESOL group and 5.3% for the ESOL group. The 7.04% of the total residual variance for the non-ESOL group and 5.3% for the ESOL group were explained by time, school level, and ESOL teacher and ESOL student predictors. If further research adds more meaningful predictors (e.g., each school or district's annual budget or the percentage of group or school level eligibility for free or reduced cost lunches), the reading outcomes of the two groups and the gap in outcomes between the two groups could be more fully explained by showing the effect of these factors and how much they are correlated with reading outcomes.

Chapter Summary

The first hypothesis stated that the gap in reading outcomes between the non-ESOL and ESOL groups is significant and would change significantly over time. The findings of this study demonstrated that the gap in reading achievement between the non-ESOL and ESOL groups at all three school levels was significant and expected to narrow significantly over time.

The second hypothesis stated that the reading outcomes of the groups are similar if they are nested within the same school and district as compared to the reading outcomes of the group in different schools and districts. The findings of this study demonstrated that school and district level learning environments had significant effects on both groups' reading achievement. The results of the study suggested that the reading outcomes of the non-ESOL and ESOL groups were more similar to each other if they were nested within the same schools and districts. The results further suggested that while the reading outcomes of the non-ESOL group tended to be similar to each other within the same school, the ESOL group's outcomes tended to be more similar within the same district. It could be speculated that the variance of the ESOL group's outcomes was distributed more widely than the variance of the non-ESOL group's outcomes because the different English language proficiency levels of ESOL students were not considered. On the other hand, the difference in learning environment for ESOL groups or the difference in the policies of each district for ESOL services might be related to these results.

The findings of this study are related to those of Thomas and Collier's report (Thomas & Collier, 2002) regarding a school's and a district's impact on ESOL students' academic achievements. In their longitudinal study conducted at five large districts located in four different states with a large percentage of ESOL students, Thomas and Collier concluded that four important factors at the district level influenced the success of ESOL students' academic achievements. These factors are first, the potential quality of the types of programs for ESOLs; second, the high quality implementation of a program in terms of administrative support, teacher training, monitoring, and evaluating the outcomes; third, the quality of the school's instructional environment (e.g. including parent engagement, developing age-appropriate proficiency in both first and second languages, etc.); fourth, the quality of available instructional time used for

ESOL students to receive maximally comprehensive instruction. Further research is needed to determine what kinds of policies and programs the districts and schools in Kansas have for ESOL programs and ESOL teacher training.

The third hypothesis stated that the reading outcome gap between the non-ESOL and ESOL groups is significantly different depending on school levels (elementary, middle, and high school) across five years. The results of the study suggested that each school level was expected to have a different impact on the size of the outcome gap over time. Among the three school levels' gaps, the high school groups' outcome was expected to be the widest, and the gap of all three school levels was expected to become significantly narrower over time.

The fourth hypothesis stated that the reading outcomes of the non-ESOL and ESOL group is positively moderated by the percentage of ESOL endorsed teachers and negatively moderated by the percentage of ESOL students at each school level. The results of the study suggested that the effects of the percentage of ESOL teachers and the percentage of ESOL students on the reading outcomes of the groups varied depending on the areas of level (i.e. within-class, within-district, between-district) and school types (i.e. elementary school, middle school, high school). The effects of the ESOL teacher and ESOL student predictors showed more significant effects on the outcome of different areas of level and different school levels of the non-ESOL group rather than the ESOL group. While the ESOL teacher percentage was positively correlated with the between-district non-ESOL group's outcome, it was negatively correlated with the within-class middle school and within-district high school non-ESOL group's outcome. The ESOL student predictor was all negatively correlated with the non-ESOL group's outcome (i.e. between-district of all school levels, within-class high school, and within-district middle school).

The addition of ESOL teacher and ESOL student predictors was expected to narrow the gap of the effect between the groups over time. However, the ESOL teacher predictor was significantly correlated only with the middle school within-district level gap in outcomes, and its effect was negative. That is, the more a middle school has a higher than average percentage of ESOL teachers, the gap between the middle school non-ESOL and ESOL groups' outcomes within the same district was expected to become wider.

In regard to the effect of ESOL student percentage, the gap between elementary school non-ESOL and ESOL groups and the gap between high school groups was significantly correlated. In high school, the increase in ESOL student numbers was negatively related to the within-class gap in outcomes and positively related to the between-districts gap in outcomes. In elementary school, the increase in the percentage of ESOL students was positively related to the within-class gap in the two groups' outcomes. This means that when an elementary school had a higher percentage of ESOL students, the gap in outcome between the non-ESOL and ESOL groups is expected to become narrower at the same school. When the high school class had a greater percentage of ESOL students, the gap between the non-ESOL and ESOL groups' outcomes is expected to widen within the same district. However, when the district had more ESOL students, the gap in outcomes between the high school non-ESOL and ESOL groups was expected to become narrower when compared to other districts in which there was only an average percentage of ESOL students.

The rapid increase of the ESOL student population in the public school of Kansas was discussed and its impact on the non-ESOL group's reading outcome was evaluated. The study found that the increase in ESOL student percentage was significantly correlated with the non-ESOL group's growth of reading. While only the within-class level elementary non-ESOL

group's reading outcome was positively correlated with the ESOL student percentage, all three levels of the high school and within-district and between-district level middle school non-ESOL group's outcomes were negatively correlated with the ESOL student percentage. The reading achievement of the non-ESOL groups nested within the schools and districts in which there was a greater percentage of ESOL students seemed to lag behind the achievement of their peer groups in the schools and districts with a lesser percentage of ESOL students.

The importance of ESOL teacher training was then discussed. The study's results suggested that the percentage of ESOL teachers was more significantly correlated with the non-ESOL group's outcomes rather than with the ESOL groups' outcomes. When comparing the effects of the percentage of ESOL teachers to the outcomes of the two groups by three school levels, the reading outcomes of the non-ESOL group at all school levels in which there were more ESOL teachers were significantly correlated to their reading outcomes whereas none of the outcomes of the ESOL groups at the same three school levels were significantly correlated.

The results of the study suggested that administrators of Kansas State Department of Education or ESOL supporting staff at the district level need to put more effort (1) into training teachers not to focus solely on ESOL students' learning as well as (2) providing periodic, high quality, professional training focusing on all students. The study also recommended that more detailed information regarding ESOL teachers needs to be collected for further research. For example, if the data for teacher training were grouped by whether an ESOL teacher took the Praxis II ESOL subject exam only or took the exam plus ESOL college courses to become endorsed, the ESOL teacher effect on non-ESOL and ESOL groups' outcomes and the gap in those outcomes could be explained in more detail.

This chapter also discussed the limitations and implications of this study along with calling for follow-up research in the future. Follow-up research can choose a smaller sample size (e.g. focus on one district) or conduct a longitudinal study for individual students' academic achievement growth over time. If more information about students or schools becomes available, a sample with more relative predictors can be used to investigate what kind of factors influenced the gap in reading outcomes between a non-ESOL student and an ESOL student. Using the same univariate and multivariate models of this study, a researcher can compare achievement in different subject areas (e.g., reading vs. math) or compare the gap in the non-ESOL and ESOL groups' math outcomes with the gap in reading outcomes of the two groups.

Finally, in considering the generalizability of the study's findings, researchers should note that the study used data from the public schools of Kansas from 2009 to 2013. Other states might have different requirements for teachers to get ESOL endorsed and different ESOL policies and programs to serve ESOL students. Since the educational policy as well as demographics of student population from 2009 to 2013 might be different from the current year, the generalizability of the findings may be limited in its applicability to other states and to current times. Even if the generalizability of findings is limited, however, to some extent the results of this study will provide useful and general information about the gap in reading achievement between the non-ESOL and ESOL groups nested within schools and within districts as a basis for future research. The effects of ESOL teachers and ESOL student percentage on the growth of reading in the non-ESOL and ESOL groups will also be useful data for future researches.

References

Abedi, J. and R. Dietal (2004). Challenges in the No Child Left Behind Act for English Language Learners. Los Angeles CA, Nationaal Center for Research in Evaluation, Standards, and Student Testing.

Aguirre-Muñoz, Z., et al. (2006). "Consequences and Validity of Performance Assessment for English Language Learners: Integrating Academic Language and ELL Instructional Needs into Opportunity to Learn Measures. CSE 678." National Center for Research on Evaluation, Standards, and Student Testing (CRESST).

August, D. and K. Hakuta (1997). Improving schooling for language-minority children: A research agenda, National Academies Press.

August, D., et al. (2009). "English language learners: Developing literacy in second-language learners—Report of the National Literacy Panel on Language-Minority Children and Youth." Journal of Literacy Research **41**(4): 432-452.

Boyle, A., et al. (2010). "Title III accountability: Behind the numbers." Evaluation brief). Washington, DC: American Institutes for Research. Retrieved from http://www. air. org/files/Title_III_Behind_the_Numbers_043010. pdf.

Brown, H. D. and P. Abeywickrama (2010). Language Assessment, Principles and Classroom Practices. White Plains, NY, Pearson Education,Inc.

Bush, M., et al. (2011). Number of Instructional Days/Hours in the School Year. Denver,CO, Education Commission of the States.

Chamot, A. U. and J. M. O'Malley (1996). "The Cognitive Academic Language Learning Approach: A Model for Linguistically Diverse Classrooms." The Elementary School Journal **96**(3): 259-273.

Cline, Z. and J. Necochea (2003). "Specially designed academic instruction in English (SDAIE): More than just good instruction." Multicultural Perspectives **5**(1): 18-24.

Colorado Department of Education. "Endorsement Requirement ". from https://http://www.cde.state.co.us/cdeprof/endorsementrequirements.

Cummins, J. (1994). Primary Language Instruction and the Education of Language Minority Students. Schooling and Language Minority Students: A theoretical framework. C. Leyba. Los Angeles, the Evaluation, Dissemination, and Assessment Center**:** 3-42.

Dabach, D. B. (2009). Teachers as a context for reception for immigrant youth: Adaptations in "sheltered" and "mainstream" classrooms., University of California, Berkeley.

Diaz-Rico, L. T. (2012). A Course for Teaching English Language Learners. Boston, MA, Pearson Education, Inc.

Edvantia (2007). Research Review: What Research Says About Preparing English Language Learners for Academic Success. Alexandria, VA, Center for Public Education.

Florida Department of Education. "Adding an Endorsement to a Professional." from http://www.fldoe.org/teaching/certification/additions/adding-an-endorsement.stml

Francis, D. J., et al. (2006). Research-Based Recommendations for Instruction and Academic Interventions. Portsmouth, NH, Center on Instruction English Language Learners Strand. **1**.

Freeman, Y. S. and D. E. Freeman (2002). Closing the Achievement Gap: How To Reach Limited-Formal-Schooling and Long-Term English Learners, ERIC.

Fry, R. (2008). The Role of Schools in the English Language Learner Achievement Gap. Washington D.C., Pew Hispanic Center.

Gandara, P., et al. (2005). Listening to Teachers of English Language Learners: A Survey of California Teachers' Challenges, Experiences, and Professional Development Needs. Santa Cruz, CA, The Center for the Future of Teaching and Learning.

Garcia, G. E. and C. P. DeNicolo (2009). Making Informed Decisions about the Language and Literacy Assessment of English Language Learners. Literacy Development with English Learners: Research- Based Instruction in Grades K-6. L. Helman. New York, NY, The Guilford Press**:** 64-86.

Genesee, F. (1981). "A Comparison of early and late second language learning." Canadian Journal of Behavioral Science **13**: 115-127.

Genesee, F., et al. (2006). Educating English Language Learners: A synthesis of research evidence. New York, Cambridge University Press.

Genzuk, M. (2011). "Specially Designed Academic Instruciton in English (SDAIE) For Language Minority Students." Center for Multilingual Research Digital Papers Series.

Gottlieb, M. (2006). Assessing English language learners: Bridges from language proficiency to academic achievement, Corwin Press.

Hakuta, K., et al. (2000). How Long Does It Take English Learners to Attain Proficiency? . Stanford University, The University of California Linguistic Minority Research Institute.

Harley, B. (1989). Age in second language acuqisition. San Diego, College Hill Press.

Hawkins, M. R. (2004). "Researching English Language and Literacy Development in Schools." Educational Researcher **33**(3): 14-25.

Hayes, M. (2014). Starting an ESOL program. Topeka, KS, Kansas State Department of Education.

Hoffman, L. (2015). Longitudinal analysis: Modeling within-person fluctuation and change, Routledge.

Hornberger, N. H. (2006). Nichols to NCLB: Local and global perspectives on US language education policy. Imaging multilingual schools: Languages in education and globalization**:** 223-237.

Irwin, P. M., et al. (2007). Technical Manual for the Kansas General Assessments, Kansas Assessments for Multiple Measures(KAMM), and Kansas Alternative Assessments (KAA) The University of Kansas, Center for Educational Testing and Evaluation.

Jepsen, C. and S. D. Alth (2005). English Learners in California Schools. San Francisco, CA, Public Policy Institute of California.

Kena, G., et al. (2015). The Condition of Education, National Center for Education Statistics.

Kindle, A. L. (2002). Survey of the states' limited English proficient students and available educational programs and services: 2000-2001 summary report. Washington, DC, National Clearing House for English Language Acquisition.

Krashen, S. and T. D. Terrell (1983). The natural approach: Language acquisition in the classroom. New York, Pergamon/Alemany.

KSDE (2008). Highly Qualified Teachers Overview 2008-2009. K. S. D. o. Education. Topeka, KS.

KSDE (2014). "Report Card." from http://online.ksde.org/rcard/.

McLauglin, B. (1992). Myths and Misconceptions about Second Langauge Learning: What Teachers Needs to Unlearn. Washington DC, National Center for Research and Improvement.

Menken, K. and T. Kleyn (2010). "The long-term impact of subtractive schooling in the educational experiences of secondary English language learners." International Journal of Bilingual Education and Bilingualism **13**(4): 399-417.

Menken, K., et al. (2012). "Spotlight on “long-term English language learners”: Characteristics and prior schooling experiences of an invisible population." International Multilingual Research Journal **6**(2): 121-142.

Mora, J. K. (2006). Differentiating Instruction for English Learners: The Four by Four Model. Supporting the Literacy Development of English Learners: Increaing success in all classrooms. T. A. Young and N. L. Hadaway. Newark, DE, International Reading Association Inc.**:** 24-40.

Morton, B. A. and B. Dalton (2007). Changes in Instructional Hours in Four Subjects by Public School Teachers of Grades 1 Through 4. Stats in Brief. Washington D.C., Education Statistics Services Institute.

National Center for Educational Statistics.

NCES (2013). Local Education Agency (School District) Universe Survey Data, 2002-03 through 2011-2012. Washington D.C., U.S. Department of Education, National Center for Education Statistics, Common Core Data (CCD).

Neugebauer, S. R. (2008). "DOUBLE THE WORK: Challenges and Solutions of Acquiring Language and Academic Literacy for Adolescent English Language Learners /The Language Demands of School: Putting Academic English To the Test " Harvard Educational Review **78** (1): 252-263.

Newport, E. (1990). "Maturational constraints on language learning." Cognitive Science **14**: 11-28.

O'Conner, R., et al. (2012). A descriptive analysis of enrollment and achievement among limited English proficient students in New Jersey. Washington D.C, Institute of Education Sciences.

Olsen, L. (2010). Reparable Harm: Fulfilling the Unkept Promise of Educational Opportunitiy for Long Term English Learners. Long Beach, CA, Californians Together.

SAS (2014). SAS Institute**:** Company and product information available on http:/http://www.sas.com.

Shoebottom, P. (2013). "Second language acquisition - essential information." 1996-2013, from http://esl.fis.edu/teachers/support/cummin.htm.

Short, D. J. and S. Fitzsimmons (2007). Double the Work: Challenges and solutions to acquiring language and reading literacy for adolescent English language learners – A report to the Carnegie Corporation of New York. A Report to Carnegie Corporation of New York. Washington, DC, Alliance For ExcESOLence Education.

Short, D. J., et al. (2008). The SIOP Model for Administrators. Boston, MA, Pearson Education Inc.

Snow, C. E. and M. Hoefnagel-Höhle (1978). "The critical period for language acquisition: Evidence from second language learning." Child Developement: 1114-1128.

Simmons, R. D. J. (2009). "The Efficacy of Florida's approach to in-service English Speakers of Other Languages (ESOL) teacher training programs." Florida Journal of Educaional Administration and Policy **2**(2): 112.

Tharp, R., et al. (2003). Research evidence: Five standards for effective pedagogy and student outcomes. Center for Research on Education, Diversity & ExcESOLence Technical Report No. G1.

Appendix A

Definition of the Variables

Definition of Variables	Type	Characteristic/ Scale
Dependent Variables		
Reading outcome (two reading outcomes)	Interval (Continuous)	Possible Range 0 to 100 outcome from the Non-ESOL Group outcome from the ESOL Group
Independent Variables		
Grade served at a school	Nominal	N/A
Non-ESOL group	Nominal	0 = non-ESOL
ESOL group	Nominal	1 = ESOL
Percentage of ESOL endorsed teachers	Interval (Continuous)	possible range 0 to 100
Percentage of ESOL students	Interval (Continuous)	possible range 0 to 100
School level	Nominal	1: grade 3-5; 2: grade:6-8; 3: grade:9-11
School year	Ordinal	0 to 4; 0= 2009 and 4=2013
District IDs	Nominal	N/A
School IDs	Nominal	N/A

Appendix B

Figures

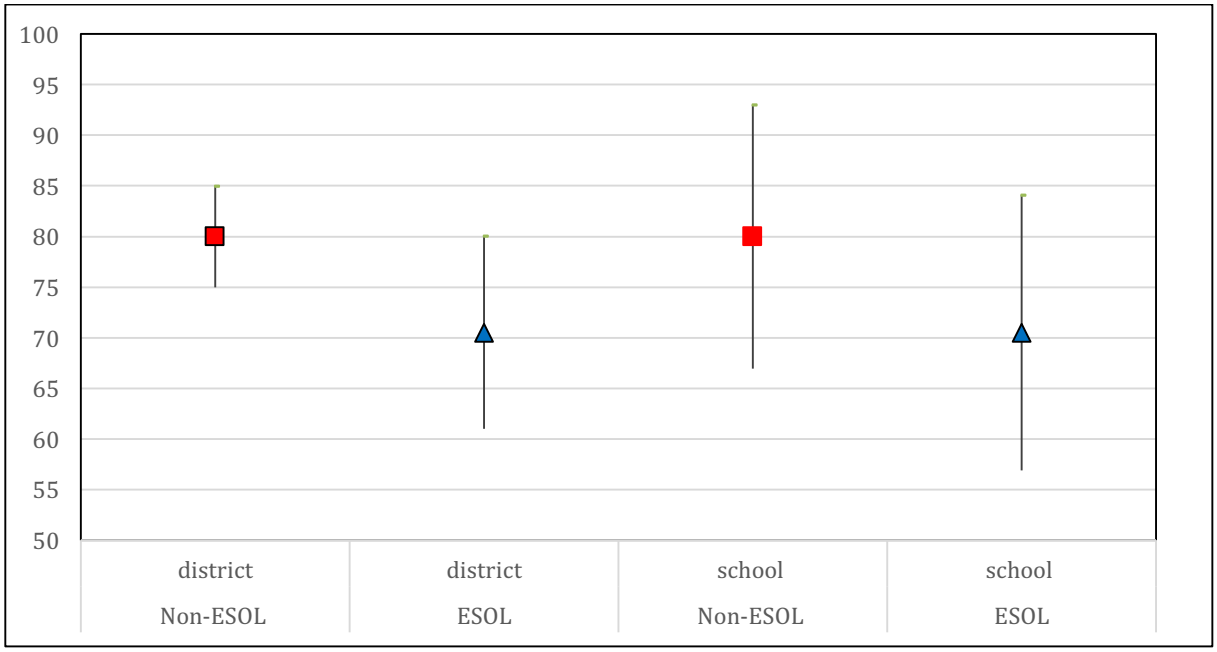

Figure 4 1. 95% Predicted Confidence Interval of intercept for reading means by groups and levels.

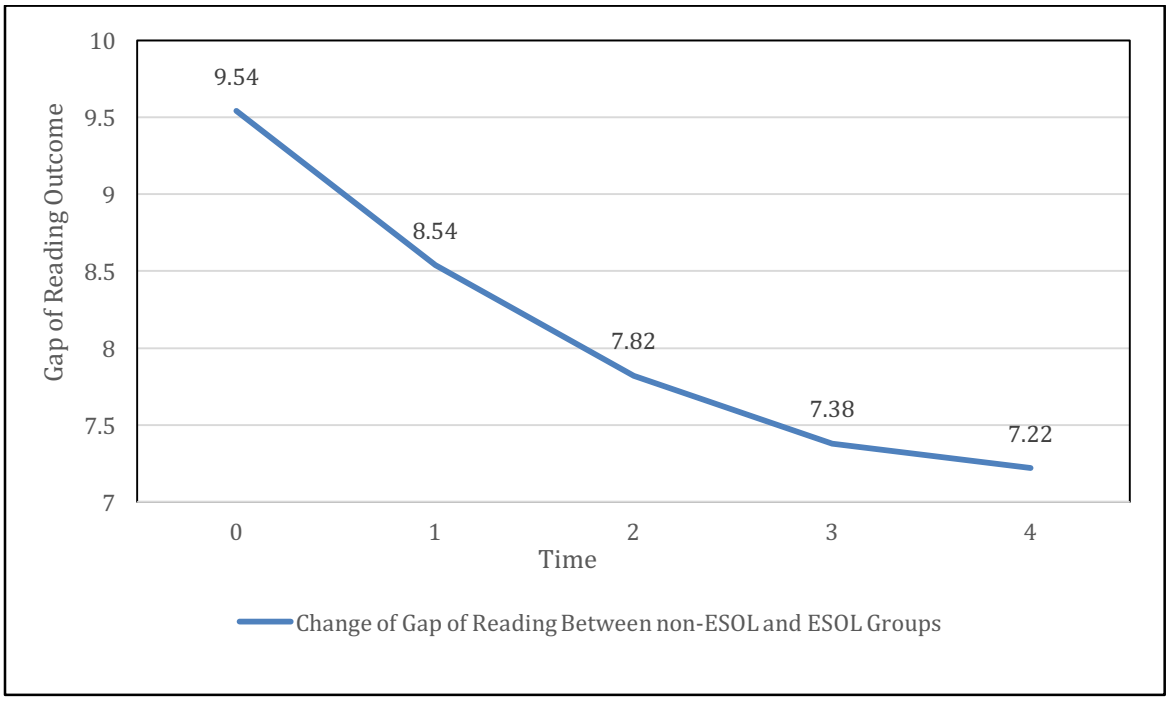

Figure 4. 2. Predicted change of gap of reading outcome over time between groups

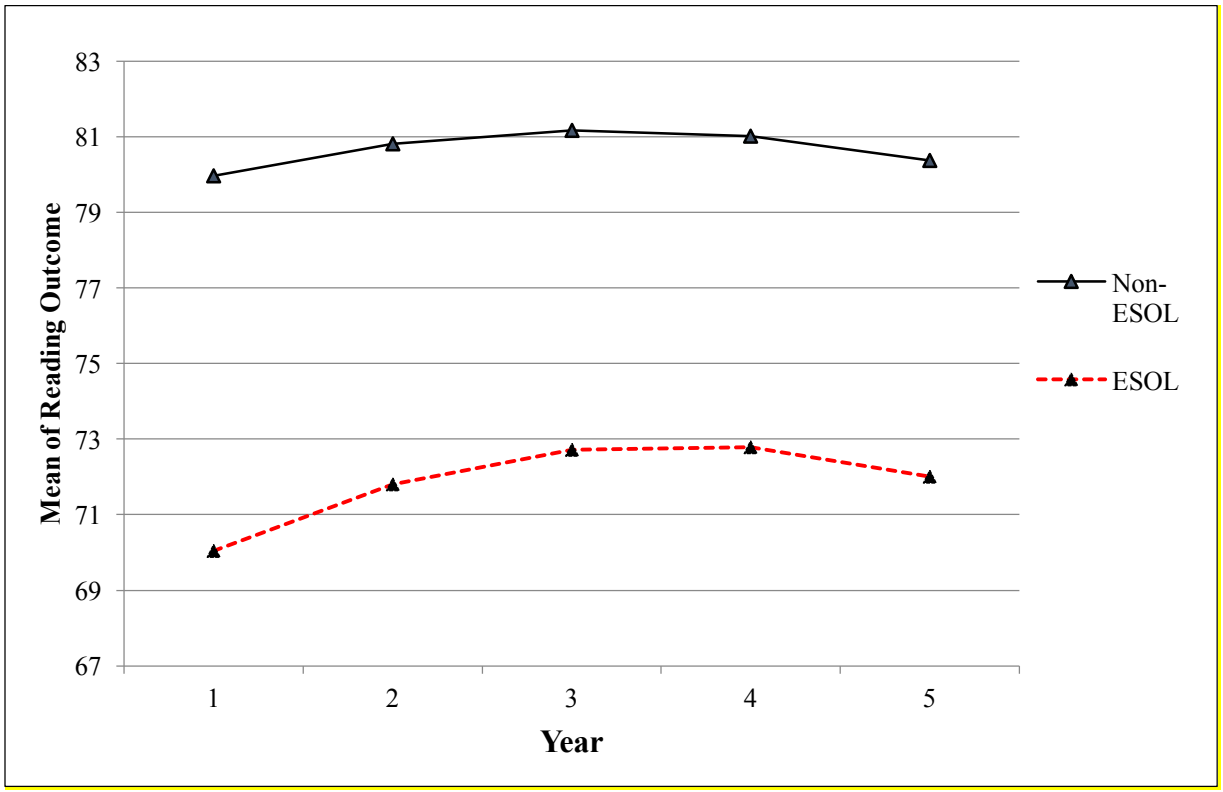

Figure 4.3 Change of reading outcome of the non-ESOL and ESOL groups over time

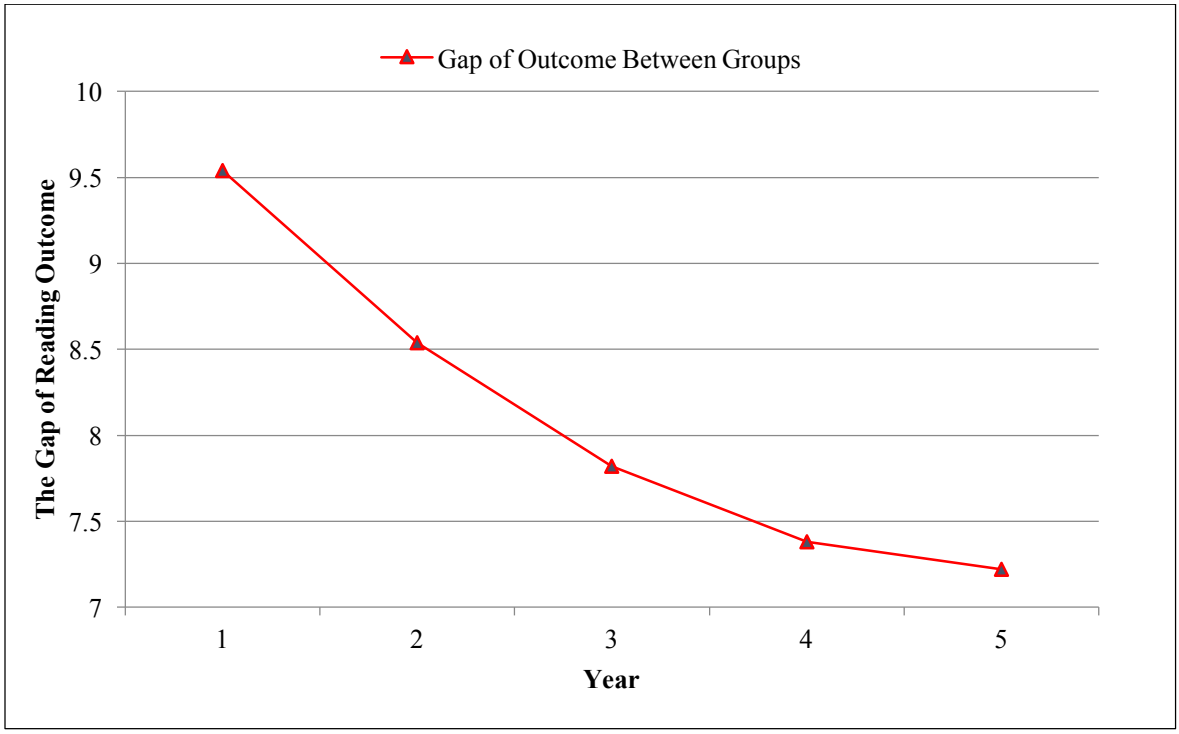

Figure 4. 4. Change of the gap of outcomes between the non-ESOL and ESOL groups

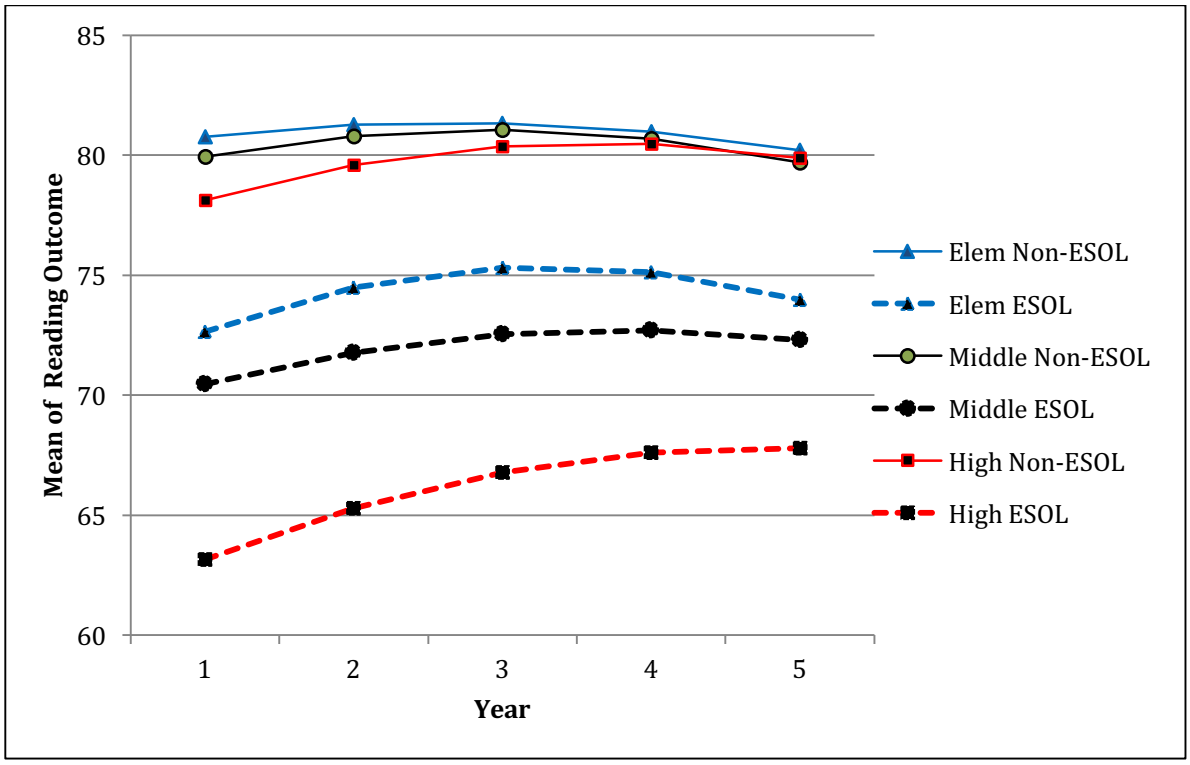

Figure 4. 5. Projected outcome change over time by school levels of the non-ESOL and ESOL groups

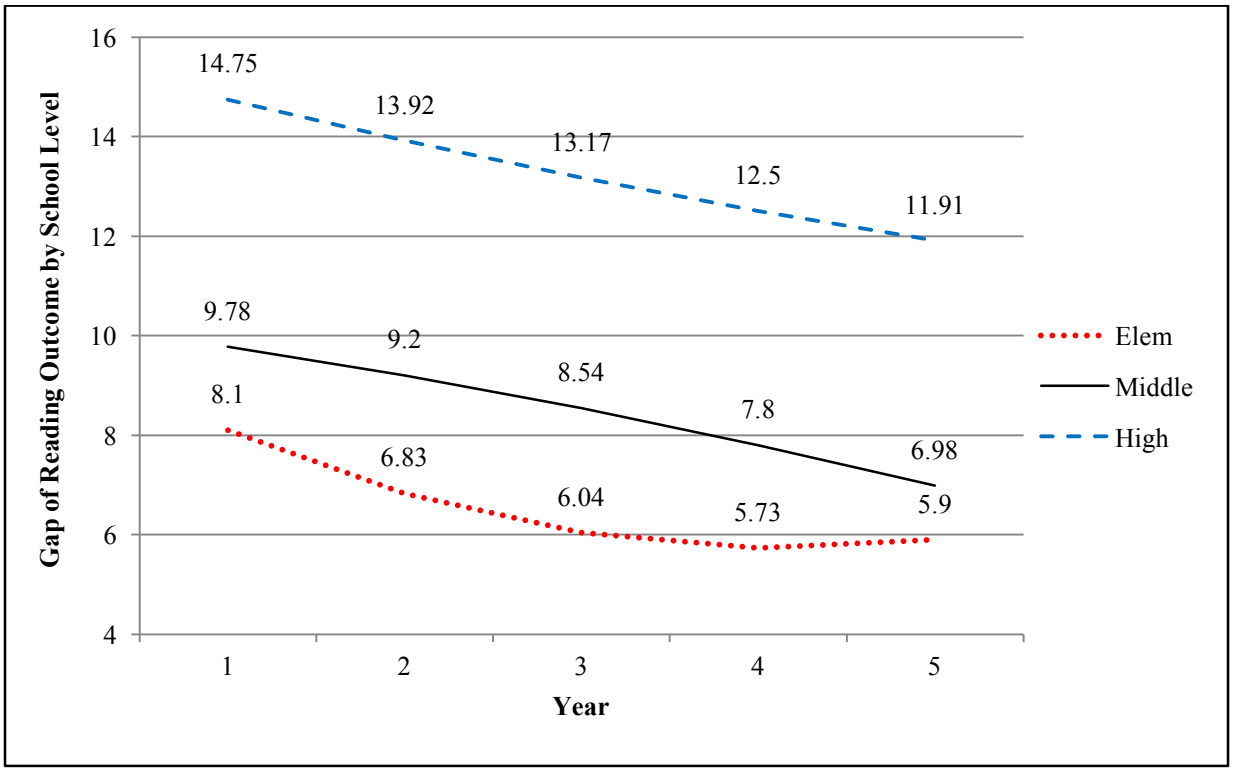

Figure 4. 6. The predicted trajectories for the gap of reading outcome by school levels

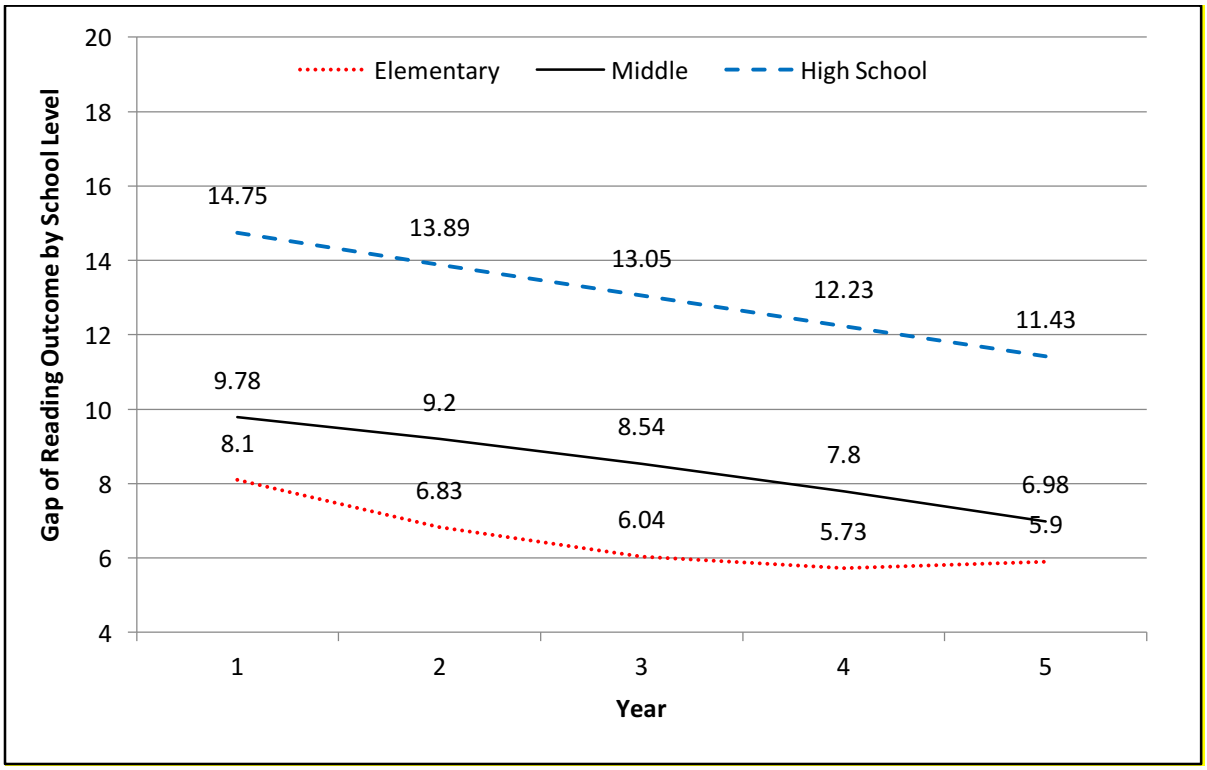

Figure 4. 7. Predicted trajectories for the gap in reading outcome by school levels

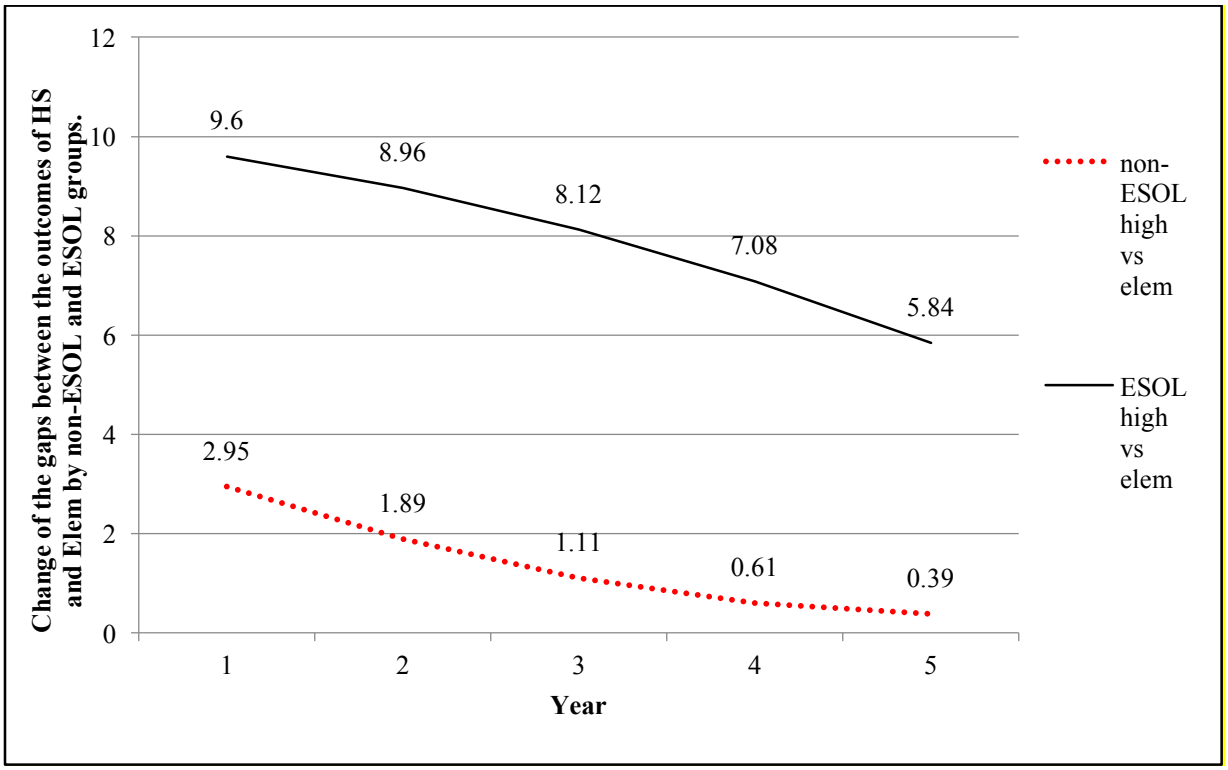

Figure 4. 8.. Predicted changes of the gap between high school vs elementary non-ESOL group and high school vs elementary ESOL groups' reading outcome

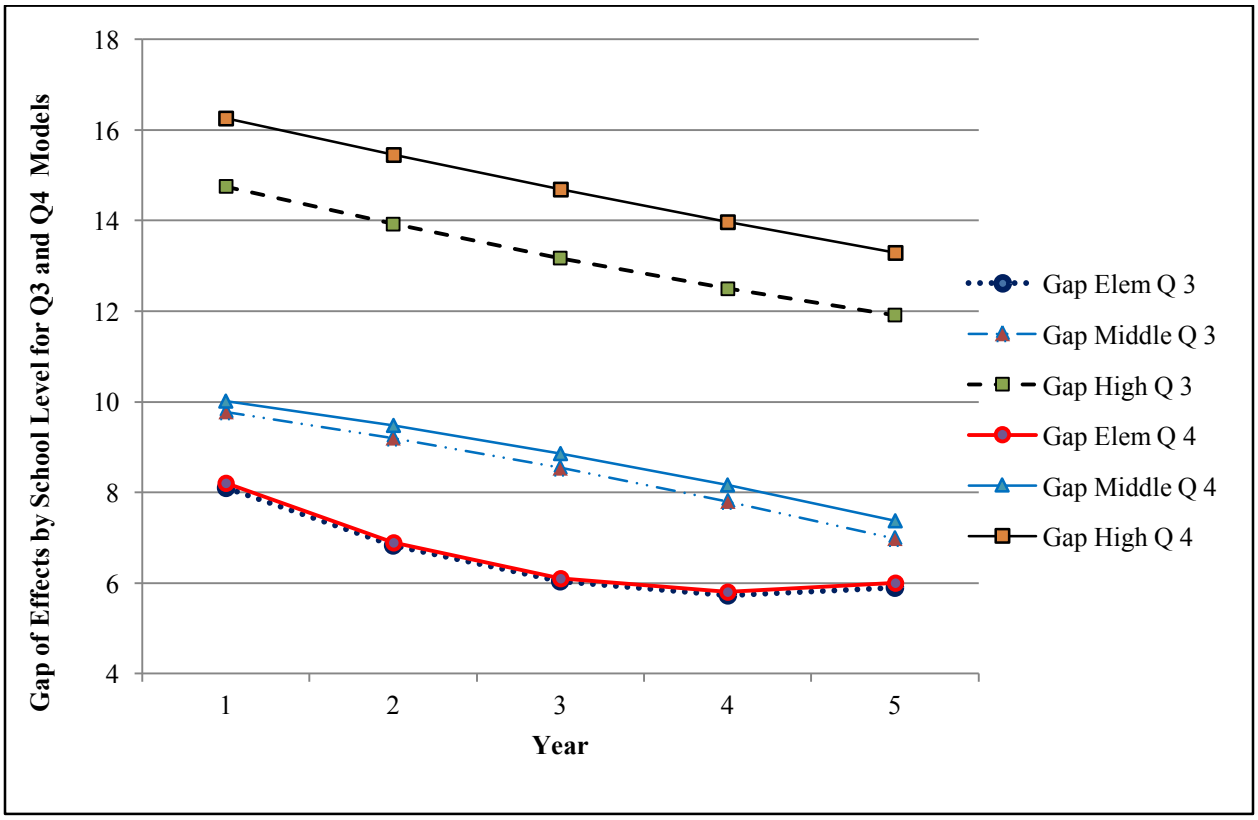

Figure 4.9. The trajectories of change of the gap between the effects of the model for question 3 and the effects of the model for question 4 by school levels

Appendix C

Tables

Table 4.1.

Descriptive Statistics for Each Variables at Each Level

Level		*Variables*	*Number*	*Mean*	*SD*	*Min*	*Max*
1	within class (occasion)	Reading outcome	28455	77.97	9.27	7.00	100.00
		ESOL teacher percent	28457	4.31	6.38	0.00	87.50
		ESOL student percent	28457	10.57	16.71	0.00	100.00
2	within school (class)	Reading outcome	28457	78.49	6.18	26.00	93.25
		ESOL teacher percent	28457	4.31	6.30	0.00	67.65
		ESOL student percent	28457	10.57	16.03	0.00	86.05
3	within district (school)	Reading outcome	28457	77.97	5.82	32.16	90.28
		ESOL teacher percent	28457	4.31	6.28	0.00	67.65
		ESOL student percent	28457	10.57	15.92	0.00	84.30
4	between district	Reading outcome	28457	77.97	4.11	66.14	88.22
		ESOL teacher percent	28457	4.31	5.04	0.00	46.30
		ESOL student percent	28457	10.57	12.44	0.00	59.53

Note. Number: number of observation, SD: standard deviation, Min: minimum, Max: maximum.

Table 4. 2.

Model Fits and Proportion of Variance at Each Level for Reading

	Level	*-2ΔLL(~1)*	*P value*	*Variance*	*SE*	*Proportion of Variance*
			Non-ESOL group			
2 level model	within-class			18.73	0.22	18.73/58.87 =.318
	between-class			40.14	0.98	40.15/58.88 =.682
3 level model	within-class	4130.1	< .001	19.09	0.23	19.09/65.33 =.292
	within-school			0.98	0.16	0.976/65.33 =.015
	between- school			45.26	1.80	45.28/65.33 =.693
4 level model	within-class	278.1	< .001	19.10	0.23	19.10/59.27 =.322
	within-school			0.99	0.16	0.99/59.27 =.016
	within-district			32.23	1.39	32.23/59.27 =.544
	between- district			6.95	1.00	6.95/59.27 =.117
			ESOL group			
2 level model	within-class			71.45	1.81	71.45/110.42 =.647
	between-class			38.97	1.23	38.97/110.42 =.353
3 level model	within-class	1095.3	< .001	70.30	1.08	70.30/117.90 =.596
	within-school			0	.	0
	between- school			47.59	2.82	47.59/117.90=.403
4 level model	within-class	167.6	< .001	70.46	1.08	70.46/121.30 =.581
	within-school			0	.	0
	within-district			28.78	2.12	28.78/121.30 =.237
	between- district			22.07	4.59	22.07/121.30 =.182

Table 4.3.

Random Effects of Confidence Interval for Intercept by Groups and Levels

Group	*Level*	*Mean of Reading outcome by group*	*95% Random Effect Confidence Interval*	
Non-ESOL	4 (district)	79.97	74.99	84.94
ESOL	4	70.50	60.99	80.01
Non-ESOL	3 (school)	79.97	66.92	93.02
ESOL	3	70.50	56.89	84.11

Table 4. 4.

Random Effects of Confidence Interval for Linear Time Slope by Groups and Levels

Group	*Level*	*Predicted Linear Time Slope for Reading Outcome*	*95% Random Effect Confidence Interval*	
Non-ESOL	4	1.01	0.55	1.47
ESOL	4	2.17	0.21	4.13
Non-ESOL	3	1.01	1.19	3.21
ESOL	3	2.17	0.57	4.91

Table 4. 5.

Model Fit and Results for the Univariate Unconditional Model for Reading

Parameters		non-ESOL (4.2)			ESOL (4.2)		
		Est	SE	p <	Est	SE	p <
Model for the Means							
γ_{000}	Intercept	79.97	0.26	<.0001	70.50	0.54	<.0001
γ_{100}	Linear Time Slope	1.01	0.09	<.0001	2.17	0.25	<.0001
γ_{200}	Quadratic Linear Time Slope	-0.25	0.02	<.0001	-0.42	0.05	<.0001
Model for the Variance							
	District Random Intercept Variance	6.43	1.13	<.001	23.56	6.59	<.001
	District Random Linear Time Slope	0.05	0.04	0.08	1.00	0.35	0.002
	District Intercept-Time Slope Covariance	0.06	0.15	0.69	-1.40	1.26	0.27
	School Random Intercept Variance	44.30	2.07	<.001	48.22	4.06	<.001
	School Random Linear Time Slope	1.26	0.10	<.001	1.96	0.31	<.001
	School Intercept-Time Slope Covariance	-4.05	0.37	<.001	-6.62	0.98	<.001
	Residual Variance	17.42	0.20	<.001	64.40	1.04	<.001
REML Model Fit							
	Number of Parameters	10			10		
	- 2LL	113382			69546		
	AIC	113396			69560		
	BIC	113422			69582.8		

Table 4. 6.

Univariate Model for Change Over Time by School Level

Parameters		*Adding School Types for Non-ESOL Group*			*Adding School Types for ESOL Group*		
		Est	*SE*	*p <*	*Est*	*SE*	*p <*
Model for the Means							
γ_{000}	Intercept	**78.13**	0.36	<.0001	**63.15**	0.98	<.0001
γ_{100}	Linear Time Slope	**1.80**	0.26	<.0001	**2.48**	0.87	0.005
γ_{200}	Quadratic Linear Time Slope	**-0.34**	0.06	<.0001	-0.33	0.20	0.10
γ_{010}	Elementary	**2.65**	0.33	<.0001	**9.50**	0.93	<.0001
γ_{110}	Time*Elementary	**-1.10**	0.28	0.04	-0.15	0.91	0.87
γ_{210}	Time*Time*Elementary	**0.13**	0.06	<.0001	-0.17	0.21	0.43
γ_{020}	Middle	**1.80**	0.32	<.0001	**7.28**	0.96	<.0001
γ_{120}	Time*Middle	**-0.62**	0.29	0.03	-0.86	0.95	0.37
γ_{220}	Time*Time*Middle	0.03	0.07	0.60	0.04	0.22	0.85
Model for the Variance							
	District Random Intercept Variance	**6.89**	1.16	<.0001	**28.90**	7.00	<.0001
	District Random Linear Time Slope	0.07	0.07	0.05	**1.02**	0.35	0.002
	School Intercept-Time Slope Covariance	-0.02	0.17	0.89	-1.78	1.34	0.18
	School Random Intercept Variance	**41.78**	2.00	<.0001	**32.95**	3.13	<.0001
	School Random Linear Time Slope	**1.19**	0.10	<.0001	**1.88**	0.30	<.0001

School Intercept-Time Slope Covariance	**-3.64**	0.36	<.0001	**-5.46**	0.85	<.0001
Residual Variance	**17.41**	0.20	<.0001	**64.51**	1.04	<.0001
REML Model Fit						
Number of Parameters	19			19		
- 2LL	113323.8			69546		
AIC	113337.8			69314.1		
BIC	113363.8			69336.9		

Note. Bold values are $p < .05$

Table 4. 7.

Gap of Time Effect on the Outcome Between Groups by School Levels

Parameters		*Est*	*SE*	*p <*
Model for the Means			*Elementary School*	
$\gamma_{01n} - \gamma_{01e}$	Intercept difference between groups	**8.10**	0.51	<.0001
$\gamma_{11n} - \gamma_{11e}$	Linear time slope difference between groups	**-1.51**	0.28	<.0001
$\gamma_{21n} - \gamma_{21e}$	Quadratic linear slope difference between groups	**0.24**	0.07	0.0002
			Middle School	
$\gamma_{02n} - \gamma_{02e}$	Intercept difference between groups	**9.78**	0.57	<.0001
$\gamma_{12n} - \gamma_{12e}$	Linear time slope difference between groups	-0.54	0.40	0.18
$\gamma_{22n} - \gamma_{22e}$	Quadratic linear slope difference between groups	-0.04	0.09	0.65
			High School	
$\gamma_{00n} - \gamma_{00e}$	Intercept difference between groups	**14.75**	0.93	<.0001
$\gamma_{10n} - \gamma_{10e}$	Linear time slope difference between groups	-0.86	0.88	0.33
$\gamma_{20n} - \gamma_{20e}$	Quadratic linear slope difference between groups	0.04	0.21	0.97
Model for the Variance				
Non-ESOL	District Random Intercept Variance	**7.13**	1.01	<.0001
	School Random Intercept Slope	**31.66**	1.36	<.0001
	Residual Variance	**19.52**	0.21	<.0001
ESOL	District Random Intercept Variance	**23.45**	4.41	<.0001
	School Random Intercept Slope	**18.27**	1.47	<.0001
	Residual Variance	**69.69**	1.07	<.0001
Cross Variable Covariances				
	District Random Intercept	**3.49**	1.43	0.01
	School Random Intercept	**5.76**	1.03	<.0001
	Residuals	**6.95**	0.42	<.0001
REML Model Fit				

Number of Parameters	27
-2LL	183131.6
AIC	183149.6
BIC	183183

Note. Bold values are $p < .05$.

Table 4. 8.

Descriptive Statistics Per Level for Model with Two Time-Varying Predictors

Level		*Variables*	*# of ob.*	*Mean*	*SD*	*Min.*	*Max.*
1	within class (occasion)	reading mean	28455	77.97	9.27	7.00	100.00
		ESOL teacher percent	28457	4.30	6.38	0.00	87.50
		ESOL student percent	28457	10.56	16.67	0.00	100.00
3	within district (school)	reading mean	28457	77.97	5.82	32.16	90.28
		ESOL teacher percent	28457	4.31	6.28	0.00	67.65
		ESOL student percent	28457	10.57	15.92	0.00	84.30
4	between district	reading mean	28457	77.97	4.11	66.14	88.22
		ESOL teacher percent	28457	4.31	5.04	0.00	46.30
		ESOL student percent	28457	10.57	12.44	0.00	59.53

Note. # of ob.: number of observation; SD: Standard Deviation; Min: minimum; Max: maximum

Table 4. 9.

Table of Model Fits and Proportion of Variances at Each Level for ESOL Teacher Percentage

Level		*-2ΔLL (~1)*	*P-value*	*Variance*	*SE*	*Proportion Variance*
Non-ESOL group						
2 level model	within-class			1.62	0.02	1.62/33.58 = .048
	between-class			31.96	0.69	31.97/33.57 =.952
3 level	within-class	11360	<.0001	1.57	0.07	1.57/43.07 =.036
	within-school			0	.	0
	between-school			41.48	1.53	41.5/43.07 =.964
4 level	within-class	589.7	<.0001	1.57	0.017	1.57/51.33 =.031
	within-school			0	.	0
	within-district			18.73	0.78	18.73/51.33 =.365
	between-district			31.03	3.14	31.03/51.33 =.605
ESOL Group						
2 level model	within-class			0.62	0.01	0.62/43.31 =.014
	between-class			42.69	1.17	42.69/43.31 =.986
3 level	within-class	9444.4	<.0001	0.53	0.008	0.52/55.33 =.010
	within-school			0	.	0
	between-school			54.81	2.46	54.80/55.33 =.990
4 level	within-class	407.3	<.0001	0.53	0.008	0.53/71.52 =.007
	within-school			0	.	0
	within-district			25.00	1.25	25.00/71.52 =.349
	between-district			45.99	5.77	45.99/71.52 =.643

Table 4. 10.

Model Fits and Proportion of Variation at Each Level for ESOL Student Percentage

Non-ESOL group						
	Level	*-2ΔLL (~1)*	*P-value*	*Variance*	*SE*	*Proportion Variance*
2 level model	within-class			22.13	0.26	22.13/224.07 =.10
	between-class			201.94	4.44	201.94/224.07 =.90
3 level	within-class	9603.9	<.0001	21.38	0.23	21.38/230.62 =.09
	within-school			0	.	0
	between-school			209.24	7.75	209.34/230.62 =.91
4 level	within-class	794.2	<.0001	21.37	0.23	21.37 /197.01 =.108
	within-school			0	.	0
	within-district			89.63	3.71	89.63 /197.01 =.455
	between-district			86.00	8.89	86.00/197.01 =.436
ESOL Group						
2 level	within-class			39.82	0.67	39.82/303.22 =.13
	between-class			263.36	7.53	263.4/303.22 =.87
3 level	within-class	4884.6	<.0001	37.59	0.57	37.59/301.15 =.12
	within-school			0	.	0
	between-school			263.55	12.04	263.55/301.15 =.88
4 level	within-class	452.3	<.0001	37.57	0.57	37.57/278.46 =.14
	within-school			0	.	0
	within-district			126.30	6.40	126.30/278.46 =.454
	between-district			114.59	15.32	114.59/278.46 =.412

Table 4. 11.

Model Fits and Results of Two Time-Varying Predictor Effects on School Level Variables

Outcome

Parameters		*Predicted Outcomes*					
		non-ESOL			*ESOL*		
		Est	*SE*	*p <*	*Est*	*SE*	*p <*
Model for the Means							
γ_{000}	Intercept (high)	**77.96**	0.38	<.0001	**61.52**	1.07	<.0001
γ_{100}	Linear Time Slope (high)	**1.81**	0.26	<.0001	**2.46**	0.87	0.005
γ_{200}	Quadratic Linear Time Slope (high)	**-0.33**	0.06	<.0001	**-0.33**	0.20	0.10
γ_{005}	within-class ESOL teacher (high)	0.05	0.03	0.13	0.07	0.07	0.33
γ_{006}	within-class ESOL student (high)	**-0.06**	0.03	0.04	**0.09**	0.04	0.05
γ_{003}	within-district ESOL teacher (high)	**-1.20**	0.29	<.0001	0.43	2.13	0.84
γ_{004}	within-district ESOL student (high)	-0.22	0.12	0.08	-0.15	0.24	0.52
γ_{001}	between-district ESOL teacher	**0.24**	0.09	0.01	0.08	0.17	0.64
γ_{002}	between-district ESOL student (high)	**-0.20**	0.05	<.0001	0.01	0.07	0.89
γ_{010}	Intercept (elementary)	**80.97**	0.28	<.0001	**72.67**	0.62	<.0001
γ_{110}	Linear Time (elementary)	**0.69**	0.11	<.0001	**2.35**	0.30	<.0001
γ_{210}	Quadratic Time (elementary)	**-0.21**	0.03	<.0001	**-0.50**	0.06	<.0001
γ_{015}	within-class ESOL teacher (elementary)	-0.03	0.03	0.31	0.01	0.05	0.80
γ_{016}	within-class ESOL student (elementary)	**0.02**	0.01	0.05	**-0.02**	0.01	0.08
γ_{013}	within-district ESOL teacher (elementary)	-0.09	0.18	0.63	0.65	0.66	0.32
γ_{014}	within-district ESOL student (elementary)	**-0.13**	0.03	<.0001	**-0.15**	0.06	0.02

γ_{011}	between-district ESOL teacher (elementary)	**0.19**	0.08	0.02	0.08	0.12	0.50
γ_{012}	between-district ESOL student (elementary)	**-0.15**	0.04	<.0001	0.03	0.06	0.65
γ_{020}	Intercept (middle)	**80.24**	0.28	<.0001	**69.89**	0.69	<.0001
γ_{120}	Linear Time (middle)	**1.17**	0.14	<.0001	**1.60**	0.41	<.0001
γ_{220}	Quadratic Linear Time (middle)	**-0.31**	0.03	<.0001	**-0.30**	0.09	0.002
γ_{025}	within-class ESOL teacher (middle)	**-0.10**	0.04	0.02	0.06	0.09	0.48
γ_{026}	within-class ESOL student (middle)	0.01	0.01	0.31	0.03	0.02	0.23
γ_{023}	within-district ESOL teacher (middle)	0.13	0.10	0.20	**-2.53**	1.16	0.03
γ_{024}	within-district ESOL student (middle)	**-0.12**	0.03	0.0002	0.06	0.07	0.44
γ_{021}	between-district ESOL teacher (middle)	**0.30**	0.08	0.0004	-0.12	0.14	0.38
γ_{022}	between-district ESOL student (middle)	**-0.16**	0.04	<.0001	0.06	0.06	0.34
Model for the Variance							
	District Random Intercept Variance	5.65	1.10	<.0001	26.94	6.64	<.0001
	District Random Linear Time Slope	0.07	0.04	0.04	1.01	0.35	0.002
	District Intercept-Time Slope Covariance	-0.01	0.16	0.95	-1.34	1.30	0.30
	School Random Intercept Variance	41.42	1.99	<.0001	33.24	3.16	<.0001
	School Random Linear Time Slope	1.19	0.10	<.0001	1.86	0.30	<.0001
	School Intercept-Time Slope Covariance	-3.62	0.36	<.0001	-5.48	0.86	<.0001
	Residual Variance	17.37	0.20	<.0001	64.29	1.04	<.0001
REML Model Fit							
	Number of Parameters	34			34		
	- 2LL	113312.7			69306.2		
	AIC	113326.7			69320.2		

BIC	113352.7	69343.0

Note. Bold values are $p < .05$

Table 4. 12.

Model Fit and Results for the Multivariate Model for the Gap of Effects

Parameters		*Model for the Gap of Effects*					
		Q3 Model			*Q4 Model*		
		Est	*SE*	*p* <	*Est*	*SE*	*p* <
Model for the Means				Elementary School			
$\gamma_{01n} - \gamma_{01e}$	Gap of Intercept between groups	**8.10**	0.51	<.0001	**8.20**	0.56	<.0001
$\gamma_{11n} - \gamma_{11e}$	Gap of Linear time slope	**−1.51**	0.28	<.0001	**−1.55**	0.28	<.0001
$\gamma_{21n} - \gamma_{21e}$	Gap of Quadratic linear time slope	**0.24**	0.07	0.0002	**0.25**	0.07	0.0002
$\gamma_{16n} - \gamma_{16e}$	Gap of within-class ESOL student effect				**-0.11**	0.05	0.02
$\gamma_{15n} - \gamma_{15e}$	Gap of within-class ESOL teacher effect				0.04	0.07	0.58
$\gamma_{13n} - \gamma_{13e}$	Gap of within-district ESOL teacher effect				0.37	2.08	0.86
				Middle School			
$\gamma_{02n} - \gamma_{02e}$	Gap of Intercept between groups	**9.78**	0.57	<.0001	**10.02**	0.71	<.0001
$\gamma_{12n} - \gamma_{12e}$	Gap of Linear time slope	−0.54	0.4	0.18	−0.50	0.42	0.21
$\gamma_{22n} - \gamma_{22e}$	Gap of Quadratic linear time slope	–0.04	0.09	0.65	–0.04	0.09	0.64
$\gamma_{26n} - \gamma_{26e}$	Gap of within-class ESOL student effect				0.02	0.02	0.36
$\gamma_{23n} - \gamma_{23e}$	Gap of within-district ESOL teacher effect				**2.38**	1.17	0.04
$\gamma_{25n} - \gamma_{25e}$	Gap of within-class ESOL teacher effect				0.08	0.09	0.35
				High School			
$\gamma_{00n} - \gamma_{00e}$	Gap of Intercept between groups	**14.75**	0.93	<.0001	**16.25**	1.19	<.0001
$\gamma_{10n} - \gamma_{10e}$	Gap of Linear time slope	−0.87	0.88	0.33	−0.82	0.88	0.35

$\gamma_{20n} - \gamma_{20e}$	Gap of Quadratic linear time slope	0.04	0.21	0.97	0.02	0.21	0.93
$\gamma_{06n} - \gamma_{06e}$	Gap of within-class ESOL student effect				0.03	0.01	0.05
$\gamma_{02n} - \gamma_{02e}$	Gap of between-district ESOL student effect				**-0.15**	0.58	0.01
$\gamma_{05n} - \gamma_{05e}$	Gap of within-class ESOL teacher effect				-0.02	0.06	0.7
$\gamma_{03n} - \gamma_{03e}$	Gap of within-district ESOL teacher effect				-0.76	0.68	0.26
$\gamma_{01n} - \gamma_{01e}$	Gap of between-district ESOL teacher effect				0.08	0.13	0.51
Model for the Variance							
Non-ESOL	District Random Intercept Variance	**7.13**	1.01	<.0001	**6.70**	1	<.0001
	School Random Intercept Slope	**31.66**	1.36	<.0001	**23.00**	4.34	<.0001
	Residual Variance	**19.52**	0.21	<.0001	**19.50**	0.21	<.0001
ESOL	District Random Intercept Variance	**23.45**	4.41	<.0001	**23.00**	4.34	<.0001
	School Random Intercept Slope	**18.27**	1.47	<.0001	**18.48**	1.49	<.0001
	Residual Variance	**69.69**	1.07	<.0001	**69.44**	1.07	<.0001
Cross Variable Covariances							
	District Random Intercept	**3.49**	1.43	0.01	**3.42**	1.42	0.02
	School Random Intercept	**5.76**	1.03	<.0001	**6.00**	1.04	<.0001
	Residuals	**6.95**	0.42	<.0001	**6.91**	0.42	<.0001
REML Model Fit							
	Number of Parameters	27			45		
	- 2LL	183132.0			183137.0		
	AIC	183150.0			183155.0		
	BIC	183183.0			183188.0		

Note. Bold values are $p < .05$

Appendix D

Equations

Equation of Empty Means, 4-Level Random Intercept Model (4.1)

Notation: t = level-1 time (year), c = level-2 class, s = level-3 school, d = level-4 district

Level 1 time (year): $y_{tcsd} = \beta_{0csd} + e_{tcsd}$

Level 2 Class: $\beta_{0csd} = \delta_{00sd} + C_{0csd}$

Level 3 School: $\delta_{00sd} = \eta_{000d} + S_{00sd}$

Level 4 District: $\eta_{000d} = \gamma_{0000} + D_{000d}$

Composite: $y_{tcsd} = \gamma_{0000} + D_{000d} + S_{00sd} + C_{0csd} + e_{tcsd}$

$$\text{ICC L2} = \frac{T^2_{D00} + T^2_{S00} + T^2_{C00}}{T^2_{D00} + T^2_{S00} + T^2_{C00} + \sigma^2_e} \qquad \text{ICC L3} = \frac{T^2_{D00} + T^2_{S00}}{T^2_{D00} + T^2_{S00} + T^2_{C00}} \qquad \text{ICC L4} = \frac{T^2_{D00}}{T^2_{D00} + T^2_{S00}}$$

Equation of Fixed Quadratic Time, Random Linear 3-Level Model (4.2)

Notation: t = level-1 time (year), s = level-3 school, d= level-4 district

Level 1 time (year): $Y_{tsd} = \beta_{0sd} + \beta_{1sd}(time) + \beta_{2sd}(time)^2 + e_{tsd}$

Level 3 School:

Intercept: $\beta_{0sd} = \delta_{00d} + S_{0sd}$

Time: $\beta_{1sd} = \delta_{10d} + S_{1sd}$

Time*Time: $\beta_{2sd} = \delta_{20d}$

Level 4 District:

Intercept: $\delta_{00d} = \gamma_{000} + D_{00d}$

Time: $\delta_{10d} = \gamma_{100}$

Time*Time: $\delta_{20d} = \gamma_{200}$

Composite: $Y_{tsd} = (\gamma_{000} + D_{00d} + S_{0sd}) + (\gamma_{100} + D_{00d} + S_{1sd})(time_{tsd}) + \gamma_{200}(time_{tsd})^2 + e_{tsd}$

Equation (4.3) after adding school level predictor:

$$Y_{tsd} = [\gamma_{000} + \gamma_{010}(\text{elementary}_i) + \gamma_{020}(\text{middle}_i) + S_{0sd} + D_{00d}] +$$

$$[\gamma_{100} + \gamma_{110}(\text{elementary}_i) + \gamma_{120}(\text{middle}_i) + S_{1sd} + D_{10d}](\text{time}_{tsi}) +$$

$$[\gamma_{200} + \gamma_{210}(\text{elementary}_i) + \gamma_{220}(\text{middle}_i)](\text{time}_{tsi})^2 + e_{tsd}$$

Equation of Multivariate Clustered Longitudinal Model (4.4)

Notation: t = level-1 time (year), s = level-3 school, d= level-4 district

dvN = non-ESOL group = 1, dvE = ESOL group = 1

Composite:

$$Y_{tsd} = dvN[\gamma_{00n} + \gamma_{01n}(\text{elementary}) + \gamma_{02n}(\text{middle}) + S_{0dn} + D_{00n} + e_{tin}] +$$

$$dvN[\gamma_{10n} + \gamma_{11n}(\text{elementary}) + \gamma_{12n}(\text{middle})](time_{tsn}) +$$

$$dvN[\gamma_{20} + \gamma_{21n}(\text{elementary}) + \gamma_{22n}(\text{middle})](time_{tsn})^2 +$$

$$dvE[\gamma_{00e} + \gamma_{01e}(\text{elementary}) + \gamma_{02e}(\text{middle}) + S_{0de} + D_{00e} + e_{tie}] +$$

$$dvE[\gamma_{10e} + \gamma_{11e}(\text{elementary}) + \gamma_{12e}(\text{middle})](time_{tse}) +$$

$$dvE[\gamma_{20e} + \gamma_{21e}(\text{elementary}) + \gamma_{22e}(\text{middle})](time_{tse})^2$$

Equation (4.5)

Notation: t = level-1 time(occasion), s = level-3 school, d= level-4 district

teach04 = between-district level 4 ESOL teacher percentage

stud04 = between-district level 4 ESOL student percentage

teach03 = within-district level 3 ESOL teacher percentage

stud03 = within-district level 3 ESOL student percentage

teach01 = within-class level 1 ESOL teacher percentage

stud01= within-class level 1 ESOL student percentage

$$Y_{tsd} = [\gamma_{000} + \gamma_{010}(\text{elementary}) + \gamma_{020}(\text{middle}) + \gamma_{001}(\text{teach04}_d) + \gamma_{002}(\text{stud04}_d) +$$

$$\gamma_{003}(\text{teach03}_{sd}) + \gamma_{004}(\text{stud03}_{sd}) + \gamma_{005}(\text{teach01}_{tsd}) + \gamma_{006}(\text{stud01}_{tsd}) +$$

$$\gamma_{021}(\text{teach04}_d)(\text{middle}) + \gamma_{022}(\text{stud04}_d)(\text{middle}) +$$

$$\gamma_{023}(\text{teach03}_{sd})(\text{middle}) + \gamma_{024}(\text{stud03}_{sd})(\text{middle}) +$$

$$\gamma_{025}(\text{teach01}_{tsd})(\text{middle}) + \gamma_{026}(\text{stud01}_{tsd})(\text{middle}) +$$

$$\gamma_{011}(\text{teach04}_d)(\text{elementary}) + \gamma_{012}(\text{stud04}_d)(\text{elementary}) +$$

$$\gamma_{013}(\text{teach03}_{sd})(\text{elementary}) + \gamma_{014}(\text{stud03}_{sd})(\text{elementary}) +$$

$$\gamma_{015}(\text{teach01}_{tsd})(\text{elementary}) + \gamma_{016}(\text{stud01}_{tsd})(\text{elementary}_i) + S_{0sd} + D_{00d}] +$$

$$[\gamma_{100} + \gamma_{120}(\text{middle}) + \gamma_{110}(\text{elementary}) + S_{1sd} + D_{10d}](\text{time}_{tsi}) +$$

$$[\gamma_{200} + \gamma_{220}(\text{middle}) + \gamma_{210}(\text{elementary})](\text{time}_{tsi})^2 + e_{tsd}$$

Appendix E

SAS Codes

Model for Question 1

```
PROC MEANS DATA=work.district_means; VAR district_reading district_ESOLteach
district_ESOLstud; RUN;
* Centering predictors at each level;
DATA work.school; SET work.school;
  reading01 = reading_mean;
  teach01   = percentage_teacher;
  stud01    = percentage_ESOL;
* Centering within-school (level-2 class) mean variables;
  reading02 = reading01 - class_reading;
  teach02   = teach01 - class_ESOLteach;
  stud02    = stud01 - class_ESOLstud;
LABEL
 reading02 = "level 2 within-school reading outcome"
 teach02     = "level 2 within-school ESOL teachers"
 stud02    = "level 2 within-school ESOL students";
 * Centering within-district (level-3 school) variables;
   reading03 = reading02 - class_reading;
   teach03   = class_ESOLteach - school_ESOLteach;
   stud03    = class_ESOLstud - school_ESOLstud;
LABEL
 reading03 = "level 3 within-district reading outcome"
 teach03     = "level 3 within-district ESOL teachers"
 stud03    = "level 3 within-district ESOL students";
* Centering between-district (level-4) variables;
  reading04 = district_reading - 80;
  teach04 = district_ESOLteach - 3;
  stud04 =  district_ESOLstud - 5;
LABEL
 reading04 = "level 4 between-district reading outcome (0=80)"
 teach04   = "level 3 between-district ESOL teachers (0=3)"
 stud04    = "level 3 between-district ESOL students (0=5)";
RUN;
TITLE1 "Descriptive Statistics for Level-1 Within-Class (occasion) level
variables";
PROC MEANS N MEAN STDDEV VAR MIN MAX DATA=work.school;
VAR reading01 teach01 stud01; RUN; TITLE1;
TITLE1 "Descriptive Statistics for Level-2 within-school (class) level
variables";
PROC MEANS N MEAN STDDEV VAR MIN MAX DATA=work.class_means;
VAR  class_reading class_ESOLteach class_ESOLstud; RUN; TITLE1;
TITLE1 "Descriptive Statistics for Level-3 within-district (school) level
Variables";
PROC MEANS N MEAN STDDEV VAR MIN MAX DATA=work.school;
VAR  school_reading school_ESOLteach school_ESOLstud; RUN; TITLE1;
TITLE1 "Descriptive Statistics for Level-4 between-district level variables";
PROC MEANS N MEAN STDDEV VAR MIN MAX DATA=work.school;
VAR  district_reading district_ESOLteach district_ESOLstud; RUN; TITLE1;
```

```
TITLE1 'Q1 Empty Means Random Intercept Model for Reading 4 level';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year ;
MODEL reading_mean = / SOLUTION CL CHISQ DDFM=Satterthwaite;
RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no;                  *Level 4;
RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no;          *Level 3;
RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no*newgrade; *Level 2;
by ESOLgroup;
RUN; TITLE1;
```

Model for Question 2

```
TITLE1 'Q2 Fixed Quadratic Linear Level-3, Level-4 Random Linear Time Model';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year ;
MODEL reading_mean = time time*time / SOLUTION CL CHISQ DDFM=Satterthwaite
OUTPM=PredEmpty;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no;          *Level 4;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
by ESOLgroup;
RUN; TITLE1;
```

Model for Question 3

```
TITLE1 'Q3 Univariate Model with School Level Predictor';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year schooltype ;
MODEL reading_mean = time time*time schooltype time*schooltype
time*time*schooltype
      / SOLUTION CL CHISQ DDFM=Satterthwaite;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no; *Level 4;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
ESTIMATE "Intercept for schooltype High"        intercept 1 schooltype 0 0 1;
ESTIMATE "Intercept for schooltype Middle"      intercept 1 schooltype 0 1 0;
ESTIMATE "Intercept for schooltype Elem"        intercept 1 schooltype 1 0 0;
ESTIMATE "Linear Slope for High"                time 1 time*schooltype 0 0 1;
ESTIMATE "Linear Slope for Middle"              time 1 time*schooltype 0 1 0;
ESTIMATE "Linear Slope for Elem"                time 1 time*schooltype 1 0 0;
ESTIMATE "Quadratic Linear Slope for High"      time*time 1
time*time*schooltype 0 0 1;
ESTIMATE "Quadratic Linear Slope for Middle"    time*time 1
time*time*schooltype 0 1 0;
ESTIMATE "Quadratic Linear Slope for Elem"      time*time 1
time*time*schooltype 1 0 0;
ESTIMATE "Int difference H vs M"                schooltype 0  1 -1;
ESTIMATE "Int difference H vs E"                schooltype 1  0 -1;
ESTIMATE "Int difference M vs E"                schooltype 1 -1  0;
ESTIMATE "Linear difference H vs M"                  time*schooltype 0  1 -1;
ESTIMATE "Linear difference H vs E"                  time*schooltype 1  0 -1;
ESTIMATE "Linear difference M vs E"                  time*schooltype 1 -1  0;
ESTIMATE "Quad difference H vs M"               time*time*schooltype 0  1 -1;
ESTIMATE "Quad difference H vs E"               time*time*schooltype 1  0 -1;
ESTIMATE "Quad difference M vs E"               time*time*schooltype 1 -1  0;
by ESOLgroup;
RUN; TITLE1;
```

```
TITLE1 'Q3 Multivariate Model with School Level Predictor';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year schooltype ESOLgroup;
MODEL reading_mean = DVN DVE DVN*schooltype DVE*schooltype DVN*time DVE*time
      DVN*time*schooltype DVE*time*schooltype DVN*time*time DVE*time*time
      DVN*time*time*schooltype DVE*time*time*schooltype / NOINT SOLUTION
DDFM=Satterthwaite ;
RANDOM DVN DVE / G GCORR TYPE=UN SUBJECT=org_no; *Level 4;
RANDOM DVN DVE / G GCORR TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
PARMS (7) (3) (21)   /* Level 4*/
      (33) (9) (28)   /* Level 3 */
      (20) (7) (71);  /* R matrix Level 1 */
REPEATED ESOLgroup / R RCORR TYPE=UN SUBJECT=org_no*bldg_no*newgrade*year;
*Level 1 crossed year*ESOL;
* DVN effects;
ESTIMATE "DVN: Intercept for schooltype High"     DVN 1 DVN*schooltype 0 0 1;
ESTIMATE "DVN: Intercept for schooltype Middle"   DVN 1 DVN*schooltype 0 1 0;
ESTIMATE "DVN: Intercept for schooltype Elem"     DVN 1 DVN*schooltype 1 0 0;
ESTIMATE "DVN: Linear Slope for High"   DVN*time 1 DVN*time*schooltype 0 0 1;
ESTIMATE "DVN: Linear Slope for Middle" DVN*time 1 DVN*time*schooltype 0 1 0;
ESTIMATE "DVN: Linear Slope for Elem"   DVN*time 1 DVN*time*schooltype 1 0 0;
ESTIMATE "DVN: Quadratic Linear Slope for High" DVN*time*time 1
DVN*time*time*schooltype 0 0 1;
ESTIMATE "DVN: Quadratic Linear Slope for Middle" DVN*time*time 1
DVN*time*time*schooltype 0 1 0;
ESTIMATE "DVN: Quadratic Linear Slope for Elem"   DVN*time*time 1
DVN*time*time*schooltype 1 0 0;
* DVE effects;
ESTIMATE "DVE: Intercept for schooltype High"     DVE 1 DVE*schooltype 0 0 1;
ESTIMATE "DVE: Intercept for schooltype Middle"   DVE 1 DVE*schooltype 0 1 0;
ESTIMATE "DVE: Intercept for schooltype Elem"     DVE 1 DVE*schooltype 1 0 0;
ESTIMATE "DVE: Linear Slope for High"   DVE*time 1 DVE*time*schooltype 0 0 1;
ESTIMATE "DVE: Linear Slope for Middle" DVE*time 1 DVE*time*schooltype 0 1 0;
ESTIMATE "DVE: Linear Slope for Elem"   DVE*time 1 DVE*time*schooltype 1 0 0;
ESTIMATE "DVE: Quadratic Linear Slope for High" DVE*time*time 1
DVE*time*time*schooltype 0 0 1;
ESTIMATE "DVE: Quadratic Linear Slope for Middle" DVE*time*time 1
DVE*time*time*schooltype 0 1 0;
ESTIMATE "DVE: Quadratic Linear Slope for Elem"   DVE*time*time 1
DVE*time*time*schooltype 1 0 0;
* Gap effects: DVN vs DVE;
ESTIMATE "GAP: Intercept for schooltype High"   DVN -1 DVN*schooltype  0  0 -
1 DVE 1 DVE*schooltype 0 0 1;
ESTIMATE "GAP: Intercept for schooltype Middle" DVN -1 DVN*schooltype  0 -1
0 DVE 1 DVE*schooltype 0 1 0;
ESTIMATE "GAP: Intercept for schooltype Elem"   DVN -1 DVN*schooltype -1  0
0 DVE 1 DVE*schooltype 1 0 0;
ESTIMATE "GAP:Linear Slope for High" DVN*time -1 DVN*time*schooltype  0  0 -1
                                     DVE*time  1 DVE*time*schooltype  0  0 1;
ESTIMATE "GAP:Linear Slope for Middle"DVN*time -1 DVN*time*schooltype 0 -1  0
                                      DVE*time  1 DVE*time*schooltype  0 1 0;
ESTIMATE "GAP:Linear Slope for Elem" DVN*time -1 DVN*time*schooltype -1  0  0
                                     DVE*time 1 DVE*time*schooltype 1 0 0;
ESTIMATE "GAP: Quadratic Linear Slope for High"
                           DVN*time*time -1 DVN*time*time*schooltype 0 0 -1
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                                DVE*time*time 1 DVE*time*time*schooltype 0 0 1;
ESTIMATE "GAP: Quadratic Linear Slope for Middle"
                               DVN*time*time -1 DVN*time*time*schooltype 0 -1 0
                               DVE*time*time 1 DVE*time*time*schooltype 0 1 0;
ESTIMATE "GAP: Quadratic Linear Slope for Elem"
                               DVN*time*time -1 DVN*time*time*schooltype -1 0 0
                               DVE*time*time 1 DVE*time*time*schooltype 1 0 0;
RUN; TITLE;
```

Model for Question 4

```
TITLE1 '0315_Empty Means Random Intercept Model for ESOL teacher, 4 level';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
      CLASS org_no bldg_no newgrade year ;
      MODEL percentage_teacher = / SOLUTION CL CHISQ DDFM=Satterthwaite;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no; *Level 4;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no*newgrade; *Level 2;
      by ESOLgroup;
RUN; TITLE1;

TITLE1 '0315_Empty Means Random Intercept Model for ESOL student, 4 level';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
      CLASS org_no bldg_no newgrade year ;
      MODEL percentage_ESOL = / SOLUTION CL CHISQ DDFM=Satterthwaite;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no; *Level 4;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
      RANDOM INTERCEPT / TYPE=UN SUBJECT=org_no*bldg_no*newgrade; *Level 2;
      by ESOLgroup;
RUN; TITLE1;
```

```
TITLE1 '0316_Q4 Univariate Model';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year schooltype ;
MODEL reading_mean = time time*time schooltype time*schooltype
      time*time*schooltype teach01 teach03 teach04 stud01 stud03 stud04
      schooltype*teach01 schooltype*teach03 schooltype*teach04
      schooltype*stud01 schooltype*stud03 schooltype*stud04 /SOLUTION CL
CHISQ DDFM=Satterthwaite;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
RANDOM INTERCEPT time / TYPE=UN SUBJECT=org_no; *Level 4;
ESTIMATE "Intercept for schooltype High"        intercept 1 schooltype 0 0 1;
ESTIMATE "Intercept for schooltype Middle"      intercept 1 schooltype 0 1 0;
ESTIMATE "Intercept for schooltype Elem"        intercept 1 schooltype 1 0 0;
ESTIMATE "Intercept for schooltype High"        intercept 1 schooltype 0 0 1;
ESTIMATE "Intercept for schooltype Middle"      intercept 1 schooltype 0 1 0;
ESTIMATE "Intercept for schooltype Elem"        intercept 1 schooltype 1 0 0;
ESTIMATE "Linear Slope for High"                time 1 time*schooltype 0 0 1;
ESTIMATE "Linear Slope for Middle"              time 1 time*schooltype 0 1 0;
ESTIMATE "Linear Slope for Elem"                time 1 time*schooltype 1 0 0;
ESTIMATE "Quadratic Linear Slope for High"          time*time 1
time*time*schooltype 0 0 1;
ESTIMATE "Quadratic Linear Slope for Middle"        time*time 1
time*time*schooltype 0 1 0;
ESTIMATE "Quadratic Linear Slope for Elem"          time*time 1
time*time*schooltype 1 0 0;
ESTIMATE "Interaction for teach01*schooltype High"      teach01 1
teach01*schooltype 0 0 1;
ESTIMATE "Interaction for teach01*schooltype Middle"    teach01 1
teach01*schooltype 0 1 0;
ESTIMATE "Interaction for teach01*schooltype Elem"      teach01 1
teach01*schooltype 1 0 0;
ESTIMATE "Interaction for teach03*schooltype High"      teach03 1
teach03*schooltype 0 0 1;
ESTIMATE "Interaction for teach03*schooltype Middle"    teach03 1
teach03*schooltype 0 1 0;
ESTIMATE "Interaction for teach03*schooltype Elem"      teach03 1
teach03*schooltype 1 0 0;
ESTIMATE "Interaction for teach04*schooltype High"      teach04 1
teach04*schooltype 0 0 1;
ESTIMATE "Interaction for teach04*schooltype Middle"    teach04 1
teach04*schooltype 0 1 0;
ESTIMATE "Interaction for teach04*schooltype Elem"      teach04 1
teach04*schooltype 1 0 0;
ESTIMATE "Interaction for stud01*schooltype High"       stud01  1
stud01*schooltype 0 0 1;
ESTIMATE "Interaction for stud01*schooltype Middle"     stud01  1
stud01*schooltype 0 1 0;
ESTIMATE "Interaction for stud01*schooltype Elem"       stud01  1
stud01*schooltype 1 0 0;
ESTIMATE "Interaction for stud03*schooltype High"       stud03  1
stud03*schooltype 0 0 1;
ESTIMATE "Interaction for stud03*schooltype Middle"     stud03  1
stud03*schooltype 0 1 0;
ESTIMATE "Interaction for stud03*schooltype Elem"       stud03  1
stud03*schooltype 1 0 0;
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ESTIMATE "Interaction for stud04*schooltype High"       stud04  1
stud04*schooltype 0 0 1;
ESTIMATE "Interaction for stud04*schooltype Middle"     stud04  1
stud04*schooltype 0 1 0;
ESTIMATE "Interaction for stud04*schooltype Elem"       stud04  1
stud04*schooltype 1 0 0;


TITLE1 '0316_Q4 Multivariate Model';
PROC MIXED DATA=work.school COVTEST NOCLPRINT NOITPRINT NAMELEN=100
METHOD=REML;
CLASS org_no bldg_no newgrade year schooltype ESOLgroup;
MODEL reading_mean = DVN DVE DVN*schooltype DVE*schooltype DVN*time DVE*time
DVN*time*schooltype
                     DVE*time*schooltype DVN*time*time DVE*time*time
DVN*time*time*schooltype
                     DVE*time*time*schooltype DVN*teach01 DVN*teach03
DVN*stud01 DVN*schooltype*teach01
                     DVN*schooltype*teach03 DVN*schooltype*stud01 DVE*teach01
DVE*teach03 DVE*stud01
                     DVE*schooltype*teach01 DVE*schooltype*teach03
DVE*schooltype*stud01
                     / NOINT SOLUTION DDFM=Satterthwaite ;
RANDOM DVN DVE / G GCORR TYPE=UN SUBJECT=org_no; *Level 4;
RANDOM DVN DVE / G GCORR TYPE=UN SUBJECT=org_no*bldg_no; *Level 3;
PARMS  (7) (3) (21)    /* Level 4*/
      (33) (9) (28)    /* Level 3 */
      (20) (7) (71);   /* R matrix Level 1 */
REPEATED ESOLgroup / R RCORR TYPE=UN SUBJECT=org_no*bldg_no*newgrade*year;
*Level 1 crossed year*ESOL;
* DVN effects;
ESTIMATE "DVN: Intercept for schooltype High"    DVN 1 DVN*schooltype 0 0 1;
ESTIMATE "DVN: Intercept for schooltype Middle"  DVN 1 DVN*schooltype 0 1 0;
ESTIMATE "DVN: Intercept for schooltype Elem"    DVN 1 DVN*schooltype 1 0 0;
ESTIMATE "DVN: Linear Slope for High"   DVN*time 1 DVN*time*schooltype 0 0 1;
ESTIMATE "DVN: Linear Slope for Middle" DVN*time 1 DVN*time*schooltype 0 1 0;
ESTIMATE "DVN: Linear Slope for Elem"   DVN*time 1 DVN*time*schooltype 1 0 0;
ESTIMATE "DVN: Quadratic Linear Slope for High"       DVN*time*time 1
DVN*time*time*schooltype 0 0 1;
ESTIMATE "DVN: Quadratic Linear Slope for Middle"     DVN*time*time 1
DVN*time*time*schooltype 0 1 0;
ESTIMATE "DVN: Quadratic Linear Slope for Elem"       DVN*time*time 1
DVN*time*time*schooltype 1 0 0;
* DVE effects;
ESTIMATE "DVE: Intercept for schooltype High"     DVE 1 DVE*schooltype 0 0 1;
ESTIMATE "DVE: Intercept for schooltype Middle"   DVE 1 DVE*schooltype 0 1 0;
ESTIMATE "DVE: Intercept for schooltype Elem"     DVE 1 DVE*schooltype 1 0 0;
ESTIMATE "DVE: Linear Slope for High"   DVE*time 1 DVE*time*schooltype 0 0 1;
ESTIMATE "DVE: Linear Slope for Middle" DVE*time 1 DVE*time*schooltype 0 1 0;
ESTIMATE "DVE: Linear Slope for Elem"   DVE*time 1 DVE*time*schooltype 1 0 0;
ESTIMATE "DVE: Quadratic Linear Slope for High"       DVE*time*time 1
DVE*time*time*schooltype 0 0 1;
ESTIMATE "DVE: Quadratic Linear Slope for Middle"     DVE*time*time 1
DVE*time*time*schooltype 0 1 0;
ESTIMATE "DVE: Quadratic Linear Slope for Elem"       DVE*time*time 1
DVE*time*time*schooltype 1 0 0;
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* Gap effects: DVN vs DVE;
ESTIMATE "GAP: Intercept for schooltype High"   DVN -1 DVN*schooltype 0 0 -1
DVE 1 DVE*schooltype 0 0 1;
ESTIMATE "GAP: Intercept for schooltype Middle" DVN -1 DVN*schooltype 0 -1 0
DVE 1 DVE*schooltype 0 1 0;
ESTIMATE "GAP: Intercept for schooltype Elem"   DVN -1 DVN*schooltype -1 0 0
DVE 1 DVE*schooltype 1 0 0;
ESTIMATE "GAP:Linear Slope for High" DVN*time -1 DVN*time*schooltype 0 0 -1
                                      DVE*time  1 DVE*time*schooltype 0 0  1;
ESTIMATE "GAP:Linear Slope for Middle"DVN*time -1 DVN*time*schooltype  0 -1 0
                                     DVE*time  1 DVE*time*schooltype  0  1 0;
ESTIMATE "GAP:Linear Slope for Elem" DVN*time -1 DVN*time*schooltype -1  0 0
                                     DVE*time  1 DVE*time*schooltype  1  0 0;
ESTIMATE "GAP: Quadratic Linear Slope for High"
                          DVN*time*time -1 DVN*time*time*schooltype  0  0 -1
                          DVE*time*time  1 DVE*time*time*schooltype  0  0  1;
ESTIMATE "GAP: Quadratic Linear Slope for Middle"
                          DVN*time*time -1 DVN*time*time*schooltype  0 -1  0
                          DVE*time*time  1 DVE*time*time*schooltype  0  1  0;
ESTIMATE "GAP: Quadratic Linear Slope for Elem"
                          DVN*time*time -1 DVN*time*time*schooltype -1  0  0
                          DVE*time*time  1 DVE*time*time*schooltype  1  0  0;
* DVN Predictors Effects;
ESTIMATE "Effects for teach01*schooltype High"   DVN*teach01 1
DVN*teach01*schooltype 0 0 1;
ESTIMATE "Effects for teach03*schooltype High"   DVN*teach03 1
DVN*teach03*schooltype 0 0 1;
ESTIMATE "Effects for stud01*schooltype High"    DVN*stud01  1
DVN*stud01*schooltype  0 0 1;
ESTIMATE "Effects for teach01*schooltype Middle" DVN*teach01 1
DVN*teach01*schooltype 0 1 0;
ESTIMATE "Effects for teach03*schooltype Middle" DVN*teach03 1
DVN*teach03*schooltype 0 1 0;
ESTIMATE "Effects for stud01*schooltype Middle"  DVN*stud01  1
DVN*stud01*schooltype  0 1 0;
ESTIMATE "Effects for teach01*schooltype Elem"   DVN*teach01 1
DVN*teach01*schooltype 1 0 0;
ESTIMATE "Effects for teach03*schooltype Elem"   DVN*teach03 1
DVN*teach03*schooltype 1 0 0;
ESTIMATE "Effects for stud01*schooltype Elem"    DVN*stud01  1
DVN*stud01*schooltype  1 0 0;
ESTIMATE "Int difference of teach01  H vs M"  DVN*teach01*schooltype 0  1 -1;
ESTIMATE "Int difference of teach01  H vs E"  DVN*teach01*schooltype 1  0 -1;
ESTIMATE "Int difference of teach01  M vs E"  DVN*teach01*schooltype 1 -1  0;
ESTIMATE "Int difference of teach03  H vs M"  DVN*teach03*schooltype 0  1 -1;
ESTIMATE "Int difference of teach03  H vs E"  DVN*teach03*schooltype 1  0 -1;
ESTIMATE "Int difference of teach03  M vs E"  DVN*teach03*schooltype 1 -1  0;
ESTIMATE "Int difference of stud01  H vs M"   DVN*stud01*schooltype  0  1 -1;
ESTIMATE "Int difference of stud01  H vs E"   DVN*stud01*schooltype  1  0 -1;
ESTIMATE "Int difference of stud01  M vs E"   DVN*stud01*schooltype  1 -1  0;
* DVE Predictors Effects;
ESTIMATE "Effects for teach01*schooltype High"   DVE*teach01 1
DVE*teach01*schooltype 0 0 1;
ESTIMATE "Effects for teach03*schooltype High"   DVE*teach03 1
DVE*teach03*schooltype 0 0 1;
```

```
ESTIMATE "Effects for stud01*schooltype High"    DVE*stud01  1
DVE*stud01*schooltype  0 0 1;
ESTIMATE "Effects for teach01*schooltype Middle" DVE*teach01 1
DVE*teach01*schooltype 0 1 0;
ESTIMATE "Effects for teach03*schooltype Middle" DVE*teach03 1
DVE*teach03*schooltype 0 1 0;
ESTIMATE "Effects for stud01*schooltype Middle"  DVE*stud01  1
DVE*stud01*schooltype  0 1 0;
ESTIMATE "Effects for teach01*schooltype Elem"   DVE*teach01 1
DVE*teach01*schooltype 1 0 0;
ESTIMATE "Effects for teach03*schooltype Elem"   DVE*teach03 1
DVE*teach03*schooltype 1 0 0;
ESTIMATE "Effects for stud01*schooltype Elem"    DVE*stud01  1
DVE*stud01*schooltype  1 0 0;
RUN; TITLE;
```