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Evaluating Middle School English Language Learners' Science and Literacy Proficiency

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Abstract

The academic success and English proficiency of ELL students are receiving more attention as a result of the growing number of ELL students and the demand for accountability and assessment in education. It is widely accepted that ELL students struggle on state standardized tests because they lack the cognitive academic language abilities needed to succeed on extensive subject evaluations (Thakkar, 2013). According to Abedi and Dietel, ELLs' academic performance lags behind that of other segments of population, and the attainment gap reduces only slightly over time (2004).

The NWEA archival data of 6th, 7th, and 8th grade students who attended a Midwest area middle school in 2018-2019 educational year was used to investigate the question of whether or not middle school ELL students' academic achievement improved in integrated science during one year of instruction while becoming more English language proficient, and improved in integrated science significantly more than the native speakers' achievement in science after both groups completed a year of science instruction.. The data were used to analyze trends over time and variation in changes over time among groups of individuals in terms of English language and science achievements. Paired t-test and analysis of variances were used to determine if there was a relationship between science achievement and English language proficiency.

The results indicated that there was a significant improvement in academic achievement of ELL students in science during one year of instruction while they were becoming more English language proficient, and ELL students' academic achievement in science did not improve significantly more than the native speakers' achievement after both groups completed a year of science instruction.

Findings may be used to develop strategies to improve English language skills of ELL students of the targeted school settings. Improvement in English language skills may allow ELL students to succeed in all subject areas.

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Chapter 1: Introduction

Background

To date, millions of people in the world make one of the most difficult decisions possible when leaving the countries where they have grown up. There are many reasons that people leave their home countries and seek to rebuild their lives in a different one. For some people, getting a better job or an education is the reason. For others, violence and persecution are the reasons to immigrate or seek asylum. Some people feel unsafe because their might have been targeted because their ethnicity, religion, or politics made them a target for violence. According to the latest annual Global Trends report from the United Nations High Commissioner for Refugees, at the end of 2018, 70.8 million individuals had been forcibly relocated around the world as a result of persecution, conflict, violence, or human rights violations (2019). In 2018, 25 people were forced to depart their homeland every minute (UNHCR, 2018).

As a nation of immigrants, America has profited from the vigor and enthusiasm that individuals seeking a better life have brought to its shores (U.S. Department of Education, 2017). The recent substantial increase in the number of young migrants entering the United States has put further demand on educational systems. Immigrant children (e.g., unaccompanied minors) and children of immigrants, Deferred Action for Childhood Arrivals (DACA) children and youth, immigrant families, adult immigrants (e.g., refugees, asylees), foreign-born professionals, migrant students, English learners and foreign language teachers, and receiving communities are among the immigrant populations supported by the US Department of Education (U.S. Department of Education, 2017).

Schools and other social structures must provide considerable assistance to newcomers. Some towns in the United States have a long history of serving immigrant and language-minority pupils, but there are still challenges to civic, economic, and linguistic inclusion. The problems faced by educators and other service providers in meeting the needs of immigrant and refugee children have never been greater (Sugarman, 2015). The unpredictability of the timing and magnitude of immigration have highlighted existing flaws in schooling systems.

Building teacher capacity is one of the greatest challenges to meeting the needs of newcomer youth (Sugarman, 2015). Due to interrupted education and a lack of language acquisition, teachers face difficulties instructing children with learning gaps. Despite the fact that the United States has a long history of English language development services, 32 states are in desperate need of teachers in English as a Second Language (ESL) and bilingual education, including Illinois, New York, and Texas, which have the highest populations of English language learners (ELLs) (Sugarman, 2015).

To meet the literacy demands of the workplace in the United States, all students must be able to understand and use academic English, which involves not only knowing the meanings of words, but also understanding the grammar, syntax, and conventions of written and spoken language used in academic contexts (CCSSO, 2010). In addition to academic English, students must also develop strong reading comprehension skills to be able to read and understand complex texts. For students who enter middle and high school with limited English proficiency, the challenges of developing these skills can be even greater. Such students need to acquire not only academic English, but also content knowledge and vocabulary specific to different subject areas (Echevarria et al., 2010).

The need to acquire a high school diploma before aging out of the system adds to the already significant hurdles. Policymakers in the United States have expressed concern about the need to enhance graduation rates for all students, particularly language learners and students from migratory backgrounds (Sugarman, 2015). The United States Department of Education recently released data on graduation rates for the 2016-17 school year, revealing that the rate for students classified as Limited English Proficient (LEP) was 66.4 percent, compared to an overall rate of 84.6 percent (NCES, 2019).

The United States' school systems are trying to provide services to students who are linguistically and culturally diverse, as well as looking for ways to improve instruction for both specialists and mainstream teachers (Sugarman, 2015). To improve the instructions given to English language learners (ELLs), educational systems must provide extensive professional development for all teachers, not just language specialists. Professional development programs must address the needs of students who have experienced trauma and the persistent stresses of family reunification, uncertain legal status, and cultural adjustment (Sugarman, 2015). Educators must be prepared to recognize and respond appropriately to the emotional and psychological needs of these students, creating a safe and supportive learning environment that helps them to thrive academically and socially.

The number of ELL students in the United States has increased dramatically due to the increasing number of immigrant, refugee, and asylum seeking families. In fall 2016, the percentage of ELLs in public schools in the United States was greater (9.6%, or 4.9 million kids) than in fall 2000 (8.1 percent, or 3.8 million pupils) (NCES, 2019).

Students who have been designated as English language learners (ELLs) can enroll in language assistance programs to help them improve their English skills and fulfill the same academic content and achievement standards as other students. Participating in these types of programs can help students enhance their English language skills, which has been linked to better educational achievements (Genesee et al., 2005).

According to recent data from international math and science assessments, it has been found that U.S. students consistently place in the middle of the pack, lagging behind numerous other advanced industrial nations (DeSilver, 2017). A cross-national test, Programme for International Student Assessment (PISA), measures reading ability, math and science literacy and other key skills among 15-year-olds in many of developed and developing countries. The most recent PISA results, from 2015, placed the U.S. an unimpressive 38th out of 71 countries in math and 24th in science (DeSilver, 2017). The United States is falling behind internationally among industrialized nations and in our competitive global economy and this situation is unacceptable (U.S. Department of Education, 2015). Improving science and mathematics education in the United States is critical for ensuring that the nation remains competitive in the global economy and prepares students for the challenges of the future (Kelley & Knowles, 2016). The increasing number of ELL students further emphasizes the need for improvement in these subjects.

The English Language Learner Information Center was created by the Migration Policy Institute's (MPI) National Center on Immigrant Integration Policy to provide informative fact sheets, maps, and state-level data resources that chronicle the demography and trends of immigrant families and their children (MPI, 2019a). Every

Student Succeeds Act (ESSA) is the 2015 reauthorization of the 1965 Elementary and Secondary Education Act, which aims to ensure that all students in the United States have equitable access to high-quality education (MPI, 2019b). According to MPI, ESSA includes a number of new requirements for the education of English Learners (ELs), including standardized criteria for identifying EL students and inclusion of English proficiency as a measurement of school quality (2019b). When it comes to standardized tests, most of the ELL students are behind their English proficient peers in all content areas. The gap is particularly wide in academic subjects that are high in language skills (Abedi et al., 2006).

Purpose

According to Thakkar (2013), there is a prevailing belief that English Language Learner (ELL) students often struggle to perform well on state standardized exams due to their lack of cognitive academic language skills required for large-scale subject assessments. A quantitative study was designed to determine the extent to which English language proficiency (ELP) of ELL students and the length of the instruction given them correlate with their science scores on standardized tests. The outcome could aid educators in understanding the necessary level of academic English proficiency that ELL students need to achieve to perform well on standardized tests, recognizing that there may be a range of proficiency levels among individual students. However, it is important to note that standardized testing is not the sole measure of success. Some other factors, such as critical thinking skills, creativity, and social-emotional learning, are also important for student growth and development. In recent decades, several authors have emphasized the necessity of equipping students with skills encompassing critical thinking, creativity, and

emotional management, as emotions play a crucial role in either facilitating or hindering children's academic engagement, commitment, and overall school success by influencing the learning process and content. (Candeias, 2020).

Research questions

As the population of English Language Learner (ELL) students continues to grow and the demand for accountability and assessment in education increases, there is a growing focus on the English proficiency and academic achievements of ELL students. No Child Left Behind (NCLB) legislation holds states accountable for ELL progress in both English language proficiency (ELP) and academic achievement (Sanchez, 2017). Under the Title I and Title III programs of the No Child Left Behind (NCLB) Act of 2001, ELLs are expected to master academic knowledge and skills at the same time that they are expected to master the academic English language necessary to represent that knowledge in memory, communicate it to others, and use it in their daily lives.

The research primarily focused on examining the correlation between English language proficiency and academic performance in science among ELL students, utilizing their Northwest Evaluation Association (NWEA) scores. Furthermore, a comparison was made between the academic improvement of ELL students and native speakers. The questions asked were:

1. To what degree will middle school ELL students' academic performance improve in integrated science during one year of instruction while becoming more English language proficient?
2. To what degree will the academic performance of middle school ELL students improve in science, compared to that of native speakers, after one year of

science instruction for both groups, while they are becoming more English proficient?

Hypotheses:

1- $H1_0$: There will be no significant improvement in middle school ELL students' academic performance in integrated science, after one year of instruction while becoming more English language proficient as measured by NWEA.

2- H1: There will be a significant improvement in middle school ELL students' academic performance in integrated science, after one year of instruction while becoming more English language proficient as measured by NWEA.

3- $H2_0$: There will be no significant difference in the academic performance of ELL middle school students in science, compared to that of native speaking middle school students, after one year of language proficiency and science instruction as measured by NWEA.

4- H2: There will be a significant difference in the academic performance of ELL middle school students in science, compared to that of native speaking middle school students, after one year of language proficiency and science instruction as measured by NWEA.

Assumptions

The population studied was middle school students in a Midwest charter public school district. The first assumption was that the sample students did not receive special math and science enrichment during the study. The second assumption was that the standardized tests given to ELL and non-ELL students are valid and reliable.

Limitations

The study population was limited to one middle school in the Midwest. Identification of ELL students were done by one senior ELL teacher using Assessing Comprehension and Communication in English State-to-State (ACCESS) test. Due to the different number of the ELL students in 2018, 2019, and 2020, it was not possible to measure the progress of the same students in English, math, and science areas using a longitudinal study. Test data were limited to 6^{th},7^{th}, and 8^{th} grade students' NWEA scores. Students whose data were analyzed are taught integrated science by different teachers who were not equally experienced.

Delimitations

- All the academic levels of middle school ELL students were included.
- Only Science and English data of the NWEA tests were used.
- Students' years of residency in the U.S. were not taken in consideration.

ELL students' years of residency in the U.S. should not be the only factor taken into consideration when comparing their academic achievement to that of native speakers of English because it is not a reliable indicator of their English language proficiency or academic abilities. Some ELL students may have been living in the U.S. for many years but may not have had access to formal English language instruction or have had limited exposure to English language and academic materials due to socio-economic or cultural factors. Conversely, some ELL students may have arrived in the U.S. more recently but may have had extensive English language instruction and support prior to their arrival.

Definitions of Terms:

ELL: English Language Learner. Students whose first language is not English and who are in the process of learning English.

ELP: English Language Proficiency. English language proficiency is measured by an English language proficiency test chosen by each state.

NWEA: Northwest Evaluation Association. It is a research-based, not-for-profit organization that supports students and educators worldwide by creating assessment solutions that measure growth and proficiency (NWEA, n.d.)

WIDA: World- Class Instructional Design and Assessment. The WIDA consortium is a group of states which design and implement standards and equitable educational opportunities for English learners (WIDA, 2020).

ACCESS: Assessing Comprehension and Communication in English State-to-State for English Language Learners. It is a test that is given to students from kindergarten to grade 12, to assess their progress in learning English (LARock, 2019).

Procedure

The targeted school, from which the study population was drawn, was located in Midwest region of the United States and were contacted to request 2018-2019 education year's Northwest Evaluation Association (NWEA) test scores. School administration and testing coordinator was informed how the data would be used. Three hundred nineteen middle school students' NWEA test scores were collected. Names of the students were stripped for confidentiality. Students were grouped as ELL and non-ELL students. No other identification was required for this study. Quantitative correlational analysis was used to investigate the relationship between language proficiency of ELL students and

their academic achievements in science. Same method was used to compare academic achievements of ELL and non-ELL students in science classes.

Significance

According to federal and state regulations, students who speak a language other than English in the home are assessed for English language proficiency, and based on the results of the assessments, potentially identified as being Limited English Proficient (U.S. Department of Education, 2020).

Across the U.S., English language learners are expected to perform academic proficiency in the standardized testing. Title III (the federal grant program created to improve language instruction for ELLs and immigrant students) of the No Child Left Behind (NCLB) Act requires that all English language learners (ELLs) receive quality instruction for learning both English and grade-level academic content and demand greater accountability for ELLs' English language and academic progress (Colorin Colorado, 2015). Title III also requires that states and local educational agencies develop and implement annual measurable achievement objectives for ELLs and report on their progress toward these objectives." (U.S. Department of Education, 2016) ELL students can face a range of linguistic challenges and limitations when attempting to achieve academic success. These challenges can include: limited vocabulary, grammar and syntax, difficulty with idiomatic expressions and cultural references, pronunciation and intonation, anxiety and self-consciousness. These linguistic challenges and limitations can make academic success extremely difficult for ELL students. According to Francis et al. (2009), on national reading, math, and science assessments, ELL students perform worse than mainstream students. It has been consistently observed that ELL students face

difficulties in achieving grade-level academic standards and often demonstrate inferior performance on standardized tests compared to their non-ELL peers (Reardon & Umansky, 2014).

The research was grounded in examining the correlation between ELL students' English language proficiency and academic achievement in science. Additionally, it involved comparing the science achievement of language proficient ELL students after a year of instruction with that of non-ELL students. Based upon potential trends in the correlation of English and science scores on NWEA, findings could give insight regarding the needs of English language learner students. Furthermore, by having a greater, research-based understanding of the interconnected relationship between English language proficiency and academic achievement in science, it may have a favorable impact on instructors' opinions of ELL students.

Summary

As a nation of immigrants, America has profited from the dynamism and energy given to the country by people seeking a better life (U.S. Department of Education, 2017). The increase in the number of young immigrants entering the United States has increased the focus on their educational needs. Teaching newcomers in secondary schools is more challenging than the teaching ones in elementary schools because the secondary curricula are academically more rigorous. The No Child Left Behind (NCLB) Act has made a great impact on states' policies in assessing ELL students (Wolf et al., 2010). ELLs are expected to gain English proficiency as well as satisfy the same academic content and achievement standards as all students.

Chapter 2: Literature Review

Introduction

With the change in the recent global dynamics, many people have started leaving their countries of origin and been seeking a safer place for a better future for themselves and their children. Some of these peoples have settled in different countries either legally or illegally. The United States is one of these countries that millions of immigrants have settled in in the past decade. To date, much attention has focused on immigration laws at the national and state levels in the United States. According to the Migration Policy Institute, the impact of immigration on U.S. classrooms and society's response to immigrants will decide the future U.S. workforce and the country's capacity to remain competitive in a global economy (MIP, 2019). Given the recent huge increase in the number of young migrants entering the United States, the expectations imposed on education institutions by immigrant students have never been greater (Sugarman, 2015). According to the United States Department of Education (2020), all children in the United States are entitled to a basic public elementary and secondary education regardless of their actual or perceived race, color, national origin, citizenship, immigration status, or the status of their parents/guardians.

The educational needs of refugee and immigrant students are frequently unmet in the United States and other nations across the globe, a new United Nations report concludes (Mitchell, 2018). The United Nations Educational, Scientific, and Cultural Organization (UNESCO) produced a report called "Building Bridges, Not Walls" that argues that the US government's present immigration laws create too many impediments for students who are immigrants or refugee (2018). The UNESCO report recommends

legislative measures to make it easier for these children to integrate into schools, boost their access to high-quality education, and ensure that immigrant and refugee families understand that schools are safe spaces (Mitchell, 2018). According to the UNESCO (2018) report, American schools face various issues. One prevalent issue is the misdiagnosis of children from non-English-speaking families as having special education needs, which is partly due to the absence of literacy tests in their native language. Moreover, immigrant parents generally do not feel welcome in schools and believe they have limited influence over their children's education and how they are treated. Additionally, older immigrant students often get placed in specialized programs that isolate them from the general student population, thereby raising their likelihood of school dropout.

For some immigrant students, starting from limited literacy to passing the required courses to earn a high school diploma in a few years can be overwhelming. In addition to adjusting to learning a new language and culture, immigrant and refugee youth must adapt to the U.S. classroom practices quickly to fill the gaps in their subject knowledge and pass the courses required to graduate from high school (Sugarman, 2017). The supports given to immigrant and refugee students by schools and communities plays an essential role in their future educations and careers.

Who Are ELL Students?

According to the National Education Association, English language learners — often called ELL students or ELLs — are the fastest-growing student population group (NEA, 2005). The No Child Left Behind Act (NCLB) of 2001, which

amended Title III of the Elementary and Secondary Education Act (ESEA), fundamentally changed how the federal government directs federal funding to support programs for children of limited English proficiency (LEP), also known as English language learner (ELL) students.

An ELL student as an individual who

"*(a) is age 3 to 21 years;*

(b) is enrolled or preparing to enroll in elementary or secondary school

(c) was not born in the U.S. or whose native language is not English

(d) is a Native American, Alaskan Native, or a resident of outlying areas

(e) comes from an environment in which a language other than English has had a significant impact on an individual's English Language Proficiency (ELP)

(f) is migratory and comes from an environment where English is not the dominant language

(g) has difficulties in speaking, reading, writing, or understanding the English language that may deny the individual the ability to meet the state's proficient 3 level of achievement, to successfully achieve in classrooms where English is the language of instruction, or to participate fully in society" (National Research Council, 2011, p.6).

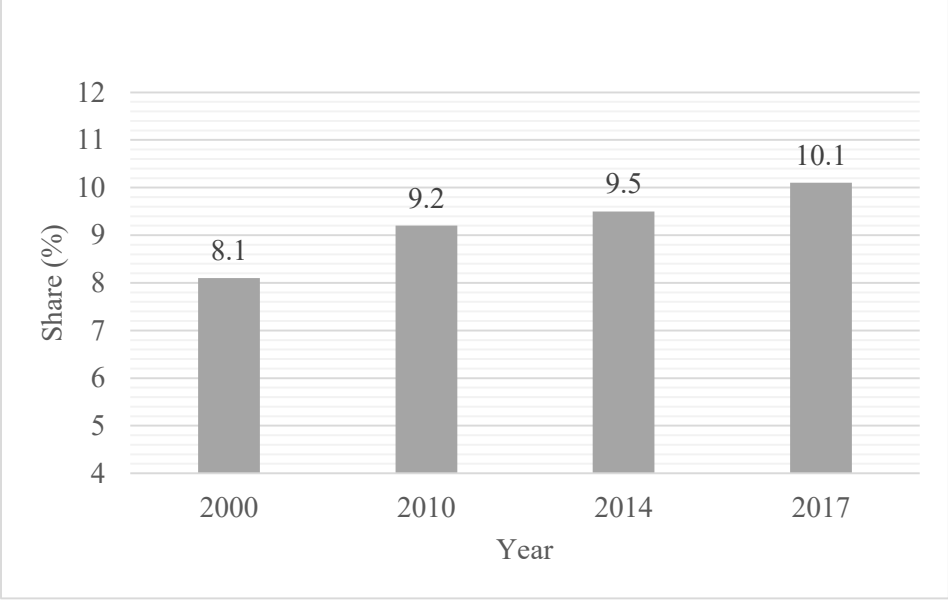
Various terms are used to refer to students who are not proficient in English, such as English Learner (EL), English as a Second Language (ESL), English Language Learner (ELL), English as an Additional Language (EAL), Limited English proficient (LEP), Culturally and Linguistically Diverse (CLD), non-native English speaker, bilingual students, heritage language, emergent bilingual, and language-minority students

(Glossary of Education Reform, 2013). Based on the No Child Left Behind act, schools in the U.S. give a home language survey, an English Language Proficiency (ELP) assessment, and academic achievement assessment(s) in content areas in order to identify ELL students. According to the National Council of Teachers of English (NCTE), *"There is no one profile for an ELL student, nor is one single response adequate to meet their educational goals and needs; ELL students are a diverse group that offers challenges and opportunities to U.S. education" (NCTE, 2008, p.2).*

According to National Center for Education Statistics (NCES), the percentage of public school students in the United States who were ELLs was higher in fall 2017 (10.1 percent, or 5.0 million students) than in fall 2000 (8.1 percent, or 3.8 million students) (2019).

Figure 2.1

Share of public school students who were enrolled as English Language Learners (ELL) in the United States from fall 2000 to fall 2017

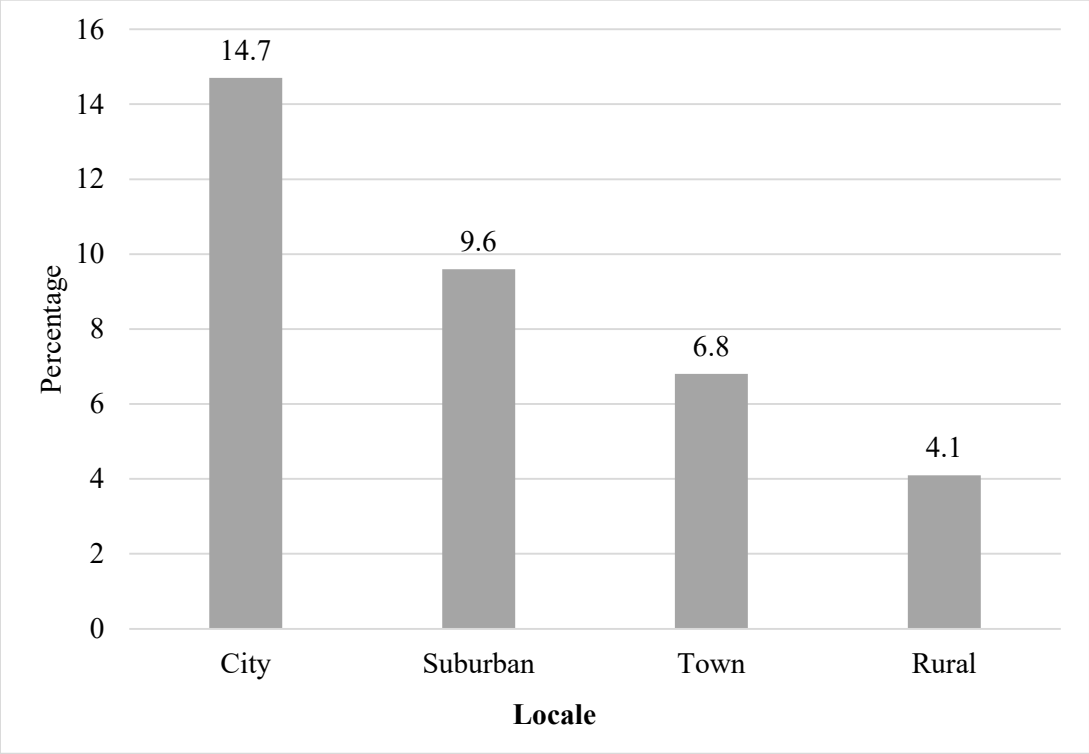


Note: Data are from U.S. Department of Education, National Center for Education Statistic

Another statistics shows that ELL students population differs based on the location of the school districts. Population of ELL students was higher in more urbanized areas than less urbanized areas in fall 2017 (NCES, 2020). ELL students made of an average of 14.7 percent of total public school enrollment in cities, 9.6 percent in suburban areas, 6.8 percent in towns, and 0.1 percent in rural areas (NCES, 2020).

Figure 2.2

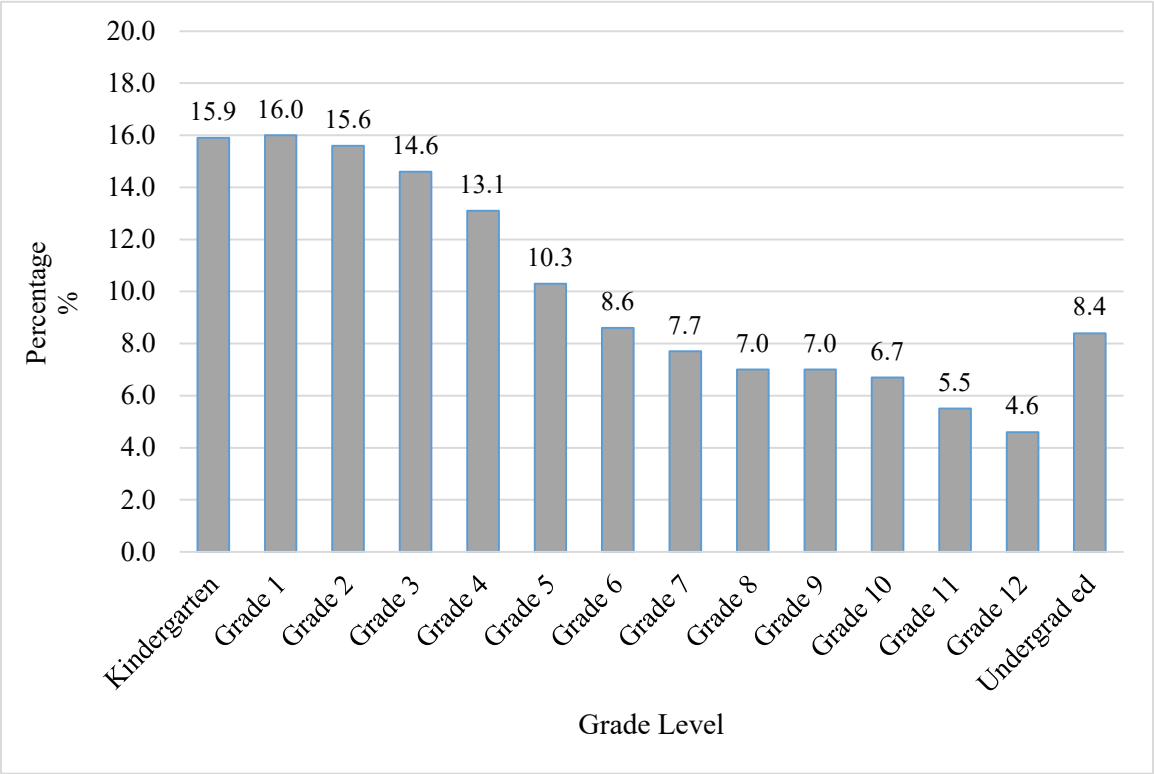
Percentage of public school students who were English language learners, by locale: Fall 2017 (NCES, 2020).



Note: Data are from U.S. Department of Education, National Center for Education Statistic

Figure 2.3

Percentage of public school students who were English language learners, by grade level: Fall 2017 (NCES, 2020).



Note: Data are from U.S. Department of Education, National Center for Education Statistic

ELL students can be a part of a language assistance programs to improve their language proficiency. Improvement in English proficiency may lead to improvement in other subject areas. ELL students' English Language exposure may differ. Most English-language learners were born in the United States, but since their parents and grandparents are often immigrants, most of them speak their native language at home; some may speak English at home; some may speak both their native language and English (Glossary of Education Reform, 2013).

Most of the recently arrived immigrants and refugees may have experienced war, persecution, violence and social chaos, and their youth may have had educational disruption. In addition, some other challenges that ELL students may face in the U.S., such as temporary settlement, poverty, and non-citizenship status and that affect their learning progress and academic achievement.

Since the states and schools differ in how to identify ELL students and in how to teach them The experiences of ELLs education vary across the country, as (Bialik et al., 2018). Regardless of educational approach, ELLs represent a growing part of the U.S. student body. ELLs tend to underperform on standardized tests, drop out of school at significantly higher rates, and decline to pursue postsecondary education compared to English-speaking peers (Glossary of Education Reform, 2013).

Achievement of English Language Learners

Numerous research studies have been conducted in the United States since 1980 on the educational outcomes of English language learners (ELLs) (Genesee et al., 2005). To measure the academic achievements of schools and students, most states use standardized achievement tests along with school achievement, high school dropout rates, or grade point average (GPA). In many studies about English language learners, the relation between educational success of ELLs and the type of the programs they receive and instructions given were examined. For example, according to Thomas and Collier (2002), students who participated in an assortment of different programs and those who received no special intervention performed at the lowest levels and had the highest dropout rates Although definitions of various programs were vague, findings showed that

ELLs who received any specialized program were able to catch up to, and in some studies go beyond, the achievement levels of their ELL and English-speaking peers who were educated in English-only mainstream classrooms (Genesee et al., 2005). Another example is that the findings of the two-way immersion programs (bilingual immersion programs where native speakers of two languages learn together) and late-exit programs (programs for English Language Learners that gradually transition to English while maintaining instruction in their first language) indicated that ELLs who participated in programs that provided extended instruction through the medium of the students' first language outperformed the students who received only short-term instruction through their first language (Genesee et al., 2005).

Nation's Report Card

English language use, both in the school and outside of school, is positively related to the development of English proficiency of ELL students. Consequently, the improvement in English proficiency of ELL students will impact their achievement in other subject areas positively. Martiniello (2008) conducted research to examine the relationship between specific linguistic features and the level of difficulty experienced by English Language Learners (ELLs) and non-ELLs when solving math word problems. "Although many of the studies did, as predicted, find a relationship between linguistic complexity and ELLs' performance in math word problems, the effect of specific linguistic features varies from test to test and from one grade to another." (Martiniello, 2008). Martiniello (2008) found a consistent negative impact on item difficulty for both ELLs and non-ELLs when considering the length of item features in various math tests

and grade levels across national and state samples. This implies that longer and more linguistically complex questions tend to result in poorer performance for both groups of students. Additional research is needed to examine if similar relationships exist in other subject areas. By comparing the results of math and its linguistic aspects to those of other subjects, a more comprehensive understanding can be obtained regarding the interaction between subject difficulty and linguistic demands.

According to the National Center for Education Statistics (NCES), there is an academic achievement gap between native English-speaking students and ELLs in the public school. ELLs in elementary and secondary schools continue to score lower than their native English-speaking peers in both mathematics and reading (NCES, 2019). Although progress has been made in narrowing achievement gaps, disparities in educational outcomes persist across various factors such as poverty, racial and ethnic background, disability, and English language proficiency. The National Assessment of Educational Progress (NAEP), often referred to as "The Nation's Report Card," is an ongoing assessment, administered by NCES, conducted in the United States. It evaluates the academic performance and progress of students in subjects like reading, mathematics, and science, providing a comprehensive overview of educational achievement and proficiency levels at national, state, and local levels., NAEP allows comparisons of student knowledge and skills among states, jurisdictions, demographic groups, and over time. Its results offer valuable insights into K-12 education and student achievement, informing education policies and practices.

Performance level of students in each subject area is determined by required knowledge at their grade level and how much they learned which are measured by the

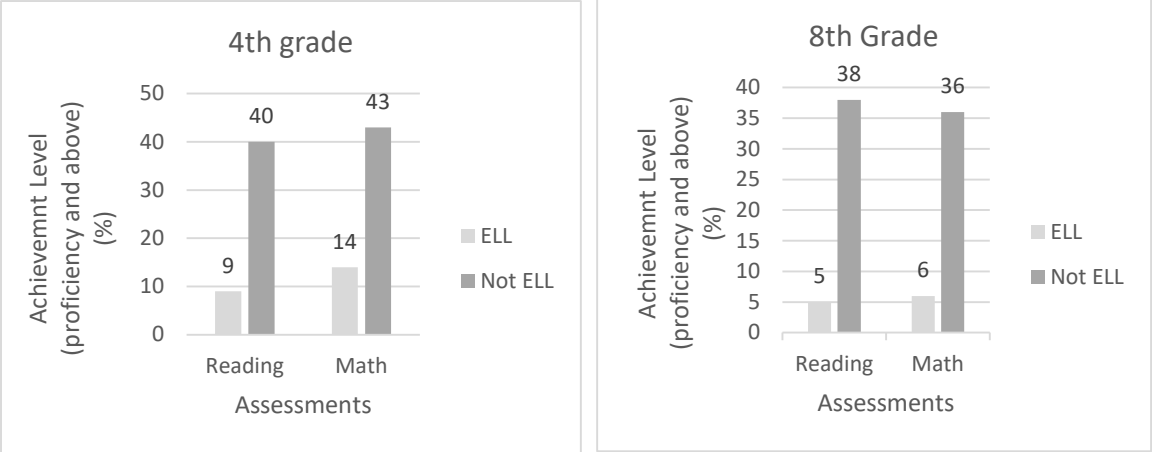
correct answers. The results of student performance on the NAEP subject assessments are presented as average scores on the NAEP subject scale and as the percentages of students obtaining NAEP subject achievement levels (NCES, 2018). The achievement levels show how well that performance compared to pre-determined goals. As a result, average scale scores reflect what students know and can accomplish, whereas achievement-level outcomes reflect how well students' performance fulfills expectations for what they should know and be able to do. (NCES, 2018). When NAEP results are reported, the group of students with shared characteristics are taken in consideration as well. Subpopulations are defined by race/ethnicity, gender, eligibility for free/reduced-price school lunch, highest level of parental education, type of school, type of school location, region of the country, status students with disabilities, and status students identified as English learners (NCES, 2018). For ELLs, the process of acquiring second language and integrating the culture can be very challenging. According to Navarrete and Watson (2013), the degree of challenge is affected by the personal, experiential, and contextual factors and how well the ELLs regulate the linguistic, cognitive, social, and emotional tasks that are required in language and cultural acquisition. The ELL findings of NAEP are based on students who were tested, and thus cannot be applied to the entire population of ELL students (NCES, 2018). Moreover, according to the National Center for Education Statistics, ELL students graduate at the lowest rate of all student groupings from high school (2018).

Since 2003, the NAEP has been administered every two years to samples of fourth- and eighth-grade students nationwide, assessing their proficiency in reading and mathematics. The assessments follow a consistent administration process and use

identical test booklets, ensuring a standardized measure of performance across states and selected urban districts (NCES, 2018). In the 2017 NAEP assessment, the data revealed that 14 percent of fourth-grade English Language Learners (ELLs) demonstrated proficiency or above in mathematics, while non-ELL students achieved a proficiency rate of 43%. Additionally, in reading, 9 percent of fourth-grade ELLs reached proficiency or above, compared to 40% of non-ELL students. Similar trends were observed in eighth grade, with ELLs consistently lagging behind their non-ELL peers in both mathematics and reading proficiency rates (U.S. Department of Education, 2018). For instance, while 36% of non-ELLs achieved proficiency or above in eighth-grade mathematics, only 6 percent of ELLs attained the same level. Similarly, in eighth-grade reading, the proficiency rates were 5% for ELLs and 38% for non-ELLs.

Figure 2.4

National Assessment of Educational Progress NAEP Assessment Data



Note: The graphs illustrate the 2017 National Assessment of Educational Progress (NAEP) results, depicting the proficiency levels of fourth-grade and eighth-grade English Language Learners (ELL) and non-ELL students in mathematics and reading. The data presented represents the percentage of students performing at or above the proficient level.

Performance level of students in each subject area is determined by required knowledge at their grade level and how much they learned which are measured by the correct answers. The results of student performance on the NAEP subject assessments are presented as average scores on the NAEP subject scale and as the percentages of students obtaining NAEP subject achievement levels (NCES, 2019). The achievement levels show how well that performance compared to pre-determined goals. As a result, average scale scores reflect what students know and can accomplish, whereas achievement-level outcomes reflect how well students' performance fulfills expectations for what they should know and be able to do. (NCES, 2019). When NAEP results are reported, the group of students with shared characteristics are taken in consideration as well. Subpopulations are defined by race/ethnicity, gender, eligibility for free/reduced-price school lunch, highest level of parental education, type of school, type of school location, region of the country, status students with disabilities, and status students identified as English learners (NCES, 2019). For ELLs, the process of acquiring second language and integrating the culture can be very challenging. According to Navarrete and Watson (2013), the degree of challenge is affected by the personal, experiential, and contextual factors and how well the ELLs regulate the linguistic, cognitive, social, and emotional tasks that are required in language and cultural acquisition. The ELL findings of NAEP are based on students who were tested, and thus cannot be applied to the entire population of ELL students (NCES, 2019). Moreover, according to the National Center for Education Statistics, ELL students graduate at the lowest rate of all student groupings from high school (2019).

The ELL student population in the U.S. is culturally and linguistically diverse. Besides cultural and language diversity, socioeconomic diversity is also seen among the ELL student population. Some students live in families with high levels of income and education, while others come from families with poverty and little formal education. Usually, socioeconomic status and education level of families have influence on the academic achievement of students (Chen et al., 2018).

The growing population of English Language Learners (ELLs) in U.S. schools necessitates the implementation of a well-structured evaluation process for the referral, assessment, and identification of ELL students. It is critical for each school to have well-developed referral protocols and procedures, as well as knowledgeable experts who can assess academic and behavioral difficulties in light of language, culture, and disability. ELL students are entitled to the same services and interventions as their non-ELL peers. Having a department designated for ELL students or using Response to Intervention (RTI) are some services that schools can provide. Response to intervention is a multi-tier approach to the early identification and support of students with learning and behavioral needs (Gorski, n.d.) RTI is not just for students with special needs or learning disabilities; it may be used to help any student succeed in the classroom. RTI educational techniques and interventions should be culturally sensitive and address the language needs of the student. In addition to RTI, schools can offer ELL services to students. The World-class Instructional Design and Assessment (WIDA) Consortium is one of the largest organizations in the United States that provides instructors the tools and resources for ELL students' language development (WIDA, 2020).

Many immigrant students drop out of high school because they have problems associated with the language, curriculum, and cultural settings. Researchers have studied high school dropout rates by documenting the characteristics of the school environment and external reasons, such as needing to get a full time job (Sugarman, 2017). The specific experiences of immigrant and ELL students is not known well enough. Research studies have pointed to obstacles in English language learners' access to rigorous, grade level content and shortages of well-trained ELL specialist influence the dropout and resilience of the ELL students (Sugarman, 2017). To reduce the dropout rates and close the achievement gaps of ELL students, educators need to investigate and find effective methods of teaching these students. However, most teachers do not have adequate knowledge and support to address the needs of ELLs (Lee, 2005). "Teachers trained and prepared to work with ELL students can effectively support their students' development" (Hansen & Quintero, 2017). Academic success for ELLs necessitates the integration of academic knowledge with understanding of English language and literacy development. According to Lee, the research community has paid little attention to ELLs' subject area training in math and science, focusing instead on their English fluency and literacy (2005). The research fields of math and science education have developed independent of the research field involving ELLs (CADRE, 2011). To date, researchers in science and math education and their colleagues in ELL education have begun to cross domains to generate new understandings and strategies in math and science education that are tailored to the requirements of English Language Learners (CADRE, 2011).

Theoretical Framework

Behaviorism or the behavioral learning theory states that all behaviors are learned through interaction with the environment and it is the earliest language theory that is propounded by J.B. Watson in 1913 (UKEssays, 2018). Children imitate the sounds and patterns they hear around and repeat words they hear, trying to use them in their conversations until they become a regular part of their daily life (UKEssays, 2018). Behaviorists think that learning a language specifically second language should be learned through practice. Burrhus F. Skinner (1957), a renowned pioneer of behaviorism and expert in behavior in language theory, delivered one of the earliest scientific explanations of language acquisition, attributing language development primarily to environmental factors (Lemetyinen, 2012). Language acquisition is a process of gaining the ability to understand and use a language to communicate. Language acquisition can take place at any period of human's life, however, it is mostly gained from birth to until the age of 6 or 7 years (Hickey, n.d.). This period of language acquisition is also referred as first language acquisition or native language acquisition. Later, Noam Chomsky, who is an American linguist, philosopher, cognitive scientist, criticized Skinner's account. He proposed the "Innateness Hypothesis" of child language acquisition which states that the human species is pre-wired to acquire language (Wagner, n.d.). According to the innateness hypothesis, children do not need to acquire universal concepts such as structural dependency because they are already included in Universal Grammar (Szczegielniak, n.d.). Chomsky's Universal Grammar theory states that children instinctively know how to combine a noun (e.g. "a boy") and a verb (to "eat") into a meaningful, correct phrase ("A boy eats") (Lemetyinen, 2012). Universal grammar aids

children's language development as well as adults' overall language processing. All children will learn a language, and if they are exposed to multiple languages, they will learn more than one. (Wagner, n.d.).

Lev Vygotsky, an influential developmental psychologist of the early 20th century, formulated a sociocultural theory of child development with a primary focus on the impact of culture on a child's growth and development. According to Vygotsky (as cited by Darhower, 2013, p. 251), he asserts that development unfolds through meaningful verbal interactions between novices and individuals possessing greater knowledge, such as parents, peers, or teachers. 2013, p. 251). According to Darhower (2013), “the sociocultural theory operates on the assumption that human cognitive development is highly dependent upon the social context within which it takes place” (p. 251). Language is a critical element of teaching and learning. It is the medium through which concepts and skills are acquired and evaluated, social relationships and identities are established, and increasingly deeper and more complex disciplinary understandings are developed over time (Anstrom et al., 2014). Language functions as a communication tool employed by individuals on a daily basis as a means to convey information and arguments to others (Rabiah, 2018). Whether through spoken or written forms, language enables us to effectively transmits our thoughts, ideas, and messages to communicate with one another.

The learning of a language other than one's native tongue is referred to as second language acquisition (SLA) or language 2 (L2). The key point to note is that SLA pertains to the acquisition of a nonnative language following the acquisition of one's native language. When acquiring a second language, the learner should be

exposed to the language naturally in an environment where the language is spoken (Aljohani, n.d.). The crucial aspect is that learning a second language typically occurs in an environment with ample exposure to speakers of the target language (e.g. German speakers learning Japanese in Japan), whereas learning a foreign language often lacks such extensive access to native speakers (e.g., French speakers learning English in France) (Aljohani, n.d.). The immigrants learning English in the United States are exposed to the language in many ways such as social interactions, shopping, working, or studying. The young people and children are exposed to the language mostly in schools. It is usually assumed that children learn a second language easier than the adults.

Norman Doidge (2008), a psychoanalyst, introduced the captivating concept of "the tyranny of the mother tongue." Doidge posited that acquiring a second language becomes more challenging as we grow older, after the critical period for language learning has passed. He explained that our native language gradually dominates the linguistic landscape in our minds, making it difficult for a second language to compete. This phenomenon, referred to as the tyranny of the mother tongue, often leads adults to rely on cross-translation when learning a foreign language, which ultimately hinders their progress (Zilberman, 2017). The distinction between L1 and L2 acquisition is that a speaker in L2 acquisition already knows the language. Learners often apply the rules pertaining to sounds (phonological), sentence structure (syntactic), and word formation (morphological) from their first language to their second language, but not all rules transfer, and many errors made by learners are unique to their second language (Szczegielniak, n.d.). These errors arise due to differences in the phonological, syntactic,

and morphological systems between the two languages and the influence of the learner's L1 on their L2 acquisition.

Stephen Krashen, a linguistics expert from the University of Southern California, has made a significant impact in the field of second language research and teaching with his widely recognized and highly regarded theory of second language acquisition (Schutz, 2019). Krashen (1982) highlights the significance of the innate subconscious process in language acquisition, prioritizing it over conscious processes like explicitly memorizing grammar rules.

Krashen's theory of second language acquisition consists of five main hypotheses:

- Acquisition-Learning hypothesis;
- Monitor hypothesis;
- Input hypothesis;
- Affective Filter hypothesis;
- Natural Order hypothesis.

Acquisition-Learning hypothesis proposes that there are two distinct systems involved in language development: the acquisition system and the learning system (Krashen, 1982). The acquisition system operates unconsciously and is responsible for the acquisition of language through exposure to comprehensible input in natural contexts. It is a subconscious process similar to the way children acquire their first language. In contrast, the learning system is a conscious process that involves formal instruction and explicit learning of language rules. This system is responsible for conscious knowledge about the language, such as grammatical rules, vocabulary, and explicit understanding of language structures. According to Krashen (1982), learning is less important than

acquisition. Krashen (1982) argues that the acquisition system is crucial for the development of fluent, natural language skills, while the learning system has a more limited impact and is primarily used as a monitor to self-correct language output.

Monitor hypothesis defines the influence of learning on acquisition and explains the link between the two. The monitoring function is a practical effect of the grammar that has been learned. According to Krashen (1982), the acquisition system initiates the utterance (spoken or vocalized expression), while the learning system acts as a 'monitor' or 'editor' (Schutz, 2019). According to Krashen, while monitoring can enhance speech accuracy, its usage should be restricted as the 'monitor' can act as a barrier by causing students to focus more on correctness rather than maintaining fluency and natural flow in their speech (Bilash, 2009).

Krashen's Input Hypothesis, which is a central concept in his theory of second language acquisition, explains how a learner acquires a second language. According to this hypothesis, language acquisition occurs through comprehensible input, which refers to language input that is just slightly beyond the learner's current level of understanding (Krashen, 1982). According to this hypothesis, when a learner gets second language 'input' that is one step beyond his or her existing level of linguistic ability, the learner improves and develops along the 'natural order' (Shutz,2019). That means by receiving input that is challenging yet still understandable, learners can gradually improve their language skills and move towards more advanced levels of proficiency. This process of comprehending input promotes language acquisition as learners subconsciously internalize and develop their linguistic abilities (Krashen,1982).

Affective Filter hypothesis states that various factors, such as motivation, self-confidence, anxiety, and individual personality traits, play a role in facilitating or hindering the process of second language acquisition (Krashen, 1982). Krashen states that learners with high motivation, self-confidence, a good self-image, a low level of anxiety and extroversion are better equipped for success in second language acquisition (Schutz, 2019). On the other hand, the opposite of these variables can form a mental block that obstructs the language acquisition.

The Natural Order hypothesis suggests that the acquisition of grammatical structures follows a predictable natural order (Krashen, 1982). According to Krashen (1982), certain grammatical structures are acquired earlier in the language acquisition process, while others are acquired at a later stage for a particular language. The Natural Order Hypothesis indicates that teachers cannot change the order of a grammatical teaching sequence because the natural order of acquisition occurs independently of deliberate teaching (Bilash, 2009).

Krashen's theory has attracted high attention from linguist, psychologists, and educators (Yang, 2007). The Monitor Model has been extremely influential in language teaching pedagogy, and it is the basis for ELL instruction at Frankfurt International School (FIS, 2009). According to his theory, if teachers make their classroom instruction comprehensible, then ELL students learn the subject content and be acquiring English at the same time (FIS, 2009). ELL, mathematics, and science teachers of non-native English students should consider themselves as teachers of language, too. In addition, in mainstream classes, ELL students are usually anxious. If teachers find ways to reduce the

ELL students' anxiety and stress, the students can gain more from the input they receive (Schwartz, 2021).

Summary

These theories offer diverse insights into language acquisition, considering the roles of environment, innate abilities, social interactions, and cognitive factors. They contribute to our understanding of language learning processes and their strengths and weaknesses inform instructional approaches and research in this field.

Behaviorism proposes that language learning is acquired through interactions with the environment, emphasizing practice and repetition. The Innateness Hypothesis suggests that language acquisition is a natural process, with children possessing innate abilities through Universal Grammar. Sociocultural Theory emphasizes the role of social interactions and cultural influences in cognitive development and language acquisition. Second Language Acquisition (SLA) focuses on acquiring a non-native language, considering factors like exposure and age. Krashen's Theory highlights subconscious language acquisition, comprehensible input, and affective factors in second language learning.

Strengths and weaknesses of these theories include behaviorism's focus on practice but potential oversight of innate abilities, the Innateness Hypothesis's recognition of innate language skills but limited explanation of environmental influences, Sociocultural Theory's emphasis on social interactions but potential neglect of individual differences, SLA's consideration of exposure and age but potential complexity oversimplification, and Krashen's Theory's emphasis on subconscious acquisition but potential oversimplification.

In comparisons, behaviorism emphasizes environmental factors, while the Innateness Hypothesis focuses on innate abilities. Sociocultural Theory highlights social interactions, while SLA considers exposure and age. Krashen's Theory incorporates elements of behaviorism, innateness, and sociocultural perspectives, emphasizing comprehensible input and affective factors.

English learners bring a wealth of resources to STEM learning, including knowledge and interest in STEM-related content that arises from their experiences in their homes and communities, home languages, differences in practices, and, in some cases, experiences with schooling in other countries (NASEM, 2018). ELLs can contribute to STEM classrooms by bringing in a diverse range of linguistic and cultural backgrounds. As noted by Lee and Buxton (2010), ELLs may have distinct discourse practices from native English-speaking students. This can enhance classroom discussions and support all students to develop a more comprehensive understanding of STEM concepts. Moreover, ELLs who speak multiple languages may be able to relate STEM concepts to real-life applications in their home countries or cultures. By understanding these theories and considering the unique assets that ELLs bring to STEM education, educators can create inclusive and culturally responsive learning environments that promote the academic success of all students.

Chapter 3: Methodology

Introduction

The two main objectives are to conduct a quantitative analysis of the English language learners' (ELL) English proficiency and their performance on science standardized tests, and to compare the improvement in science knowledge of ELL students with that of native English speakers.

The research questions investigated were:

1- To what degree will middle school ELL students' academic performance improve in integrated science during one year of instruction while becoming more English language proficient?

2- To what degree will the academic performance of middle school ELL students improve in science, compared to that of native speakers, after one year of science instruction for both groups, while they are becoming more English proficient?

Both questions were addressed by using students' Northwest Evaluation Association (NWEA) Measure of Academic Progress (MAP) assessment scores in English and science. NWEA test is a state-aligned, computerized adaptive test for students in grades K-12. Students in kindergarten through second grade take reading and math assessments, while those in third through twelfth grade take reading, language usage, math, and science assessments. These examinations reflect each student's educational level and track their progress over time (NWEA, n.d.). These features have influenced research partnerships between the Northwest Evaluation Association and education researchers that used MAP assessments as a key data source in studies of

educational initiatives (Cordray et al., 2012). The NWEA has the nation's largest archive of student progress data and has produced multiple technical reports providing strong evidence of reliability and validity in its array of MAP assessments (REL, n.d.).The NWEA test is not a high-stakes test, that is, the test scores are not used to determine grade retention, promotion or graduation of students, but is given to students at the beginning, middle, and end of the school year to measure a student's academic achievement and calculate academic growth. NWEA assessments are untimed, multiple choice tests. Since all tests are given electronically, the difficulty of the questions adjusts depending on how students answer. For instance, if a student answers a question correctly, the next question will be harder. If a student misses a question, the next question will be easier until the student answers one correctly. By adapting to each student's learning level, the test delivers a personalized assessment experience, accurately measuring each student's progress and growth. It provides measurement of students who perform on, above, and below grade level.

Studies have shown that limited proficiency in English among primary and secondary education students is the cause of low scores in math and science on standardized tests. According to Abedi and Dietel (2004), ELL students' school performance in standardized state assessments is 20 to 30 percentage points lower than that of other students, and shows no progress over time. ELLs' academic performance has lagged behind that of other groupings, and the attainment gap has reduced only slightly over time (Abedi & Dietel, 2004). There may exist a significant correlation between the acquisition of the English language and academic accomplishments.

The NWEA Measure of Academic Progress (MAP) growth tests are given at various times throughout the school year, depending on the school's or district's schedule. Some schools administer the tests three times a year (fall, winter, and spring), while others may give them once or twice a year. Most students take approximately 45 to 55 minutes to complete a MAP Growth test. However, the MAP Growth is not timed, and students may take as much time as they need to complete it. Once a student finishes a MAP Growth test, the MAP Growth system automatically scores the assessment and makes the results accessible within 24 hours (NWEA, n.d.). NWEA offers a variety of reports that aid schools and educators in utilizing MAP Growth data. Teachers have access to progress reports for individual students and class-wide performance. Schools typically distribute the MAP Growth Family Report to families. The report presents a student's most recent MAP Growth assessment scores and related information. It is recommended that parents consult with their child's teachers to fully comprehend the report and how to utilize their child's subject scores to identify resources that can support learning at home (NWEA, n.d.).

A middle school located in Midwest area was chosen as the research site. The targeted school administers the NWEA MAP growth test three times in a year. The tests are untimed, and computer based. Students do not take the test in one session. For each subject, different days are assigned, and subject course teachers administer the test. Principals and administrators review the scores to evaluate the performance and progress of a grade level, school, or district as a whole. The targeted school provides the scores to teachers within a week and discusses them in department meetings. Teachers can examine the progress of individual students and of their classes as a whole after the

testing is completed school-wide. Teachers may design instruction that maximizes the learning potential of each student. MAP Growth also supplies information on the expected growth for students in the same grade, subject, and starting achievement level, which students can use to set goals and track their progress (NWEA, n.d.). The school provides MAP Growth Family Report to the parents and students.

To answer the research questions, NWEA archival data was requested from administrator and test coordinator of the targeted school. Since the research design did not require the identifiable student records, no consent was necessary to access the data. The school provided the NWEA test scores of 6th, 7th, and 8th grade students who attended the school in 2018-2019 educational year. The data consisted of each student's fall and spring English language arts (ELA) and science scores by indicating whether the student is an English language learner (ELL) or not, but without indicating their names, birth days, school IDs, grade levels, first language or any other identifiers. The data were used to analyze trends over time and variation in changes over time among groups of individuals in terms of English language and science achievements.

To answer the first research question, using paired t-test was the most appropriate method. The paired t-test compares the means of two measurements taken from the same individual, object, or related units (KSU, n.d.). Measurements taken in pairs can be indicative of various effects, such as a measurement taken at different points in time (such as scores taken before and after an intervention). The measurements employed in this research consisted of the NWEA scores of ELL students during fall and spring of 2022, with the intervention being a year of English language learning. Using paired t-test was the most appropriate method.

To answer the second research question, the statistical method, Analysis of Covariance (ANCOVA) was employed. The repeated measures ANCOVA compares means across one or more variables that are based on repeated observations while controlling for a confounding variable. A confounding variable can potentially distort or influence the observed relationship between the independent and dependent variables, leading to inaccurate or misleading conclusions. Confounding variables are important to identify and control for in research studies to ensure that the observed effects are truly due to the independent variable and not influenced by other factors. The repeated measures aspect referred to the fact that the same group of participants (ELL and native speaker) were measured twice, once before (NWEA fall test) and once after (NWEA spring test) the instruction.

The sample was limited to students of the selected school located in Midwest area. There were 42 middle school ELL students and 277 native speakers. Determining the appropriate sample size is a crucial step in ensuring that the minimum sample size is met. A 5:1 ratio is used to look for commonality between variables. That means there should be at least five observations for each independent variable. This ratio is used to ensure that there is an adequate amount of data to accurately estimate the relationships between variables and identify the most important factors or components that explain the variation in the data. When there are too few observations relative to the number of variables, the analysis may suffer from low statistical power and/or instability, which can lead to inaccurate results. The term "commonality" refers to the relationship that exists between an item and a factor. For example, various aspects of a person's work environment, such as pay, benefits, and opportunities for advancement, might be

measured in a study of job satisfaction. How these different variables relate to each other and which underlying factors contribute to overall job satisfaction could be identified by using factor analysis. The degree to which each variable is associated with each factor could then be determined by the commonality of each variable, which could assist in prioritizing which aspects of the work environment to focus on when attempting to enhance overall job satisfaction. In research studies, higher commonality means that a variable is strongly related to a specific factor or set of factors that are common across multiple variables. This can be advantageous because it allows researchers to simplify their study design and analysis by reducing the number of variables they need to measure and analyze (Stevens, 2009). By doing this, researchers can save time and resources and may not need to collect as large of a sample size to achieve sufficient statistical power. More precisely, it is the proportion of that variable's variance accounted for by common components (MacCallum et al., 1999).

Summary

The English language learners' (ELL) English proficiency and their performance on science standardized tests was analyzed. The improvement in science knowledge of ELL students was compared to that of native English speakers. The research questions addressed the improvement of academic performance and science knowledge of middle school ELL students over a year of instruction and how this compared to those of native speakers. The Northwest Evaluation Association (NWEA) test scores in English and science were used to answer the research questions. The NWEA test is a state-aligned, computerized adaptive test for students in grades K-12. The tests are untimed, computer-based, and provide reports that aid schools and educators in utilizing MAP Growth data.

The NWEA 2018-2019 archival data from a middle school in the Midwest area were collected. Detailed information about the NWEA test, its use in schools, and how it was used to track student progress and growth was presented.

Chapter 4: Results

Introduction

Observation were gathered to determine

1) the academic performance of middle school ELL (English Language Learner) students in integrated science, specifically looking at their improvement over one year of instruction while also becoming more proficient in the English language

2) whether the academic performance of middle school ELL students in science, compared to that of native speakers, improve after one year of science instruction for both groups, while they are becoming more English language proficient.

The researcher wanted to measure the impact of one year of instruction and English language proficiency development on the academic performance of ELL students in science, and to compare it with that of native speakers.

These questions were important in understanding the effectiveness of instruction and support for ELL students in improving their academic performance in science, and in promoting equity and inclusion in education.

The science achievement data came from the NWEA test that measures understanding of scientific concepts on an interval scale. An interval scale is characterized by a meaningful difference between two values and a specific order (Bhandari, 2021). Interval scale provides a framework for measuring and analyzing data, where the difference between two values is meaningful and consistent. This means that the distance between two points on the scale is uniform and can be used to make meaningful comparisons between different values. For instance, on an interval scale that measures temperature in Celsius, the difference between 20°C and 30°C is the same as

the difference between 30°C and 40°C. However, the interval scale does not have a true zero point. This means that zero on the scale does not represent a complete absence of the variable being measured. It is simply an arbitrary point that indicates a specific value on the scale. For instance, on a temperature scale that measures temperature in Celsius, zero degrees does not represent the complete absence of temperature; it simply indicates a point on the scale where the temperature is defined as zero degrees Celsius.

Although the interval scale provides a useful framework for measuring and analyzing data, but there may be situations where the difference between two values is not meaningful or consistent. For instance, when dealing with categorical data (such as gender, race, or religion), an interval scale would not be meaningful, as there is no inherent order to the categories, and the differences between them are not necessarily consistent. Similarly, when dealing with subjective measures, such as pain or happiness, the difference between two values may not always be consistent or meaningful, as individuals may have different perceptions or thresholds for these experiences. In such cases, other scales or measurement tools may be more appropriate for analyzing the data. Understanding the concept of interval scale is important because it is a fundamental concept in statistics and data analysis (Fraenkel et al., 2012).

The concept of interval scale and its properties help researchers choose appropriate statistical tests and methods for analyzing data. It also allows researchers to make meaningful comparisons between different values on the scale and interpret the results of their analysis correctly. For instance, in the context of this study, if we were measuring the academic achievement of middle school ELL students in science on an interval scale, we could compare the difference in achievement between two students and

interpret the results meaningfully. This is important in educational research because it allows us to make informed decisions based on the data we collect, and helps us to understand the impact of different interventions and strategies aimed at improving student outcomes. Mean, median, or mode can be used to calculate the central tendency in this scale.

NWEA's Rasch unIT (RIT) scale is an interval scale that has equal intervals between values and allows for meaningful comparisons between scores RIT scale is based on the Rasch measurement model, a statistical model used to create interval measurement scales (Marion, 2021). The RIT scale is used to measure student progress in reading, language usage, mathematics, and science, and provides an estimate of a student's instructional level and academic growth over time (NWEA, n.d.). As an interval scale, the RIT scale allows for comparisons of growth and achievement between students and across different grade levels. These NWEA scores are not to be interpreted as target scores, but rather as benchmarks of a student's academic skill level over a given period of time. The numerical RIT value given to a student predicts that at that specific difficulty level, a student is likely to answer about 50% of the questions correctly. Results are scored across an even interval scale, meaning that the difference between scores remains consistent regardless of whether a student scores high or low. These RIT scales are stable, equal interval scales that use individual item difficulty values to measure student achievement independent of grade level. "Equal interval" means that the difference between scores is the same regardless of whether a student is at the top, bottom, or middle of the RIT scale. "Stable" means that the scores on the same scale from different students, or from the same students at different times, can be directly compared, even

though different sets of test items are administered. A RIT score also has the same meaning regardless of the grade or age of the student. RIT scores range from about 130 to 300. Students typically start at the 130 level in Grade K and progress to the 240 to 300 level by high school. RIT scores make it possible to follow a student's educational growth from year to year.

In summary, the RIT scale is a measurement scale that is used to assess student academic growth over time, and it is an equal interval scale that provides accurate and reliable information about student achievement. (NWEA, n.d.).

The research questions were:

1. To what degree will middle school ELL students' academic performance improve in integrated science during one year of instruction while becoming more English language proficient?
2. To what degree will the academic performance of middle school ELL students improve in science, compared to that of native speakers, after one year of science instruction for both groups, while they are becoming more English proficient?

The null hypotheses of these two questions were:

1- $H1_0$: There will be no significant improvement in middle school ELL students' academic performance in integrated science, after one year of instruction while becoming more English language proficient as measured by NWEA.

2- H20: There will be no significant difference in the academic performance of ELL middle school students in science, compared to native speaking middle school students, after one year of language proficiency and science instruction as measured by NWEA.

The dataset utilized in this study was obtained from a Midwest area middle school, specifically comprising the NWEA fall and spring English Language Arts (ELA) and science test scores of 6th, 7th, and 8th grade students during the 2018-2019 school year. The dataset included data from both English language learners (ELL) and native speakers.

Figure 4.1

Science and ELA mean test scores of ELL and native speakers

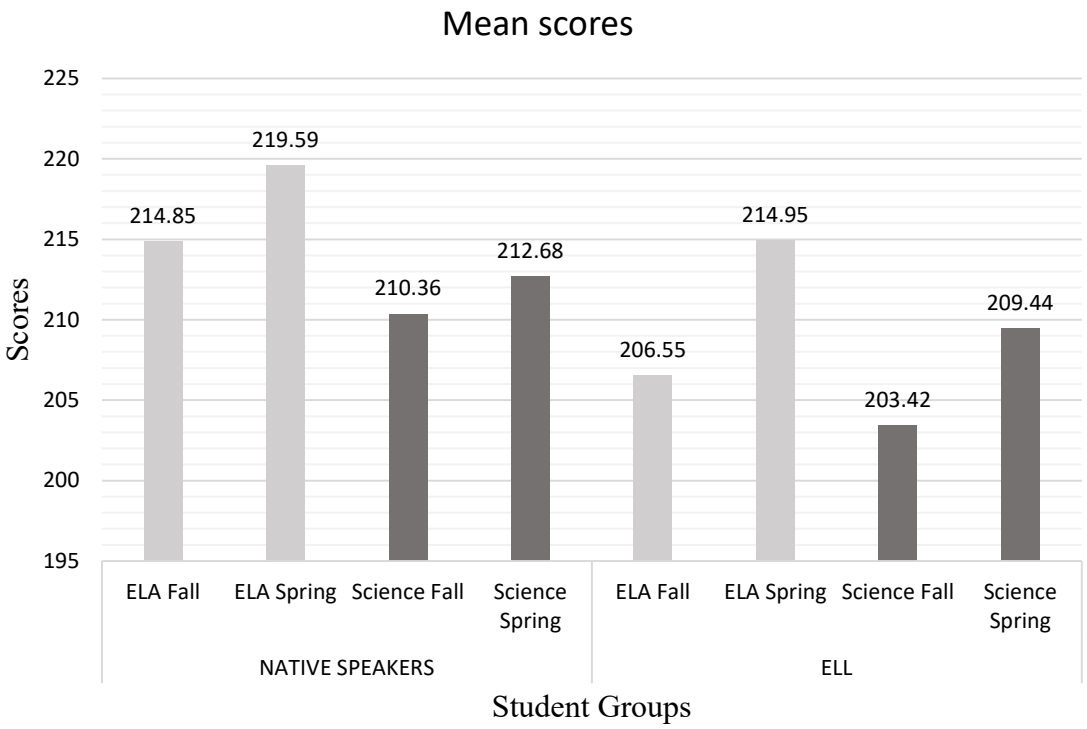


Figure 4.1 depicts the mean test scores of ELLs and native speakers in the areas of English language arts and science, as measured by the NWEA MAP test in the fall of 2018 and spring of 2019. The bar graph indicates that both ELLs and native speakers performed better in science and English language arts in the spring test. To understand their performance, table 4.1 was developed.

Table 4.1

Descriptive Statistics

Student group	*N*	*min.*	*max.*	*M*	*SD*
Native speakers					
NWEA ELA Fall	255	165.0	244.0	214.85	14.95
NWEA ELA Spring	252	157.0	254.0	219.59	15.18
NWEA Science Fall	255	179.0	249.0	210.36	11.38
NWEA Science Spring	252	174.0	261.0	212.68	13.07
Valid N	246				
ELL					
NWEA ELA Fall	40	176.0	234.0	206.55	13.92
NWEA ELA Spring	39	171.0	241.0	214.95	14.47
NWEA Science Fall	38	177.0	229.0	203.42	12.48
NWEA Science Spring	39	188.0	245.0	209.44	12.26
Valid N	35				

Notes: The valid N (complete cases) in each group represents the number students who took all four tests (Fall ELA and science tests and spring ELA and science tests) during the school year.

Table 4.1 provides descriptive statistics for the NWEA test scores in English language arts and science for two groups of students: native speakers and English

language learners. For each group, the table displays the number of students (N), the minimum and maximum scores, the mean (M), and the standard deviation (SD) for each test taken during the 2018-2019 school year.

The number of native speakers who took the tests ranged from 252-255, with valid N of 246. The mean scores for the Fall ELA, Spring ELA, Fall Science, and Spring Science tests were 214.85, 219.59, 210.36 and 212.68 respectively. The standard deviations ranged from 11.38 to 15.18.

The number of ELL students who took the tests ranged from 38-40, with valid N of 35. The mean scores for the Fall ELA, Spring ELA, Fall Science, and Spring Science tests were 206.55, 214.95, 203.42, and 209.44 respectively. The standard deviations ranged from 12.26 to 14.47.

The chart provides a comparison between the two student groups' performances in the four NWEA tests. It shows that the native speaker group had higher mean scores than the ELL group in all four tests, with a significant difference of around 6-15 points. The chart also provides information on the variability of scores within each group, as represented by the standard deviation values. It indicates that both ELL and native students' mean performance increased over time in English Language Arts (ELA) and science. In general, the mean growth of native speakers was significantly higher than that of ELL students in both science and ELA areas: the mean score for native speakers in NWEA Science Fall was 210.36, while for ELL students, it was 203.42. Similarly, the mean score for native speakers in NWEA English Language Art (ELA) Fall is 214.85, while for ELL students, is 206.56. The same pattern is seen in spring tests, too. The mean growth of native speakers was higher than that of ELL students in both science and ELA

areas: the mean score for native speakers in NWEA Science Spring was 212.68, while for ELL students, it is 209.44. Similarly, the mean score for native speakers in NWEA English Language Art (ELA) Spring was 219.59, while for ELL students, it was 214.95.

ELL students demonstrated slightly better mean growth in ELA compared to native students, with an increase of 8.4 points for ELL students and 4.7 points for native speakers. A similar trend was observed in science performance. ELL students had lower mean scores in both fall (203.42) and spring (209.44) compared to native students (210.36 and 212.68 respectively). However, the growth difference in science was higher for ELL students, with an increase of 6 points, compared to 2.1 points for native speakers. Such differences were analyzed further to determine if the difference was statistically significant. There is less variability in the test scores of ELL students compared to native students in both science and ELA testing. This means that ELL students have more consistent scores across their tests. Additionally, the range of the standard deviation of ELL students' scores was between 12.26 and 14.47, while for native students, the range was wider, ranging from 11.38 to 15.18. Based on this information, it can be concluded that ELL students scored more consistently when compared to native students, but it cannot be determined whether the overall performance of ELL students is higher or lower than that of native students.

Analysis of first research question:

The first question was focused on measuring the degree of improvement in academic achievement of middle school ELL students in integrated science during one year of instruction while becoming more English language proficient. To answer this

question, paired t-test was used. The paired sample t-test, sometimes called the dependent sample t-test, is a statistical procedure used to determine whether the mean difference between two sets of observations is zero (Statistics solution, n.d.). In a paired sample t-test, each subject or entity is measured twice, yielding pairs of observations. The scores of the students who did not take at least one of the tests were accounted as non-valid data and deleted.

Table 4.2

Parameter	Value
P-value	0.000007888
t	5.2604
Sample size (n)	35
Average of differences ($\bar{x}d$)	5.8286
SD of differences (Sd)	6.5551
Normality p-value	0.6
A priori power	0.8195
Post hoc power	0.9992
Skewness	-0.1666

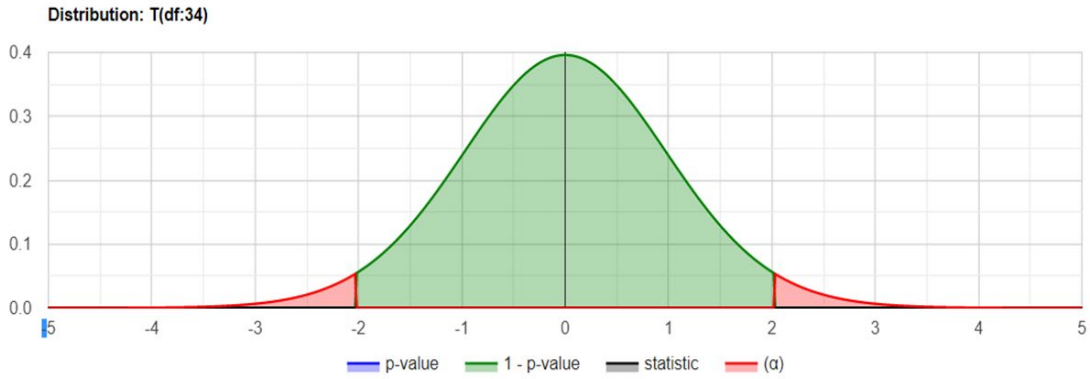
Results of the paired-t test indicated that there is a significant difference between NWEA fall test (M = 204.5, SD = 12.2) and NWEA spring test (M = 210.3, SD = 12.5), $t(34) = 5.3$, $p < .001$ of ELL students.

The test statistic T equals 5.2604, which is not in the 95% region of acceptance: [-2.0322, 2.0322]. The 95% confidence interval of NWEA fall minus NWEA spring was: [3.5768, 8.0803].

The priori power is 0.8195 and the post hoc power is 0.9992, this suggests that the results had sufficient statistical power to detect a significant effect with a high degree of confidence. The a priori power of 0.8195 indicates that the study was designed with a

sample size and effect size that would provide at least an 81.95% chance of detecting a true effect, assigning a significance level of 0.05. The post hoc power of 0.9992 indicates that the results actually had a higher power than expected, which means that the sample size and effect size were large enough to provide almost complete confidence in the observed effect. Overall, these values suggest that the study was well-designed and had a high likelihood of producing reliable and valid results.

Figure 4.2

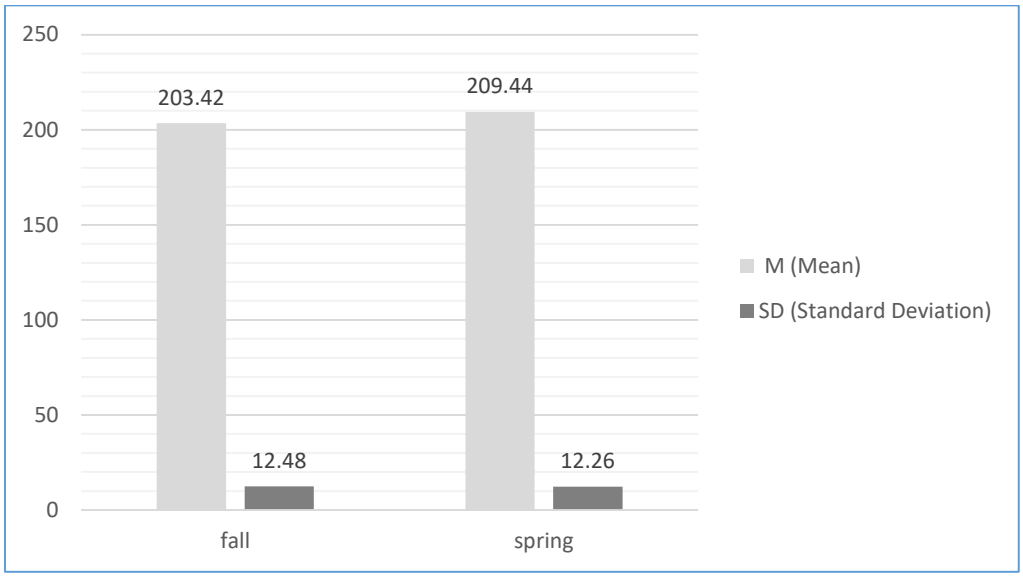


The normality assumption was checked based on the Shapiro-Wilk Test. (α=0.05). It was assumed that spring minus fall test scores follow the normal distribution (normality p-value is 0.6), that means, the normality assumption cannot be rejected. Normality assumption states that if many independent random samples are collected from a population and calculated some value of interest (like the sample mean) and then created a histogram to visualize the distribution of sample means, a perfect bell curve will be observed as in figure 4.2. It is important to check if the normality assumption is met. If the normality assumption is violated, then the results of these tests become unreliable and the findings from the sample data will not be generalized to the overall population with confidence.

Figure 4.3 a shows the comparisons of mean scores and standard deviations of ELL students' NWEA Science fall and spring tests.

Figure 4.3

Fall and spring science mean scores and standard deviations of ELL students



The null hypothesis ($H1_0$) of the first question stated that there would be no significant improvement in ELL students' academic achievement in integrated science, after one year of instruction while becoming more English language proficient as measured by NWEA. Since the p-value < α, H_0 is rejected. The p-value equals 0.000007888, ($P(x \leq 5.2604) = 1$). It means that the chance of type I error (rejecting a correct H_0) is small: 0.000007888 (0.00079%). The smaller the p-value the more it supports H_1. There was a significant improvement in middle school ELL students' academic achievement in integrated science, after one year of instruction while becoming more English language proficient. ELL students' science achievement improves gradually over time as they become proficient in language.

Analysis of second research question:

The second research question emphasizes whether ELL students' improvement in science surpasses that of native speakers' after a year of instruction. Both groups took the science test twice over a year. To answer this question, the statistical method, Analysis of Covariance (ANCOVA) was employed. The repeated measures ANCOVA compares means across one or more variables that are based on repeated observations while controlling for a confounding variable (Statistics solutions, n.d.). A repeated measures ANCOVA has at least one dependent variable and one covariate, with the dependent variable containing more than one observation. In order to carry out the analysis, students' language (ELA) scores must be controlled. Therefore, their ELA scores were added to the method as covariate. The use of a covariate (ELA scores) in ANCOVA helps to reduce the potential confounding effect of ELA skills on science achievement, Therefore, this approach allows for a more precise evaluation of the relationship between language proficiency and science achievement.

Table 4.3

Means and Standard Deviations of Students' Science Scores when controlling their ELA scores

Measurement	*Fall*	*Spring*	**n**
ELL	204.46(12.23)	210.29(12.50)	35
Native	210.43(11.35)	212.77(13.13)	246

Figure 4.4

ELL and native students' fall and spring NWEA Science test mean scores along with their standard deviation

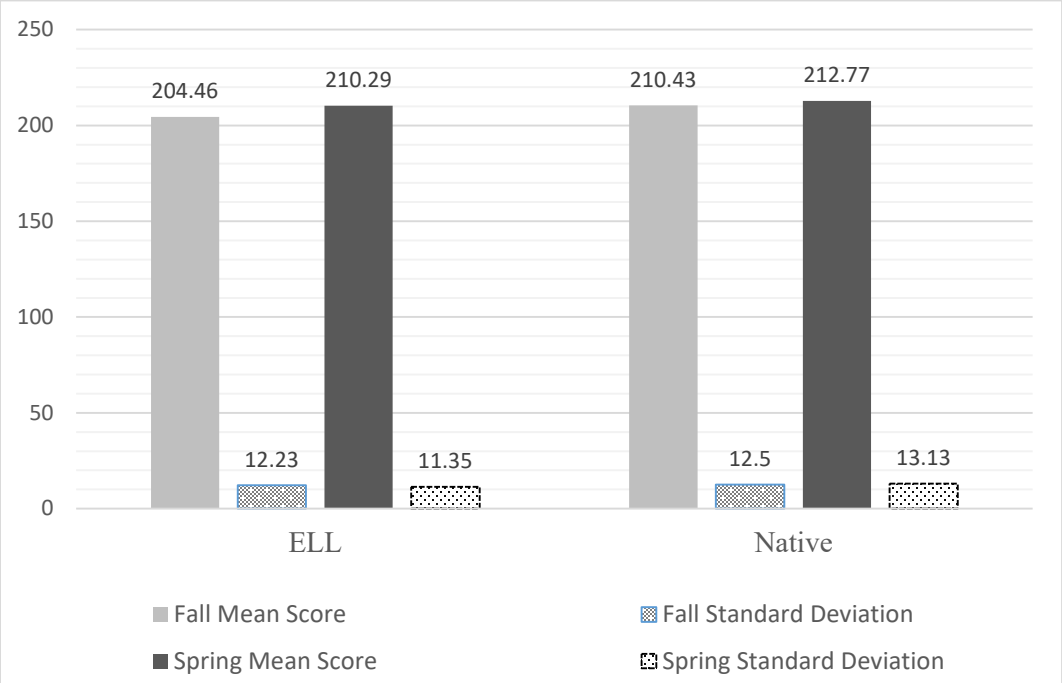


Table 4.3 displays the means and standard deviations of the science scores for ELL and native students, as measured in the fall and spring tests while controlling for their ELA scores. The test scores of both groups are shown as a bar graph in Figure 4.4, too. The results show that both ELL and native students demonstrated a rise in their mean science scores in both tests. The fact that the standard deviations are quite similar for both groups at both times indicates that the variation among the scores was quite homogeneous. If there were a large difference in standard deviations between the groups or between the two tests, this would suggest that the variation of the scores was not homogeneous, which could lead to biased results and inaccurate conclusions.

Figure 4.5

Mean Scores of Fall and Spring NWEA Science Tests

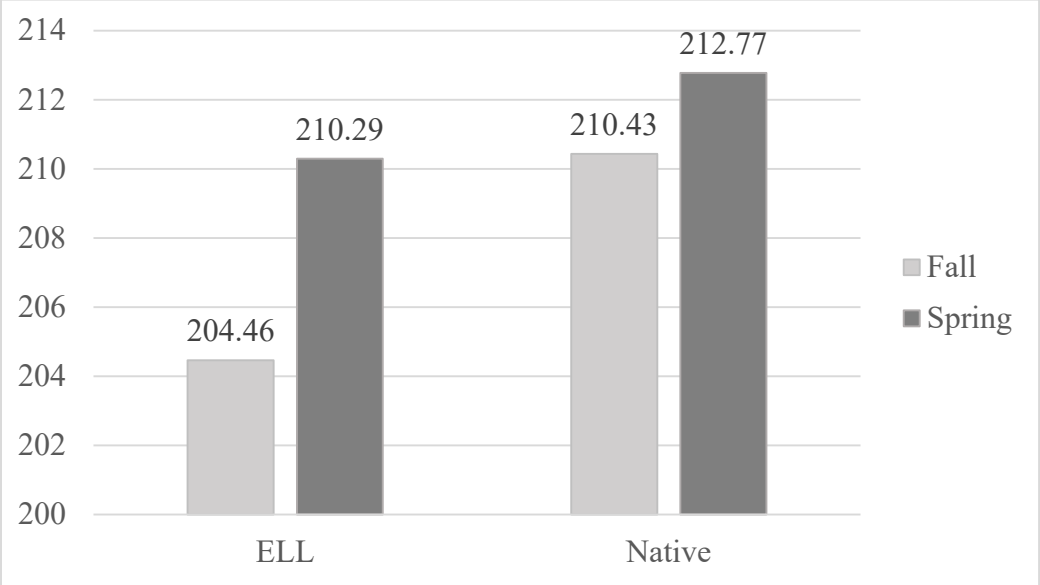


Figure 4.5 provides a clear comparison between the two student groups' performances in the fall and spring NWEA science tests' mean scores. It shows that the native speaker group had higher mean scores than the ELL group in both times. It also indicates that both ELL and native students' mean performance increased over time in science. The mean score for native speakers in NWEA Science in fall was 210.43, while for ELL students, it was 204.46. Similarly, the mean score for native speakers in NWEA science in spring was 212.77, while for ELL students, it was 210.29. However, ELL students' mean growth difference in science was higher than that of native speakers. ELL students' mean growth in science increased 5.83 points while native speakers' scores increased 2.34 points. Further analysis was required to determine whether the change in test scores was statistically significant.

Table. 4.4

ELL Repeated Measure ANCOVA results

Source	SS	df	MS	F	η^2	Sig.
ELL	126.99	1	126.99	2.49	.01	.12
Error	14048.87	276	50.90			

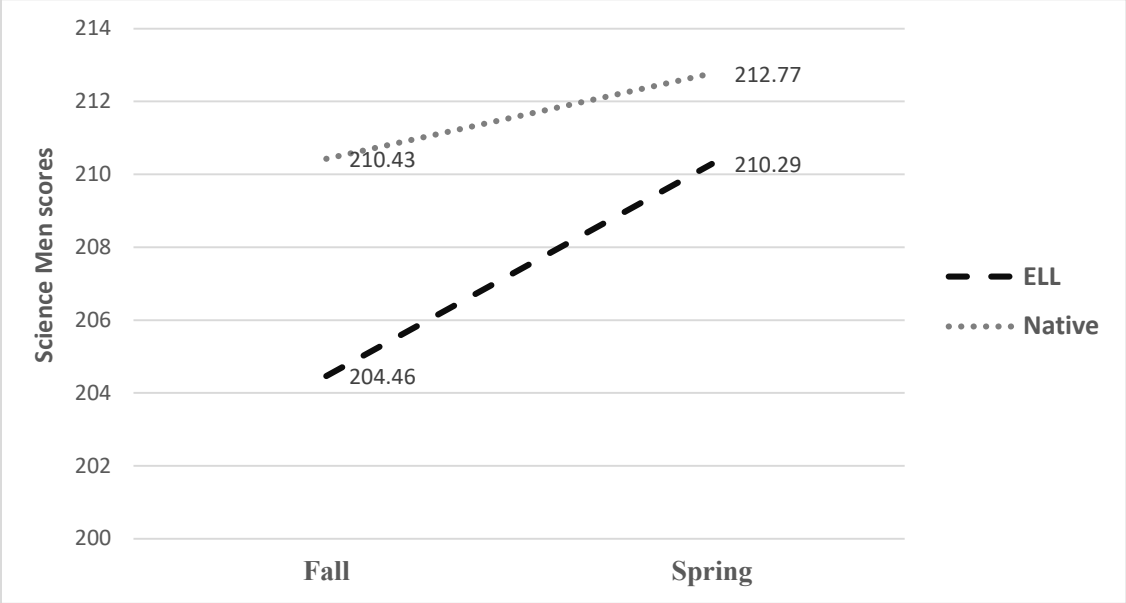
*Lower-bound correction used.

Note: The table presents the sources of variance, sums of squares (SS), degrees of freedom (df), mean squares (MS), F-statistic, and effect size (η^2). The source "ELL" represents the effect of ELL status on the outcome variable (test scores), while "Error" represents the unexplained variation in the scores.

Table 4.4 shows the results of a repeated measures analysis of covariance (ANCOVA) for ELL students. Native and ELL students' English proficiency was controlled by adding their ELA scores into the statistical calculation. The results of the analysis indicated that *p*-value (.12) is greater than the significance level (.05). Therefore, the difference in science scores between ELL and native speaking students is not statistically significant. The null hypothesis was not rejected; ELL students did not outperform ($F(1, 276) = 2.49$, p (.12)>.05, $\eta^2 = .01$) the native students in the science achievement test.

Figure 4.6

Mean Scores of Fall and Spring NWEA Science Tests



The Figure 4.6 clearly depicts ELL students showed a higher mean growth in science compared to native speakers. ELL students' mean score in science increased by 5.83 points, while native speakers' scores increased by 2.34 points. This indicates significant growth for ELL students. However, such growth is not statistically significant with regard to science improvement over time. Despite the lack of statistical significance, both ELL students and native speakers performed at a similar level in science, indicating no significant difference between the two groups.

Summary

The academic performance of native speakers and ELL students in four NWEA tests were compared, and found that native speakers had higher mean scores in all tests, and their growth was higher than that of ELL students in both science and ELA areas. However, ELL students' mean growth in ELA was higher than that of native students,

and their scores were more consistent across tests. The study was designed to measure the improvement in academic performance of middle school ELL students in integrated science over a year of instruction while becoming more English language proficient. A paired t-test to compare NWEA fall and spring test scores of ELL students was used, and the results showed a significant difference between the two. The findings showed a significant improvement in ELL students' academic performance in integrated science after one year of instruction while becoming more English language proficient. The second research question investigated whether ELL students' science performance exceeds that of native speakers after a year. The analysis revealed that ELL students did not perform better than native students in the science achievement test, but at the end of the school year, ELL students and native speakers demonstrated the same level of performance in science achievement.

Chapter 5: Conclusion

Introduction

ELL students' educational experiences exhibit significant variation across the country, as states and schools adopt diverse approaches to identifying and instructing ELL students. Regardless of approach, ELLs represent a growing part of the U.S. student body. The number of ELL students in the United States has surged. In fall 2018, the percentage of ELLs in public schools in the United States was greater (10.2%, or 5 million students) than in fall 2016 ((9.6%, or 4.9 million students) which was higher than in fall 2010 (9.2 percent, or 4.5 million students) (Pewresearch, 2019). With the growing number of ELL students and the increasing demands for accountability and assessment in education, ELL students' English proficiency and academic achievements are receiving more attention. The No Child Left Behind (NCLB) law holds states accountable for ELL improvement in both English language proficiency and academic success (Sanchez, 2017). ELLs are expected to master academic knowledge and skills at the same time as they are expected to master the academic English language necessary to show this knowledge in the standardized tests.

Summary of Findings

The relationship of ELL and native speaking students regarding English language proficiency and academic performance in science using their 2018-2019 NWEA scores was studied. NWEA assessments measure the growth and proficiency of each student in English language arts, science and math. The study showed that a Midwest middle school ELL students' academic performance in science improved during one-year of instruction while they were becoming more English language proficient. In addition, he

academic performance in science of both middle school ELL and native students was compared after one year of science instruction for both groups, while taking into account their increasing English proficiency. Student's data consisted of fall and spring English language arts and science scores. To address the research questions, paired t-test and ANCOVA were used. As a first step of analyzing the data, descriptive statistics were computed (table 4.1). Both, ELLs' and native speakers' mean scores in English language art and science improved. ELL students' mean scores in English language arts in fall and spring were 206.55 and 214.95 respectively whereas native speakers' scores in the same subject were 214.85 and 219.59 respectively. In science, ELL students' mean (203.42 and 209.44) scores were lower compared to native students' mean (210.36 and 212.68).

Although ELL students achieved lower mean scores than native-speaking students in both English language arts and science, their mean score differences were greater than those of native speakers. Specifically, ELL students had a mean score difference of 8.40 in English language arts compared to the 4.74 difference of native speakers. In the science domain, ELL students demonstrated a relatively higher growth difference of 6.02, while native speakers had a growth difference of 2.32. These numbers suggest that while ELL students may start with lower scores, they demonstrate greater progress and potential for improvement in both subjects compared to their native-speaking counterparts. To determine the statistical significance of these differences, a paired t-test was conducted.

Results of the paired-t test indicated that there is a significant difference between NWEA science fall test ($M = 204.5$, $SD = 12.2$) and NWEA science spring test ($M = 210.3$, $SD = 12.5$), $t(34) = 5.3$, $p < .001$. In the fall, ELL students' science understanding

was lower than the that of native speakers because of the language deficiency. However, their achievement gradually and significantly increased over time as they became more proficient in language. The null hypothesis (H_0) of the first research question was rejected and alternative hypothesis (H_1) was supported; there was a significant improvement in academic performance of ELL students in science during one year of instruction while they were becoming more English language proficient as measured by NWEA. As evidenced in the data, as English language proficiency scores of ELL students increased as did their performance on the science area.

The second research question examined whether ELL students performed better in science compared to that of native speakers after one year of science instruction for both groups while they were becoming more English proficient. To answer this question, ELA scores of both groups were controlled. the ELA scores of both groups were controlled. Figure 4.6 demonstrates that ELL students displayed a more substantial improvement in their science performance from fall to spring, with mean scores rising from 204.46 to 210.29. In contrast, native speakers experienced a smaller increase in their science scores, going from 210.43 to 212.77. The smaller growth difference in the science scores of native speakers compared to ELL students indicates that ELL students demonstrated greater progress in their science performance. However, further analysis was conducted to determine the significance of the improvement in science scores for ELL students. The results revealed that the growth in ELL students' science scores over time was not statistically significant ($F (1, 276) = 2.49$, $p > .05$, $h2 = .01$). This means that the progress in ELL students' science achievements did not surpass that of native speakers after both groups completed a year of science instruction. Thus, the findings

support the null hypothesis (H_{20}) and suggest that the academic performance in science for targeted middle school ELL students did not improve significantly more than that of native speakers.

Limitation of Findings

There were several limitations that could have affected the findings. The study was conducted at a single middle school located in the Midwest region. The proportion of ELL and non-ELL students was unbalanced, with 42 ELL students and 277 native speakers enrolled. Not all students participated in all four NWEA tests, which included fall and spring science and ELA tests. Therefore, statistical calculations only included students who completed all NWEA tests, resulting in a valid sample of 35 ELL students and 246 native speakers. he sample size of ELL students may be considered relatively small compared to the sample size of native speakers. This difference in sample size may affect the precision of the estimates and the statistical power specifically for the ELL group. It is important to consider this when interpreting the results and drawing conclusions, particularly when comparing the performance or outcomes between the ELL and non-ELL groups. The study solely relied on NWEA test scores from the 2018-2019 academic year. These limitations may have impacted the ability of the study to answer the research questions posed. The reduced sample size may have limited the ability to detect significant differences between groups, and the use of time-bound data (only for one education year) may have limited the ability to track changes in academic performance over time. A longitudinal study tracking the same ELL and native students from 6^{th} grade to 8^{th} grade may have provided better picture. Collecting data from the same individuals or groups over an extended period of time, throughout the middle school education, can

provide valuable insights into the long-term progression of ELL students' achievement in science while they are becoming more English proficient.

Implication to Practice

With the rapid growth of ELL (English Language Learners) populations in the U.S., it is becoming increasingly important for schools to address the unique needs and challenges faced by these students. ELL students often require different assessment and accommodation strategies than native English-speaking students, and may benefit from specialized teacher education and training (Baker et al, 2014). For instance, one study found that ELL students tend to perform better on assessments that are designed specifically for non-native speakers of English, rather than on traditional English-language assessments (Popham, 2016). Additionally, ELL students may benefit from accommodations such as extra time on tests, the use of visual aids or manipulatives, and preferential seating in the classroom (Baker et al, 2014). Teachers who work with ELL students may need to be trained on these accommodations and strategies in order to provide effective support for their students.

Findings may be used to develop strategies to improve English language skills of ELL students of the targeted school settings. It was seen that ELL students' mean growth in science and ELA were lower than native students' mean growth in the same subjects. By looking at the ELL students' initial assessment scores in content areas, there may be immediate bias about their capability in those areas. Academic terminology used in content assessments may be challenging for ELL students. Inferences about students' knowledge and skills may be incorrect if they cannot grasp the questions in an assessment because of the academic language. Also, this study showed that when ELL students

became more proficient in language, their scores in content areas improved as well. If content teachers have little knowledge about ELL instructions and accommodations, the ELL students' academic growth will be effected directly. Schools could provide professional development programs that aim building successful strategies between content teachers and ELL specialists. Sometimes, ELL students' low performance of on content assessments results from a lack of learning opportunities. According to Wolf et al. (2010), some ELL students are being taught with below-grade level materials and this method may be based on a belief that ELL students will find such materials easier to understand due to ELL language and/or content knowledge deficiencies, but this practice can make it harder for ELL students to meet the same high standards expected of other students. ELL students' needs should be met at their levels of academic and English language proficiency levels. It is important that educators put effort to provide an equitable education for English Language Learners to ensure they are receiving a well-rounded.

Further Research

It is recommended that a larger group of ELL students be involved in the study. As sample size increases, so does the power of the significance test. This is because a larger sample size narrows the distribution of the test statistic. Also, more categorical variables can be used in a further study. ELL groups may be divided into sub groups based on gender or native tongue. However, to do that, more sites may be required instead of one middle school. Another study can be conducted to measure the effect of the length of ELL support on ELL students' success. Furthermore, a qualitative study can be conducted and added to this quantitative study. The NWEA scores, notes from

interviews and observations can be used to triangulate the data so that a stronger and more accurate picture of ELL students' performance can be portrayed

Conclusion

The findings corroborate previous studies. English language learners generally perform lower than non-ELL(native) students on reading, science, and math (Abedi, 2002). In content areas with a higher language demand, language proficiency has a larger impact on ELL students' assessments. Due to the fact that most standardized, content based tests, such as those in science, are designed based on native English speaking students. As well, tests may inadvertently serve as English language proficiency assessments primarily for English language learners. The linguistically complicated structure of test questions may be unfamiliar to English language learners, who may not recognize vocabulary phrases or misinterpret an item literally (Duran, 1989; Garcia, 1991).

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