

THE EFFECTS OF TARGETED LANGUAGE DEVELOPMENT ON SCIENTIFIC
LITERACY AND LANGUAGE PROFICIENCY

by

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DEDICATION

To my loving and supportive family, thank you for giving me time and space to complete this important work.

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ABSTRACT

This project was designed to investigate if direct language instruction could impact ELL students' literacy skills and content knowledge acquisition. Students were coached in the Reading for Meaning Strategy, an active reading strategy that incorporates the four language skill areas: reading, writing, speaking and listening. Student assessments and artifacts revealed gains in content knowledge and improvement in writing skills.

INTRODUCTION AND BACKGROUND

For the past two years, I have taught environmental science in the rural and highly diverse setting of West Noble High School in Ligonier, IN. The local economy is largely based in agriculture and industry, and the economic stability of students' families follows the relative strength of these two economic sectors. Our area was badly hurt in the recession, but we are slowly and steadily continuing along a path toward recovery. Median household income is now estimated at \$36,314. According to the Indiana Department of Education (IDOE), 62% of West Noble students qualify for free or reduced lunch. Many of my students suffer from stress and insecurity as a result of poverty. Ethnic minorities account for just over half of the student population, with 48% Hispanic and 2% Asian, Black, Middle Eastern, and multiracial (2015). For many of these students, English is not a first language.

Our school ranks fairly well within our state grading system because of the strong overall performance of our students on standardized tests; the IDOE reports that 80% of our students are considered proficient in math, and 69% are considered proficient in reading (2015). However, one segment of our student population continues to lag behind their peers; these are our English Language Learners (ELL). The Indiana Department of Education defines the ELL student as "any student who may or may not be in the ENL (English as a New Language) program but those who are continuing to acquire the English language" (2015). Of the ELL students, 31.5% continue to receive formal services, such as a ELL class or sheltered study hall, but the remainder has only their classroom teachers providing support. In the area of science, ELL students are working to master a second language while also learning science content knowledge. This is

challenging work for the learner, and it is my responsibility to create a supportive and rich experiential environment to facilitate this process.

The majority of my students face academic challenges. Environmental science is an introductory course for struggling ninth grade students designed to better prepare them for future secondary science courses. The focus is to develop students' scientific literacy, language proficiency, study and organizational skills in order to help them be successful. It is a highly supportive environment with a strong focus on mastery.

My direct observations have revealed a clear achievement gap between ELL students and students learning science in their native language. In order to address this need, my classroom research project aimed to narrow this achievement gap. In an effort to meet students' needs more effectively, I researched the impact of language-rich instructional strategies on student learning. While this topic is highly relevant to my personal teaching situation, it is also timely and reflective of the current challenges within many U.S. science classrooms. The National Center for Educational Statistics cited that in the 2012-2013 school year, 9.2% of American students were classified as ELL, and this trend shows little sign of slowing. All classroom teachers have an interest and responsibility to develop instructional strategies that will make content accessible to all students.

Within every classroom, there exists amazing diversity. This diversity may come in the form of background experience, socio-economic status, ethnicity, academic strengths or weaknesses, learning style, or language proficiency. My classroom is no different, but what sets my own classroom apart is the students' genuine drive to succeed. My students are energized and hopeful, and I must meet them where there are to take

them where they want to go. To address the varied needs of this diverse student population, I need a portfolio of diverse yet targeted learning strategies. While this classroom research project targeted an at-risk ELL population, I was equally interested to see if focusing on language development benefits the general student population.

Focus Question

ELL students face unique and varied challenges in their academic work. In order to make content more accessible, language barriers must be addressed. The following question will be addressed during this project: In what ways might targeted language development strategies impact ELL students' literacy skills and acquisition of science content knowledge? The following sub-questions were addressed: 1) Do targeted language instructional strategies yield measurable gains for students at various levels of language proficiency? 2) To what extent does diversification of strategies impact student engagement levels? 3) In what ways does targeted language development benefit students' scientific writing? By providing opportunities for interacting with content and others, I hope to increase accessibility and encourage students to grow in their science literacy skills. The overarching goal of this classroom study was to close the ELL performance gap by addressing language skills within the context of an environmental science classroom. Success was measured by the mastery level demonstrated on summative assessments, growth in student products, and improvement in student engagement.

CONCEPTUAL FRAMEWORK

ELL students are a fast-growing demographic within our United States public school system. The National Center for Education Statistics stated that between the years

1999 and 2007, the ELL population grew from 8.8 to 10.8 million students (2012). In today's America, nearly one in every ten students is acquiring English as a second language (National Center for Education Statistics, 2015). The fast growth and dramatic shift in classroom dynamics has left teachers feeling underprepared, and students feeling underserved. In the science classroom, the task can feel overwhelming at times. Teachers must make academic content engaging and accessible to students at a variety of levels of language proficiency, design tasks that allow for growth and challenge at these various levels, give consistent and structured feedback, and monitor progress in both content knowledge and language growth (Wright, 2010). This is demanding work, but these are the basic requirements for student growth in academic language.

If the basic needs of the students are met, ELL students have the potential to acquire knowledge and skills at an incredibly rapid rate. Given the opportunity to speak, listen, write and comprehend, students will grow in language. Within the context of the science classroom, they can build scientific literacy at the same time. In the National Science Education Standards (1996), scientific literacy is defined as, "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (p. 22). The language skills that are involved are questioning, finding answers to those questions, describing what they observe, making predictions, reading with understanding popular science articles, and forming and evaluating arguments. Students must be offered supports, scaffolding, and they must be equipped with the tools necessary to do this work. In the process of learning, students build upon what they already know. This is the key principle of social constructivism (Piaget, 1954).

To develop effective support and scaffolding, West Noble has chosen to adhere to the standards and best practices outlined by World -Class Instructional Design and Assessment (WIDA). WIDA was originally named for Wisconsin, Delaware, and Arkansas, the states involved in developing this professional program. The mission of WIDA is to advance “academic language development and academic achievement for linguistically diverse students through high quality standards, assessments, research, and professional development for educators” (WIDA, 2014). There are two main tenets of WIDA philosophy: content must be understandable and students must receive timely feedback on any use of their second language.

To facilitate language growth, an ELL student should be presented content at a language level that is just beyond his or her current level of proficiency. In the early 1970s, Stephen Krashen referred to this as “comprehensible input” (Krashen, 1985). By aiming just above current proficiency levels, content is made understandable. It is essential for students to feel that they understand, or they can disengage. “When instruction is in English, ELLs’ science learning is in direct relation to their level of English proficiency” (Lee, 2005, p. 500). By aiming slightly above current proficiency levels, students are encouraged to rise to the next level. We want to challenge students, but we want to avoid language frustration.

The second major piece of WIDA philosophy is the importance of timely and constructive feedback on productive language skills. The productive language skills include speaking and writing skills. Both teachers and peers can provide valuable feedback, particularly if students are coached in the peer feedback process. Quality interactions within the classroom are essential and small group and paired activities allow

students to focus on oral language development. (Lara-Alecio, Tong, Irby, Guerrero, Huerta, & Fan, 2012; Matthews & Mellom, 2012).

Learning is a journey of discovery, and while many students make these discoveries internally, others benefit from social and cultural experiences to give context to their learning (Vygotsky, 1978). For students with little formal education, such as migrant workers, this base of foundational academic experiences can be weak. Classroom experiences must help compensate for a lack of formal early childhood education, and students and teachers must build on shared practical life experiences that take place outside a classroom. Students learn by connecting to prior knowledge and by making connections with other students, so building a portfolio of common experiences and connections is essential to learning. The goal is to create a supportive classroom community, where students feel accepted and motivated to learn science (Johnston, 2007). In this environment, students are encouraged to bring and share their own knowledge and experiences, but also create a new set of experiences together.

Science literacy does require language proficiency, and while science content knowledge and skills may be the primary goal, the secondary goal of developing language proficiency is a supporting focus (Tong et al., 2014).

“Literacy objectives should support the content objectives of science learning for ELLs and science educators have claimed that reading instruction is a powerful vehicle for engaging students’ minds, fostering the construction of conceptual understanding, supporting inquiry, and cultivating scientific habits of mind” (p. 412).

Literacy and content knowledge skills cannot be taught in isolation because of the natural crossover that exists between the two. While science teachers are proficient in the academic language of their content area, they often lack the tools to bring this vocabulary in to their students' working or active vocabulary (Schleppegrell & O'Halloran, 2011).

The multitude of ability levels within the classroom require personalized and differentiated instruction to meet student needs. Involving the students in this differentiation process is essential. Asking students about their science learning experience and language practices is our most direct feedback on instruction. ELL students can provide valuable feedback both on the challenges they face and the instructional practices that benefit their learning process. This process serves a dual purpose; it informs instruction, assisting the teacher in identifying effective strategies, and it allows students to become active players in their own learning (Baeden, 2016). This shift toward a more student-centered learning process is a first step toward building a strong and productive learning relationship.

METHODOLOGY

My classroom study involved two sections of 9th grade environmental science. One section of 22 students was used as the treatment group, while another group of 23 students served as the comparison. The treatment group was 36% ELL, currently qualifying for services, 18% ELL, no longer receiving services, and 18% Resource, receiving services for language-related learning disabilities. The comparison group was 22% ELL, currently qualifying for services, 22% ELL, no longer receiving services, and 13% Resource.

In order to analyze whether the treatment impacted students differently at various levels of English language proficiency, I grouped the students into three categories. Group I included ELL students and language resource students. These students have been identified as qualifying for services based on WIDA testing or the Woodcock-Johnson III: Tests of Achievement. Group II included ELL students that have graduated from the program based on their academic performance and WIDA testing results. Group III included native English speakers.

My treatment consisted of a daily application of WIDA standards and framework. In addition to a content learning objective, students had a language objective. The treatment group received targeted language instruction in addition to traditional science content instruction. The comparison received science content with no supplementary literacy development. Engagement and performance of the treatment group was compared to a traditionally taught class throughout the course of this classroom research project. The study, beginning in early January and finishing in early March, spanned the duration of two units: Chapter 4: Population Ecology and Chapter 5: Community ecology. Both these units were designed to cover the Indiana State Science Standards.

In order to approach language development in tandem with scientific content, the treatment group had dual targets for each day. The daily language target focused on at least one of the four language skill areas (reading, writing, speaking and listening). In order to meet needs and offer opportunities for growth, these daily language targets aligned directly with WIDA standards and Can Do Descriptors. These standards have been adopted by our school corporation, and through their application, we hope to help students advance to full language proficiency. The Can Do Descriptors outline practical

academic language skills that students should be able to accomplish at their varying levels of language proficiency. The language development goals varied based on proficiency levels. Language testing occurs annually, and this data is made available to classroom teachers.

The primary intervention that I implemented was the Reading for Meaning Strategy. This active reading strategy incorporates many key supports and lays the groundwork for success for the ELL student: 1) activation of prior knowledge; 2) setting a purpose for reading; 3) guided evidence collection; 4) identification of the main idea; 5) drawing conclusions based on evidence; 6) developing a point of view and supporting with textual evidence; 7) use of graphic organizers; 8) working in small group to create meaning from a text; 9) and reflection and revising thinking as more information becomes available. I selected this intervention because of the adaptability of the strategy, the dual focus on thinking and language development, and the opportunity to build common background knowledge through shared reading experiences.

There are three phases in a Reading for Meaning lesson: pre-reading, active reading, and post-reading. In the pre-reading phase, I offered students a series of statements to evaluate based on prior knowledge or intuition. They were asked to agree or disagree. This anticipatory set prepared students for the coming content and allowed them to make predictions about the text. These initial ideas were shared in a whole-group session, so all students benefited from each other's background knowledge. In the active reading phase, students were asked to collect evidence that supported or refuted the various statements. To organize notes and student thinking, a graphic organizer was provided (Appendix A). Small-group discussion followed evidence gathering, so

students could share and exchange ideas and details drawn from the text. In the post-reading phase, students reflected on original predictions and revised ideas based on textual evidence. Post-reading products included position paragraphs, concept maps, and small-group discussions and informal presentations (Silver, 2007).

My lowest students were offered a paired-reading accommodation. Students took turns reading and worked together to fill out the graphic organizer. Students normally sit in clusters with four students to each cluster, so student pairs would separate for the active reading portion. Post-reading products were evaluated according to the Can Do Descriptors and their individual objectives for language development.

All other students were evaluated according to the Reading for Meaning Assessment Rubric (Appendix B). This rubric evaluated students active reading skills, engagement in discussion, synthesis of ideas, use of supporting evidence, and ability to revise thinking. The activity challenged students to become strategic readers, flexible and responsive in their positions, and directly tied to textual evidence. This rubric was designed to highlight progress in these areas.

In order to get a baseline measure for students' engagement in the science classroom, I administered the Student Science Engagement Survey (Appendix C). This survey asked students to consider their attitudes, actions and interactions in the context of environmental science classroom setting. Students were given the Instructional Strategies Feedback Form at the completion of each unit in order for them to provide feedback on the effectiveness and engagement value of the Reading for Meaning Strategy.

Data were drawn over the course of the trimester from a variety of sources. These sources included: pre and post-tests, student engagement self-assessment (SEA), individual student interviews, teacher observation log, student writing samples and the student science notebooks. For all these sources, data were collected at various points to track change over time and to evaluate the effectiveness of the strategies that I employ. The SEA was given at the beginning and end of the treatment to evaluate skill and knowledge growth as well as engagement levels. The teacher observation log and student knowledge served as a running record of classroom activities, and I periodically evaluated notebooks for evidence of growth and engagement.

This classroom research methodology was approved for an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained. The instruments used were non-invasive, and were chosen to evaluate the effectiveness of the treatment. In order to give weight to my findings, I gathered data from a variety of sources. For each research question, at least three data sources were used to evaluate potential relationships and effects. These data sources and the related questions can be found in Table 1 *Data Triangulation Matrix*.

Table 1
Data Triangulation Matrix

Questions	Data Sources		
Focus Question: In what ways might targeted language development strategies influence ELL students' literacy and acquisition of science content knowledge?	1	2	3
	Pre-test/ Post-test	Student Science Notebooks	Formative Assessment Data

Questions	Data Sources		
Sub-question 1: Do targeted language instructional strategies yield measurable benefits for students at various levels of language development?	Pre-test/ Post-test	Individual Student Interviews	Student Science Notebooks
Sub-question 2: To what extent does diversification of strategies impact student engagement levels?	Student Engagement Self-Assessment	Teacher Observation Log	Individual Student Interviews
Sub-question 3: In what ways does targeted language development benefit students' scientific writing?	Student Writing Samples	Reading for Meaning Assessment Rubric	Student Science Notebooks

One of the essential data sources will be individual student interviews. I selected the semi-structured interview format to allow students space to provide feedback on the usefulness and engagement value of the various strategies. I included a combination of specific and open-ended questions that allow students to share opinions. Student Input Interview Questions can be found Appendix D. Follow-up questions were asked to draw more information out of students. A random number generator was used to select students for the interview process. I chose representatives from all my language proficiency groupings (low, average, and high), choosing two to three students from each group. Students were allowed to opt out of participation, and all potential participants were informed that participation would have no effect on their grade. Student interviews were carried out upon the completion of the two treatment units.

One of the most important artifacts of the study was the student science notebooks. These served as a physical record of the students thinking, and in many ways I feel they reveal more about a student's growth and learning than any other piece. The notebooks were evaluated periodically, often as a form of formative assessment. In tracking writing development, early samples were compared to later entries. These samples were drawn from the students' science notebooks as well as more formal writing assignments.

DATA AND ANALYSIS

This study was designed to see if a language-targeted intervention could benefit students' content knowledge acquisition and general language development. To evaluate content knowledge gains, I examined pre and post-test data, student science notebooks and formative assessment results. Results differed for the two units; strong gains over the comparison were observed in the first unit, while no significant difference between the groups was observed in the second unit. In self-evaluations within the science notebooks, students reported increased confidence and understanding throughout the study. In formative assessments and classroom observation, the treatment group revealed slightly greater levels of understanding. Based on these measures, I feel that the Reading for Meaning intervention did benefit students' content knowledge acquisition.

The Pre-Test/Post-Test results were compared as a measure of student performance gains. In analyzing the treatment group and the comparison group, both raw scores and normalized gain were considered. Normalized gain was used to adjust for varying degrees of background knowledge and differences in Pre-Test scores. The

normalized gain was calculated using the formula: $(\text{post-test} - \text{pre-test}) / (100 - \text{pre-test})$. Results follow in Figures 1 and 2.

For the Chapter 4 Unit, the Treatment Group’s average score was lower on the pre-test, but the post-test score average was higher. The average gain for the treatment group was 47 percentage points, while the average gain for the comparison was 30 percentage points. For the Chapter 5 Unit, the results for the two groups were very similar. Both groups displayed an average gain of 34 percentage points.

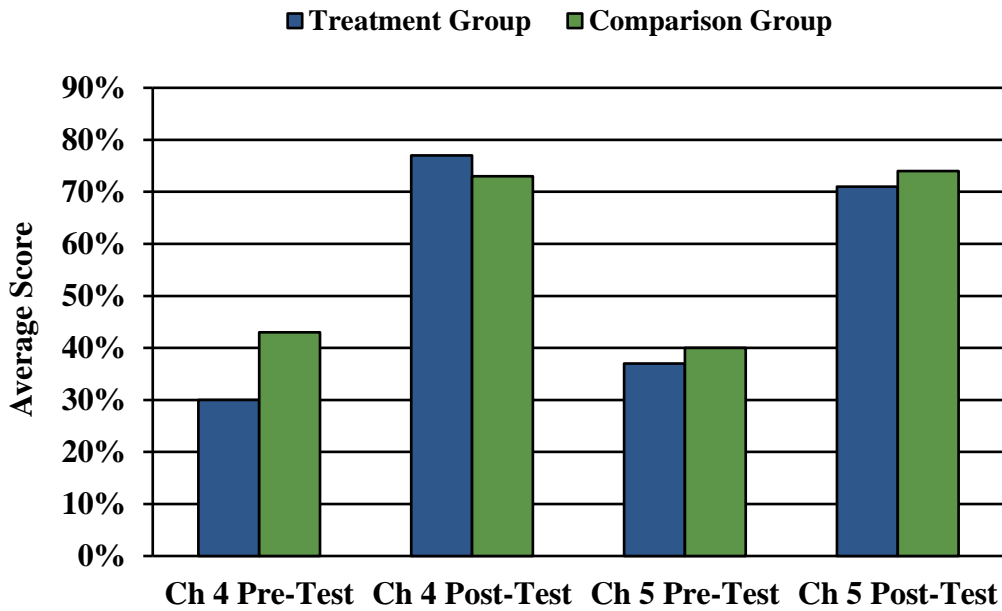


Figure 1. Comparison of Average Raw Scores, Treatment Group (N=22) and Comparison, (N=23).

Mixed results were observed in terms of normalized gains. A significant difference in normalized gains was observed in the Chapter 4. The Treatment Group had a normalized of .65, while the Comparison Group had a normalized gain of .49. There was no significant observed difference in normalized gain for the Chapter 5 Unit.

According to Hake, a normalized gain score ranging from 0.3-0.7 would be considered a

medium gain (1998). Both classes fell into the medium range, but the treatment group would fall on the higher end of medium for the Chapter 4 Unit. In the Chapter 5 Unit, the classes were right in the middle in terms of normalized gain, at 0.54 and 0.53.

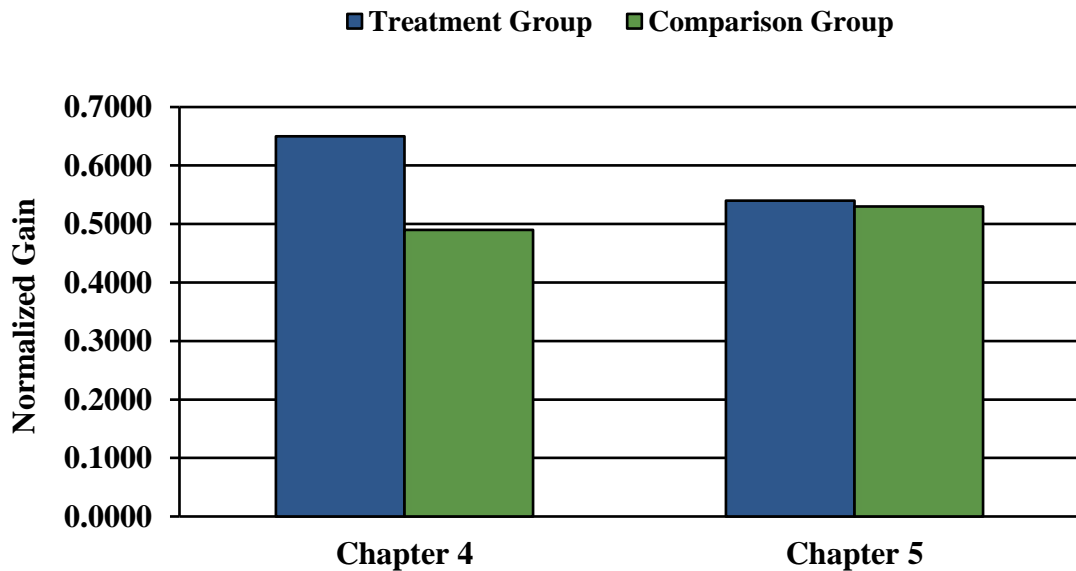


Figure 2. Normalized Gains for Unit I and Unit II , Treatment Group (N=22) and Comparison Group, (N=23).

My first subquestion asked whether this intervention might affect students at various language proficiency levels differently. A deeper examination of pre and post-test data revealed the strongest benefits were observed in students with rapidly advancing English language skills, those who had just recently graduated from receiving ELL services. To judge whether language development intervention could benefit students at varying levels of proficiency, I examined the data based on the students' WIDA proficiency level and Language Resource status. Those students currently receiving

services were Group I. ELL students that have graduated from program services were Group II. Non-ELL students were Group III. Student performance was analyzed by both raw score and normalized gains. Results follow in Figures 3 and 4.

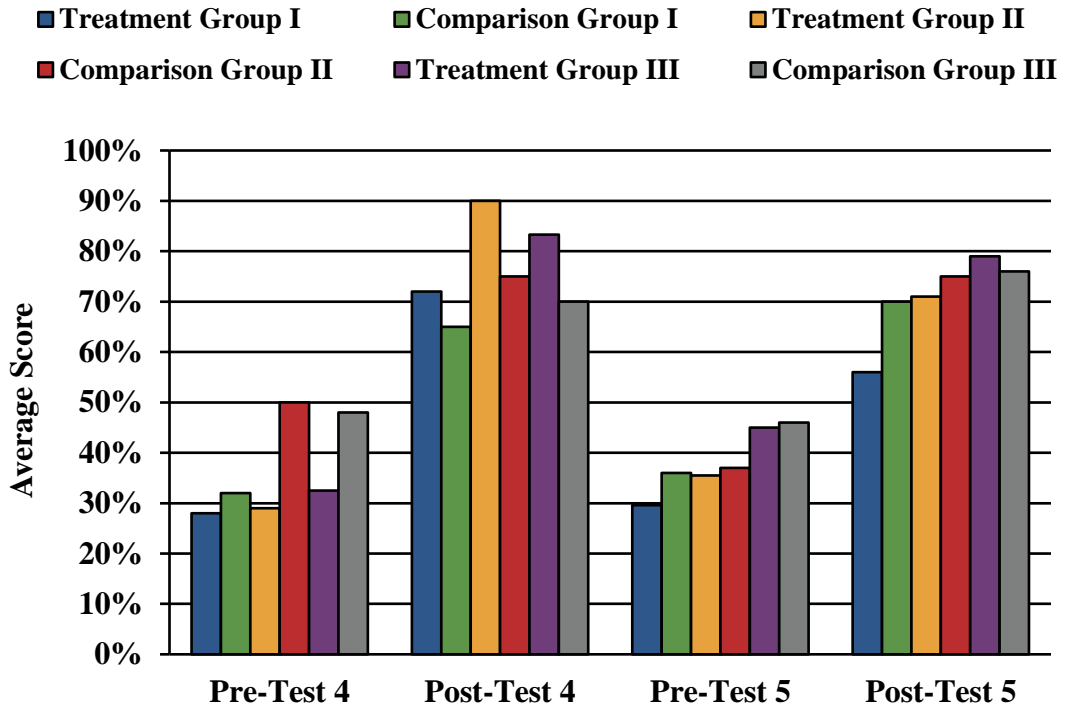


Figure 3. Comparison of Average Raw Scores for Units I and II, Treatment Group I (N=9), Comparison Group I (N= 7), Treatment Group II (N= 4), Comparison Group II (N=5), Treatment Group III (N= 9), Comparison Group III (N=10).

Figure 3 shows the students’ average raw scores broken down for the three language proficiency groups in both the Treatment Group and the Comparison Group. It reveals raw score gains for all groups in the Chapter 4 Unit, and less impressive results in the Chapter 5 Unit. For the Chapter 4 Unit, average percentage gains in the treatment group were as follows: 44% for Group I, 61% for Group II, and 51% for Group III. The comparison group experienced these gains; 33% for Group I, 25% Group II, and 22%

Group III. Average percentage gains in the treatment were higher for all three language proficiency groups, with strongest gains observed in Group II. For the Chapter 5 Unit, average percentage gains for the treatment group were: 26% Group I, 35%, for Group II, and 34% for Group III. In the comparison group, gains were similar: 34% for Group I, 38% for Group II, and 30% for Group III. The comparison Group I performed significantly better than their counterparts in the treatment group.

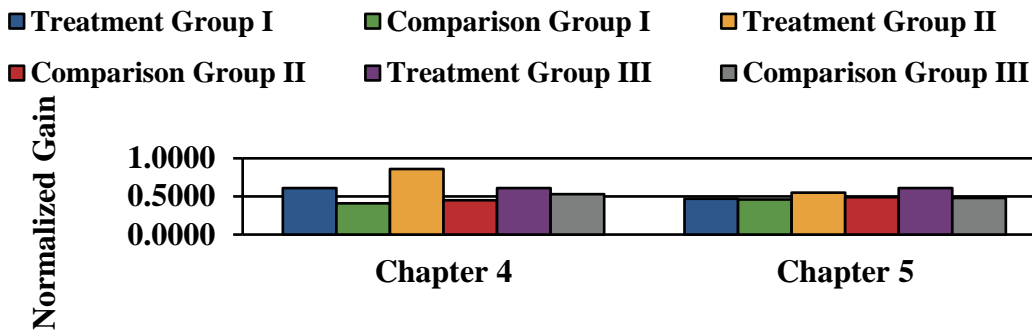


Figure 4. Normalized Gains by Proficiency Level. , Treatment Group I (N=9), Comparison Group I (N= 7), Treatment Group II (N= 4), Comparison Group II (N=5), Treatment Group III (N= 9), Comparison Group III (N=10).

The normalized gains reveal that students in all groups made progress. Treatment Group II made the largest gain in the Chapter 4 Unit. Treatment group II had a high average normalized gain for the Chapter 4 Unit at .86. Treatment Group III made solid gains in both units at .61. Treatment Group I normalized gain was disappointing, but they performed better in the Chapter 4 Unit, significantly better than the comparison group.

My second subquestion examined whether and in what ways language-targeted interventions might impact student engagement. Evidence suggests that this intervention may have had a direct positive impact on student effort, confidence and participation. The

Student Engagement Self-Assessment revealed some growth over the course of the two treatment units. Students who believed “putting forth effort” was *characteristic* or *strongly characteristic* of them increased from 64% to 82%. Students who felt “confident that they could learn and do well in the class” increased from 56% to 77%. Another gain was observed in “participating actively in small group discussions”, rising from 73% to 91%. The greatest gain was in the “helping other students” statement: 59% of students felt that statement described them at the beginning, while 91% students felt that they could help others at the end of the treatment. In student interviews, one student commented, “Reading with a partner really helped. We picked out different stuff from the book, but we learned it from each other.”

For the comparison class, gains in some of the same areas were witnessed, but there was a decline in other areas. In “putting forth effort”, 61% reported at the beginning of the two units, while 70% reported at the end. Students who felt “confident they could learn and do well in the class” fell from 61% to 57%. A decline was also reported small group discussion participation from 65% to 61%. A gain was reported in “helping other students”, rising from 65% to 78%.

My last subquestion asked whether a targeted language intervention could benefit student writing. Student writing was one area where exciting progress was made. In an initial writing sample, taken pre-treatment, there was little use of textual evidence in a student work. In a well-developed paragraph of 5-7 sentences, I challenged students to include three supporting details drawn from resources. Results follow in Table 2. I attributed the gains observed to the strategic reading approach. By using a graphic organizer, students were able to collect evidence as they read, and they organized their

thinking at the same time. They read with a purpose, and that raised their engagement level with the text.

Table 2
Use of Textual Evidence in Student Writing

Textual Evidence	Pre-Treatment	Post-Treatment
No Detail	50%	9%
1 Detail	36%	14%
2 Details	9%	41%
3 Details	5%	36%

Note. (N=22).

Student writing improved over the course of the treatment. Samples of work from a recent ELL graduate demonstrate growth from pre-treatment to post-treatment. When asked, “Identify cause and effect relationships from the reading that are related to plate tectonic movement. Explain how the relationships might cause Denver to be a mile high. Make connections among the facts to show relationships. Cite facts from the text and film, as well as what you may already know, in your response.”, the student’s first response was:

Heat and magma makes the water release. Everyone was just away enough to make sure no one would get hurt. It has convergent plate tectonics and it pushes against each other which cause for the air to release.

For the post-treatment prompt, the student was asked, “How should we deal with the challenges facing the elephants and ecosystems of South Africa? Take a position, should we consider culling elephants to reduce the elephant population, or is culling elephants an impossible solution? Support your position with evidence from the text.” The student responded:

Yes, I think we should consider culling elephants. The reason I think why we should consider culling elephants is because the elephants historically created habitat for to other species, now they are destroying habitat for many species by outcompeting other species for food and water since the elephants have a huge advantage of being the largest land animal. Elephants are destroying the environment of South Africa and Zimbabwe, the elephants are the largest land animal on earth so they need so many resources to survive like needing to eat, and they don't stay in one place because the elephants follow wherever the resources which means they destroy what they leave behind. I also disagree that Africa should be populated with millions of elephants. The elephants are so huge and their way of staying at a habitat is now endangering other species. The elephants population have also risen beyond the carrying capacity of their environment, there can only be so many elephants that the parks can take in, so some elephants wander off and eat farmers crops. Human and wildlife like the elephants can coexist, if we consider culling to the elephants, we can make sure that they don't overpopulate so humans and elephants and other species can be kept in balance. This is why I consider culling elephants because all the damage they can cause intentionally.

These two samples illustrate the benefits of pre-reading, active reading, and discussion to students. Sample 2 reveals a depth of understanding, mastery of essential vocabulary and a fluent use of textual evidence to support a position. Students need an opportunity to process what they read, and many strongly benefit from the intensive strategic reading that was implemented over the course of the study. In student interviews, 71% of students identified writing as their area of greatest gain. When asked how their writing has changed, one student replied, “I feel like I know what I want to say. I know why, and I can tell you in my paragraph.” This reveals increased confidence in the content knowledge, and students felt they could effectively communicate their understanding in their own writing.

INTERPRETATION AND CONCLUSION

This classroom research project sought to address the genuine needs of the ELL student. In my classroom and many others, limited language proficiency can act as a

barrier to academic progress. To be successful, a student must be provided with the tools and space to make sense of the academic content that is presented. The treatment was designed to make science content more comprehensible and feedback more consistent. My research provided evidence that targeted language development could improve student mastery of scientific content. Significant gains were observed in the first unit of study for the treatment group. It seemed the intervention most greatly impacted students with rapidly expanding language proficiency, those that had recently graduated from receiving ELL services, but all three treatment groups showed gains over the comparison class in this first unit. In the Chapter 5 Unit of study, normalized gains were somewhat higher for the Treatment Group, but not significantly higher.

The differences in performance may be partly explained by the strong emphasis placed on population ecology vocabulary in Chapter 4. Key vocabulary terms were introduced in the initial central case study reading, and this natural experience with the vocabulary gave students a strong foundation upon which to build future understanding. By working through the Reading for Meaning process, students developed a language scaffolding that allowed students of all language proficiency levels to move forward successfully. Chapter 5 covers a broad range of ecology topics, from species interactions to ecological succession, and it was more difficult to reinforce concepts and academic vocabulary in the same manner. While there was ample opportunity for constructive feedback on science content and academic vocabulary in Chapter 4, this was difficult for Chapter 5 due to the scattered nature of the unit.

This study suggests that a secondary focus on building language proficiency can result in gains in the primary content area, especially if content is comprehensible and

students are encouraged to interact directly with that content. I feel that I made some significant inroads in making content more accessible for students. The case study approach provided the necessary scaffolding allowing students to make connections and build academic vocabulary (Soto, 2001). They responded well to the graphic organizer supports that were developed for the treatment, using them appropriately during the active reading phase and also drawing evidence from them during the post-reading application phase. Additionally, I feel I provided quality opportunities for students to interact with the content through pre-reading, active reading and post-reading. These activities forced students to draw on all their resources to create understanding. Students accessed background knowledge, pulled ideas directly from the text, and worked through their thinking as they bounced ideas off one another in a small group discussion setting.

Some of the differences observed in the performance and engagement of levels of the treatment class and the comparison class may be attributed to the treatment, but classroom dynamics certainly played a role too. The treatment group was hopeful and upbeat, while the comparison group was low energy and difficult to motivate. Both classes were cooperative and there were no significant discipline problems. The main difference was in enthusiasm and willingness to actively participate in the classroom. It may be that the treatment emphasis placed on discussion and collectively building understanding enhanced student investment in the class and each other. This observation is supported by the work of Vygotsky. It seems possible that my highly social students directly benefited from the open exchanges and more interactive environment. Two students specifically mentioned that small group discussion was a favorite activity.

This study has benefitted my students in three primary ways. It offered students a more comprehensible exposure to science content, it allowed students to receive consistent and timely feedback on their productive language skills, and it provided tools to help them interact with scientific content in their reading and writing. By emphasizing language, I was actually emphasizing communication and understanding. My student population is gregarious highly social, and they seemed to thrive when given regular opportunity to discuss and share. The benefits in terms of student engagement and satisfaction, while hard to quantify, were real and directly observable.

The personal value of this classroom research is that I have awoken to the value of capitalizing on peer interactions. Through careful seating arrangements, I can create the potential for really productive collaborations between students, whether this might be a paired reading activity or a small group discussion. The beauty of these collaborations is that they benefit a wide range of students. Students deepen their own understanding when coaching others, gain confidence and satisfaction, and become more self-aware of gaps in their own knowledge. Coaching benefits struggling students in that concepts are explained in a conversational way by peers, with less emphasis on academic language. This makes content accessible, and helps students of all levels of language proficiency to form connections to the content and with each other.

My personal teaching practice has grown through this experience. I feel that I have gained a deeper understanding of the needs and strengths of my students. My students are talented, warm, helpful and driven to succeed. I value the feedback the students offered me throughout the process, and I plan to continue the practice of student

interviews, surveys, and exit feedback. The student perspective is invaluable, and it has allowed me to become a more effective and responsive teacher.

REFERENCES CITED

- Bergman, D. (2013). "Blending language learning with science: with purposeful planning, teachers can reach all students with the dual goals of language development and scientific inquiry." *The Science Teacher* 80(4).
- Braden, S., Wassell, B., Scantlebury, K., & Grover, A. (2016): Supporting language learners in science classrooms: insights from middle-school English language learner students, *Language and Education*, DOI: 10.1080/09500782.2015.1134566
- "Corporation Enrollment by Ethnicity and Free and Reduced Lunch Status." *Indiana Department of Education*. Indiana Department of Education, 2015. Web. 24 Apr. 2016.
- Cummins, J. (2011). Literacy Engagement: Fueling Academic Growth for English Learners. *The Reading Teacher* 65(2), 142-146.
- English Learner Guidebook. Indiana Department of Education. 2015.
- Guthrie, J.T. (2004). Teaching for literacy engagement. *Journal of Literacy Research*, 36(1), 1–30.
- Hake, R. 1998. Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics Teachers*, 66, 64-74.
- Hakuta, K., Santos, M., & Fang, Z. (2013). Challenges and Opportunities for Language Learning in the Context of the CCSS and the NGSS. *Journal Of Adolescent & Adult Literacy*, 56(6), 451-454.
- Handelsman, M., Briggs, Sullivan, M. L. W., & Towler, A. (2005). A measure of college student course engagement. *Journal of Educational Research*, 98, 184-191.
- Johnston, L., Sandefur, S., and Watson, S. (2007). Literacy development, science curriculum, and the adolescent English language learner: modifying instruction for the English-only classroom. *Multicultural Education* 14(3): 41.
- Krashen, S.D. (1985). *The input hypothesis: Issues and implications*. New York, NY: Longman.

- Lara- Alecio, R., Tong, F., Irby, B, Guerrero, C, Huerta, M, Fan, Y. (2012). The effect of an instructional intervention on middle school English learners' science and English reading achievement. *Journal of Research in Science Teaching*. 49 (8), 987-1011.
- Lee, O. (2005). Science Education with English Language Learners: Synthesis and Research Agenda. *Review of Educational Research*, 75, 491-530.
- Lee, N., Cortada, J., Grimm, L. (2013). "WIDA Focus on group work for content learning" WIDA Consortium, University of Wisconsin-Madison: Madison, WI.
- Marian, M., and Zhou, G. (2012). The Impact of Differentiated Instructional Materials on English Language Learner (ELL) Students' Comprehension of Science Laboratory Tasks. *Canadian Journal of Science, Mathematics and Technology Education* 12(4), 334-349.
- Matthews, P. H. & Mellom, P. J. (2012). Shaping aspirations, awareness, academics, and action: Outcomes of summer enrichment programs for English-learning secondary students. *Journal of Advanced Academics*, 23(2), 105-124.
- Miller, M., and Veatch, N. (2010) Teaching Literacy in Context: Choosing and Using Instructional Strategies. *The Reading Teacher* 64(3), 154-165.
- Myududu, N., Theil-Burgess, J. (2012). Constructivism in Practice: The Case for English Language Learners. *International Journal of Education* 4(3), 108-118.
- National Center for Education Statistics. (2015) *National Assessment of Educational Progress (NAEP): Reading and Mathematics* (Washington, D.C.).
- National Research Council. (1996). *National Science Education Standards*. Washington, DC: The National Academies Press.
- Nixon, S., Saunders, G., & Fishback, J. (2012) Implementing an Instructional Framework and Content Literacy Strategies Into Middle and High School Science Classes, *Literacy Research and Instruction*, 51:4, 344-365.
- Piaget, J. (1954). *The Construction of Reality in the Child*. New York, NY: Basic Books.
- Rojas, Virginia. (2007). Strategies for Success with English Language Learners. Alexandria, VA: Association for Supervision and Curriculum Development.
- Schleppegrell, M., and C. O'Hallaron. (2011). Teaching Academic Language in L2 Secondary Settings. *Annual Review of Applied Linguistics*, 31, 318.

- Silva, C., Weinburgh, M., Malloy, W., Horak Smith, K. and Nettles Marshall, J. (2012). Toward Integration: An Instructional Model of Science and Academic Language. *Childhood Education* 88(2), 91-95.
- Silver, Harvey F, Richard W. Strong, and Matthew J. Perini. (2007). *The Strategic Teacher: Selecting the Right Research-Based Strategy for Every Lesson*. Alexandria, Va: Association for Supervision and Curriculum Development.
- Soto, L. Y. (2001). *English language learners' second language development via the natural approach* (Order No. 3008141). Available from ProQuest Dissertations & Theses Global. (304692803).
- Tong, F., Irby, B., Lara-Alecio, R. and Koch, J. (2014). Integrating Literacy and Science for English Language Learners: From Learning-to-Read to Reading-to-Learn. *The Journal of Educational Research* 107(5), 410-426.
- U.S. Department of Education, National Center for Education Statistics. (2012). *The Reading, Mathematics and Science Achievement of Language-Minority Students in Grade 8* (NCES 2012-028), English Language Learners.
- Van Roekel, D. (2008) *English Language Learners Face Unique Challenges*. Rep. Washington D.C.: NEA Policy and Practice Department.
- Vygotsky, L. (1978). *Interaction Between Learning and Development: Readings on the Development of Children*. NY, NY. Scientific American Books.
- Weinburgh, M., Silva, C., Horak-Smith, C., Groulx, K., & Nettles, J. (2014). The Intersection of Inquiry-based Science and Language: Preparing Teachers for ELL Classrooms. *Journal of Science Teacher Education* 25(5), 519-541.
- WIDA. (2014). *Mission and the WIDA Story*. The Board of Regents of the University of Wisconsin System.
- Wright, W. (2010). *Foundations for Teaching English Language Learners: Research, Theory, Policy, and Practice*. Philadelphia, PA: Caslon Publishing.

APPENDICES

APPENDIX A

SAMPLE READING FOR MEANING ACTIVITY

Name: _____

Cleaning the Tides of San Diego and Tijuana

A Reading for Meaning Activity

Statement	Agree	Disagree	Evidence
The Tijuana River is polluted.			
The United States is responsible for the pollution.			
Mexico is responsible for the pollution.			
The pollution problems of the Tijuana River are a difficult environmental issue.			
Pollution has economic consequences.			
The environment and the economy are connected.			

Why is this issue so complicated?

Did any of your positions change after completing the reading? Which positions changed, and what evidence helped change your mind?

In your opinion, what needs to be done? Who should do it? Who should pay for it? Why do you recommend this course of action? Respond to these questions in a well-developed paragraph (5-7 sentences). In your writing, include **supporting evidence from the text** (2-3 supporting details).

APPENDIX B

READING FOR MEANING ASSESSMENT RUBRIC

Reading for Meaning Assessment Rubric

Performance Level	4	3	2	1	Pts
Active Reading: Student identified key ideas and collected evidence to support these ideas.	Demonstrated strong understanding of text by identifying important ideas and supporting evidence	Demonstrated good understanding by identifying most important ideas and supporting details	Demonstrated some understanding by identifying ideas and information that are simple yet relevant	Demonstrated a limited understanding of text; describes few details from text; ideas are not always relevant	
Discussion: Student contributed to small group and/or whole class discussion.	Contributed to discussion, supporting ideas and comments with textual evidence, listened attentively	Contributed to discussion, stayed on topic, loosely referring to the text, listened attentively	Participated, stayed on topic, but strayed from the text, listened attentively	Abstained from the discussion, or derailed the discussion	
Synthesis: Student applied knowledge and used supporting evidence in assigned task.	Interpreted information effectively, forms connections, and creates an understanding supported with evidence	Interpreted information and formed connections	Interpreted information from the text but the main idea is irrelevant to the text; extension was not appropriate or not given	Difficulty interpreting the text and unable to determine main idea or extend	
Evaluation: Student reflected on his/her knowledge and revised thinking as more evidence became available.	Reviewed and revised thinking based on evidence gathered.	Students reviewed and revised thinking, offering some evidence for the student's thinking	Student reviewed, and revised thinking, but offered little explanation for the change in their thinking	Students failed to review or revise thinking.	

APPENDIX C
STUDENT ENGAGEMENT SELF-ASSESSMENT

Name: _____

Student Engagement Self-Assessment

How well do the following actions, thoughts, and attitudes describe you, in this course? Please rate each of them on the following scale:

- 5 = very characteristic of me
- 4 = characteristic of me
- 3 = moderately characteristic of me
- 2 = not really characteristic of me
- 1 = not at all characteristic of me

Thoughts, Actions, and Attitudes	1	2	3	4	5
Raising my hand in class					
Participating actively in small group discussions					
Asking questions when I don't understand Mrs. Venturi or the material					
Doing all the homework					
Coming to class every day					
Attending study sessions or studying on regular basis					
Thinking about environmental science topics outside of class					
Finding ways to make the course interesting and relevant to me					
Taking good notes in class					
Looking over notes to make sure I understand the material					
Being confident that I can learn and do well in the class					
Putting forth effort					
Really desiring to learn the material					
Being organized					
Getting a good grade					
Doing well on the tests					
Staying up on the readings					
Having fun in class					
Helping fellow students					
Listening carefully in class					

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

[Adapted from the following source: Handelsman, M. M., Briggs, W. L., Sullivan, N., & Towler, A. (2005). A measure of college student course engagement. *Journal of Educational Research*, 98, 184-191.]

APPENDIX D
STUDENT INPUT INTERVIEW QUESTIONS

Student Input Interview Questions

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. What have been the highlights of environmental science this past six weeks? What were the low points?
2. In your opinion, have the language-based activities (reading, writing, listening and speaking) helped you increase your understanding of environmental science?
3. In your opinion, have the language-based activities (reading, writing, listening and speaking) helped you gain confidence in your abilities as a science student?
4. Do you feel the variety of activities and content were interesting and engaging?
5. In what areas do you feel you have made the greatest progress?
6. Have you found my feedback helpful?
7. Have you found the peer feedback to be helpful? Do you feel like you have helped others? In what ways?
8. Did the weekly self-assessments make you more aware of your own learning process?
9. In what ways could the class structure be improved?
10. Is there anything else that you would like to share?