Disciplinary Literacy & Structured Student Talk in a Newcomer Science Classroom

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The supervisory committee met with the candidate for a final evaluation in which all aspects of the candidate's program were reviewed. The committee's assessment and recommendations are:

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- ✓ Degree should be awarded

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Chapter One

Educational History

I grew up and attended K-12 public schools in the state of Wyoming. As a whole, Wyoming is extremely rural and conservative, and my school district was no exception. While I had some fantastic teachers throughout the years, the primary model of education I experienced was what Paolo Freire (2018) calls the "banking system of education," wherein knowledge is simply "deposited" from the teacher to the student (pp. 72-73). There was little room for constructing our own knowledge or independently exercising creativity. In my social studies classes, we primarily took notes out of a textbook, took notes on lectures, and then took tests that asked us to simply recall these facts, without doing much to actually *learn* the material. In my math class, we predominantly received direct instruction from the teacher, had an opportunity to practice on our own, and then again, took tests that asked us to regurgitate the information. In my English classes, we usually read a book (either as a class or independently) and then wrote essays. There were occasional projects, of course, but these still had pretty strict parameters. Even science class felt like a place where facts were to be memorized, rather than a place where problems were to be solved.

Growing up White, upper-middle class, in a town that was largely racially homogenous, this form of education wasn't a huge problem for me at the time. Education was not viewed as a way to counter systemic inequities, it was simply a job that needed to get done. I did what I was supposed to do, I received good grades; my parents were happy, my teachers were happy, I was happy. I fit the status quo and all was well. However, as much as I loved school, I always felt like there was something missing.

After graduating high school, I went off to college in Seattle. This was life-changing for me in so many ways. I had never lived in a city before, and I had never been surrounded by so many different people and perspectives. In college, I quickly realized that the model of education I had been so used to would not help me to be successful. I struggled my first quarter at college because I had no idea how to study, how to construct my own knowledge, and how to learn independently from just memorizing facts. I went from a big fish in a little pond to a little fish in a big pond. Additionally, while I would study with my peers, I had never gained the skills necessary for truly collaborating with others in a way that allows for the co-construction of knowledge.

However, I absolutely loved the subjects I was studying, and I loved my professors. I had several professors who continuously encouraged me, helped me, and taught me skills so that I could be successful. With some time, I came to learn how to construct knowledge independently and how to learn without being told what to memorize. I also gained skills that allowed me to be a more successful collaborator. I was taught valuable leadership skills that allowed me to be a better learner– not for the sake of getting better grades, but for the sake of learning. As a science major, I had many opportunities to study and research projects of my own choosing. I was excited about what I was doing, and felt like I was contributing. We had professors who would let us do mini-projects related to their own research and it felt exhilarating to get to help contribute to “real” research. This type of meaningful learning is vital to who I am today, and who I want to become as a teacher.

I am lucky to have had the experiences I had– my parents valued education and encouraged me to leave my hometown to attend college. There were many teachers and professors who helped me along the way. I had a support system who helped me become a better learner, and now is helping me to become a better teacher. However, I know that not everyone has the same support and opportunities that I was given. In my own teaching context, I have many students who face systemic barriers to education that I will not be able to eradicate. However, I believe that I can help give students tools and skills that will allow them to find creative solutions to problems.

In particular, in working with students who have arrived in the United States in the past year (newcomer students), I find that the narratives surrounding these students are detrimental to their learning. There are narratives that these students cannot or should not have access to grade-level content due to not having English language proficiency. Some people believe that newcomer students should learn English before they start working on grade-level content. However, I believe that multilingual learners of English should be given the opportunity to access grade-level content so that they are able to start constructing their own meaning and learning English through the content. I believe that language is best learned in context, because that is how language is used (Vygotsky, 1978).

A key aspect of learning both science and working toward English language acquisition is collaboration with peers as well as the teacher. Social constructivism theory provides a framework for understanding how important collaborative learning is for students. Knowledge cannot be constructed in isolation, and as a teacher, my goal is to facilitate the co-construction of knowledge between students, and myself.

Guiding Pedagogical Theory

Social constructivism is an educational theory that has been developed through the works of many different educational researchers. Constructivism as a general theory is largely built upon the work of Piaget (1971), who stated that individuals construct knowledge based on their prior experiences (Van Le & Nguyen, 2024). Constructivism also builds upon the ideas of Vyogosky and Cole (1978) who argued that knowledge is constructed through interactions with others (Van Le & Nguyen, 2024). Social constructivism in particular is largely influenced by the work of Vygotsky (1978), who highlights the importance of social and cultural factors on learning.

However, the theory has evolved and changed over time based on the works of several other educational researchers. Essentially, social constructivism can be boiled down to the idea that knowledge is socially constructed. Idaresit Akpan (2020) writes that, "language and culture are the frameworks through which humans experience, communicate, and understand reality" (p. 50). In other words, our experiences as humans, and as learners, cannot be separated from the language and culture in which we have those experiences. Additionally, the social constructivist theory posits that interaction with others is vital for learning (Van Le, 2024). There are several principles to the social constructivist theory: knowledge is constructed, not passively obtained; learning is an active, not passive, process; knowledge is not obtained in isolation– it is socially constructed within groups to make meaning (NU, 2023). This idea is part of why the "banking" theory of education is so problematic– knowledge is ever-evolving, and cannot be simply passed from one person to another (Freire, 2018).

In my experience in education, knowledge was treated as an object that can be passed from one person to another. Put another way, in my educational experience, knowledge was obtained passively, rather than in actively constructed. In this way, knowledge could easily be gatekept from individuals who were not "deserving" of said knowledge. Additionally, there is a pervasive belief in education that only some people can create knowledge, while the rest must simply be consumers of that knowledge. For example, in Freire's (2018) model of banking education, knowledge is gatekept by the teacher-centered approach, in which the teacher instills knowledge into the student as the teacher sees fit, furthering systems of oppression. Examples of this knowledge gatekeeping can be found throughout our educational system– through student tracking, not providing grade-level content to English language learners, and not holding students to rigorous standards because of their backgrounds.

Additionally, I was not co-constructing knowledge with peers, but rather learning in isolation. While the "banking system" of education allowed me to memorize lots of information, it did not allow me to build skills for learning at a deep level, such as the co-construction of knowledge with peers in order to solve problems and be creative (Freire, 2018, p. 74). Furthermore, in my educational history, there is a huge gap where collaborative learning experiences should have occurred. Of course, I did the occasional group project, but the interactions between students were not built into the way learning occurred in the classroom. This not only felt isolating, but it also created a culture of competition and knowledge hoarding. It deepened the divide between the "smart" students and the students who fell behind. In addition, collaborative group skills are an important life-skill that I missed out on learning. If knowledge is co-constructed, then without these opportunities to truly collaborate with one another, the depth of my knowledge was stunted, and I did not have the opportunity to learn from my peers. I dreaded group projects because students were never held accountable for acting in a cooperative manner; we were never taught how to. This led to animosity between peers because typically one person ended up doing all the work while other students coasted by. This was not a beneficial learning model for any students. I also grew up believing that sharing ideas and talking about ideas was less important than reading or writing about those ideas. While reading and writing are absolutely essential, these skills in isolation, apart from interactions with other learners, are often meaningless. According to Vygotsky (1978) because our reality is co-constructed, without interaction with others, reading and writing done in isolation don't actually further our understanding of reality.

The social constructivist theory is a guiding framework for this study because it posits that language is vital for learning– stating that learning cannot be separated from language. Students need to be able to communicate with one another in order to build a construction of reality in which they can understand their newfound knowledge. Language is what facilitates this co-construction of knowledge (Vygotsky, 1978). Furthermore, the social constructivist theory allows me to build in pedagogical strategies that require students to construct knowledge together, rather than me simply "depositing" knowledge into them (Freire, 2018). Rather than simply passively absorbing information, constructivist approaches foster moving away from the "banking system" of education (Freire, 2018, p. 72-73). I believe that because this approach moves away from the banking system of education, it can be used to oppose the systemic inequities that my students face (Freire, 2018). Instead of "depositing" information into my students, with the assumption that I hold all of the information, and my students must passively absorb the information, I want to focus more on building community with my students, and acting more as a guide and facilitator as they work to build an understanding of science and the English language simultaneously (Freire, 2018, p. 72-73). Instead of centering my own experiences, as done in the banking system of education, I can counter this by centering what my students already know, allowing them to not simply accept the "passive role imposed on them" (Freire, 2018, p. 73). To state another way, I want my students to play an active role in their education and to construct their own meaning, as they learn science content and English together.

Connection to INTASC Standards

As a teacher, I want to create a learning environment where students engage collaboratively to share ideas and co-construct knowledge. This aligns with INTASC Standard 3b which states, "the teacher develops learning experiences that engage learners in collaborative and self-directed learning that extends learner interaction with ideas and people locally and globally" (CCSSO, 2013, p. 21). This standard aligns with the constructivist theory because it states that teachers need to be able to foster collaboration among students, a key tenet of the social constructivist approach. Additionally, teachers need to create an environment where students interact with ideas outside of their own. This is key for a social constructivist approach where students share ideas and co-construct knowledge in a way that benefits from varying perspectives. In this way, reality is co-constructed among students, rather than one person determining what students should know.

I also want to create a classroom environment where students are not just passively getting knowledge passed down, but instead are actively working to construct meaning together. As a teacher, my role should not always be as the sole holder of knowledge, but often should be a role of co-constructing knowledge, and acting more as a facilitator. This helps dismantle systems of oppression, because it centers and values my students' experiences. It also aligns with INTASC Standard 8d, which states "the teacher varies their role in the instructional process in relation to the content and purposes of instruction and needs of learners" (CCSSO, 2013, p. 38). My goal is to move towards an instructional model where I am a facilitator of groups who are taking ownership over their own learning, with me as the teacher acting more as a guide than as an authority figure. For example, students will be provided with scaffolded input in the form of complex scientific texts, as well as participating in structured student talk and other collaborative activities as a way to prepare to write argumentative paragraphs.

Summary

After growing up in rural Wyoming in a well-resourced school, with many opportunities available to me, yet still feeling like my education was lacking something important, I am looking forward to teaching in a way that students feel like they are leading their own learning. Through my own educational experiences as a student, to now teaching in an under-resourced urban school where students face many challenges in their everyday lives, I have come to understand the role that social construction of knowledge plays. As humans, we need each other to learn and grow. Specifically, science and language learning cannot occur in isolation, but must exist within a collaborative community of learners. Through the social constructivist view of education, I propose that I can become a stronger teacher, as aligned with the INTASC standards, by fostering this type of learning environment in my classroom.

Chapter Two

Introduction

Because of my work with newcomer students, and desire to provide them with a more equitable science education, I was interested in understanding how scaffolded input and space for co-construction of knowledge with peers can improve students' language acquisition and ability to effectively communicate. Specifically, I wanted to ensure that students are working collaboratively with one another to construct their own meaning of scientific knowledge, with language as a facilitator. Much research has been done on the integration of literacy within the science classroom. Through the following chapters and articles, I gained a deeper understanding and appreciation for how much crossover exists between language acquisition and learning science content. The researchers presented a variety of pedagogical strategies to help improve literacy within the science classroom for Multilingual Learners of English (MLE) students. Additionally, it is clear from the research how important it is for students to be able to construct their own meaning-making when developing skills in both language acquisition and the discipline of science.

Annotated References

Ardasheva, Y., & Tretter, T. R. (2015). Developing science-specific, technical vocabulary of high school newcomer English learners. *International Journal of Bilingual Education and Bilingualism*, *20*(3), 252–271. https://doi.org/10.1080/13670050.2015.1042356

In this article, the authors looked specifically at how vocabulary can be effectively taught to newcomer refugee students in the science classroom, using a specific curriculum called Science Vocabulary Support. The authors used a quasi-experimental setup to compare student vocabulary learning in students in "regular" instruction compared to those using the curriculum specific for developing science vocabulary. In a quasi-experimental setup, groups are not randomly assigned. Given that this is a classroom setting, it would be difficult, if not unethical, to randomly assign students. Ardasheva & Tretter (2015) examined this study through the lens of schema theory– the idea that new knowledge builds on and connects to prior knowledge. The study found that vocabulary retention was higher in newcomer students who experienced the targeted curriculum. This curriculum included daily word study activities and ongoing explicit vocabulary instruction. The results indicated that this is an important aspect of teaching science to newcomer students.

This study was unique in that it looked specifically at newcomer students. This is uncommon to find in literature regarding teaching science to MLE students. It was great that the article included the specific word study routines that were a part of the curriculum. This allows teachers to implement these routines into their own classrooms, helping to improve explicit instruction in vocabulary. However, as the authors themselves explain, because the design of this study is quasi-experimental, we cannot say for sure whether this curriculum is what caused students to score higher on their vocabulary retention. It's possible other factors were at play such as other pedagogical methods the teacher employed, or practice at home with the language.

August, D., Artzi, L., & Barr, C. (2015). Helping ELLs Meet Standards in English Language Arts and Science: An intervention focused on academic vocabulary. *Reading & Writing Quarterly*, *32*(4), 373–396. https://doi.org/10.1080/10573569.2015.1039738

In this study, August et al., (2015) compared the effectiveness of extended vocabulary instruction to embedded vocabulary instruction for helping MLE students acquire academic English. In extended vocabulary instruction, the class spends a lot of time engaged in learning the definition of the word and doing a deep dive into the word. However, in embedded vocabulary instruction, the students are given a brief definition of a word before they encounter it in a text, but extended study time is not devoted to the word. The authors used a "within-subjects" approach to their research, which meant that participants experienced both types of vocabulary instruction. Though not explicitly stated, the authors appeared to take a sociolinguistic and sociocultural approach in their study, by demonstrating that language is learned in a context. The study found that the extended vocabulary instruction was more effective than the embedded instruction, though there were learning gains found in both categories. The study found that this was true of both science and general academic vocabulary. Interestingly, the study also found that reinforcement (i.e. continuing to practice with the vocabulary word) did not improve student learning of the vocabulary words.

This study is intriguing because it suggested that while extended vocabulary instruction showed greater gains, embedded vocabulary instruction was also useful, and allowed students to make gains. This is helpful to me as a teacher because we do not have time in our curriculum for extended vocabulary instruction for every new word encountered. However, students are still able to make language gains from just encountering new words and seeing or hearing brief definitions of them.

Callahan, R. M., Sampson, V., & Rivale, S. (2019). Activating bilingual English language learners' strengths in Science: The Pedagogy of Argument Driven Inquiry (ADI). In *Teaching the content areas to English language learners in secondary schools* (pp. 183–197). https://doi.org/10.1007/978-3-030-02245-7_12

In this chapter the authors presented the Argument Driven Inquiry instructional approach as a beneficial pedagogical intervention for MLE students to develop both science and literacy skills. The authors used the specific 8 step pedagogical approach to integrate literacy and science learning. It starts with students identifying a question, followed by them collecting data, developing an initial argument, reflecting, and revising. The Argument Driven Inquiry approach comes out of the social constructivist view, in that students have the opportunity to take ownership over their own learning . This chapter suggested that using this approach will allow students to practice both their linguistic skills and science skills. Additionally, they suggested that it can help change patterns of inequality that cause MLE students to be excluded from understanding STEM classes because students have agency in their learning. Additionally, it is scaffolded in a way that allows access for MLE students. It allows MLE students to utilize their linguistic skills in the classroom, by taking part in constructive arguments, discussions, and peer feedback, which leads to increased engagement and improved student outcomes.

The Argument Driven Inquiry approach is interesting because it allows students to not only integrate science and literacy skills, but it also allows students to take agency over their own learning. In this approach, students design their own inquiry into a scientific phenomenon. As intriguing as this sounds, it would be difficult to implement this to the same extent within a newcomer classroom. It would take a lot of time for students to understand what was being asked of them. The authors did acknowledge that the implementation of this strategy needs to be done carefully, or it could risk further ostracizing MLE students or cause more confusion. However, through translanguaging and other scaffolding strategies, newcomer students could participate and benefit from the outcomes of this approach. Additionally, as a teacher, I could implement some of the steps of the approach without necessarily implementing all of them.

Llosa, L., Lee, O., Jiang, F., Haas, A., O'Connor, C., Van Booven, C. D., & Kieffer, M. J. (2016). Impact of a Large-Scale Science Intervention focused on English Language learners. *American Educational Research Journal*, *53*(2), 395–424. https://doi.org/10.3102/0002831216637348

This study examined the impact of a specific curriculum on MLE student outcomes in a science classroom. The authors used a randomized control trial to select 66 schools across three different districts in their state. Half of the schools implemented the curriculum while the other half did not. The schools were then studied for a three year period. Though not explicitly stated, the authors appeared to take a sociolinguistic approach to their curriculum– combining the content knowledge of science with the teaching of language, demonstrating that language is learned in the context of authentic tasks. The study found that the Promoting Science among English Language Learners (P-SELL) intervention was beneficial for students. This curriculum ensures that each chapter provides scaffolded language support for students to practice reading and writing in a scientific context, while pairing this with inquiry-driven activities. The study found that students in the treatment group significantly outperformed students in the control group on both the researcher-written assessment and the state science assessment. Additionally, it was found that the impact of the treatment did not significantly differ between language proficiency subgroups.

This article clearly demonstrated the effectiveness of integrating language instruction into science content for MLE students, by using a combination of scaffolded reading and writing and inquiry driven activities. This practice is extremely beneficial and allows MLE students to achieve at higher levels. However, the article did not spend much time discussing what specific practices are included in the curriculum. Additionally, it did not provide much guidance for teachers on how to implement some of the ideas from their curriculum. Clearly, a curriculum that integrates science and language is useful, but without specific information about it, teachers cannot utilize the findings of this study in their own classrooms.

Lyon, E. G., Stoddart, T., Bunch, G. C., Tolbert, S., Salinas, I., & Solis, J. (2018). Improving the preparation of novice secondary science teachers for English learners: A proof of concept study. *Science Education*, *102*(6), 1288–1318. https://doi.org/10.1002/sce.21473

This article looked at restructuring science teacher preparation courses as a way to increase the interrelation between science and language literacy in science classrooms. Lyon et al. (2018) used a mixed-methods approach that compared teacher candidates enrolled in the intervention group, which utilized the Secondary Science Teaching with Literacy and Language Acquisition (SSTELLA) framework to teacher candidates not enrolled in the intervention group. The teachers were followed for 2 years in the teacher preparation program and 2 years following– their first 2 years teaching. The authors utilized a sociocultural and sociolinguistic perspective in this study, drawing on the idea that language is learned through “authentic contexts” (i.e. within the discipline of science). The study found that out of the 9 SSTELLA practices, there was the most positive effect of interventions surrounding “student talk” and "student interaction” once teacher candidates were teaching in their own classrooms (Lyon et al., 2018, p. 1307). However, the study also found considerable variation between groups studied.

The article provided an interesting look at integrating science and language– rather than focusing on student outcomes, the researchers instead looked at how preservice teachers are prepared for integrating science and language. Although the study had mixed results, and thus we cannot draw wide conclusions from it, the SSTELLA framework is particularly impactful for me. This framework provides a guide for teaching both science and language literacy in a synergistic manner. It provides explicit ideas for how to integrate language learning into my science class. The biggest takeaway from this study is that preservice teachers should have explicit instruction about implementing student talk and student interaction into their science classes.

Pando, M., & Aguirre-Muñoz, Z. (2019). Engaging English Language learners in Model-Based Science instruction. In *Teaching the content areas to English language learners in secondary schools* (pp. 215–230). https://doi.org/10.1007/978-3-030-02245-7_14

In this chapter the authors suggested that model-based science instruction can allow MLE students to access the content and be able to participate more fully in science classes. The authors use model-based science instruction as a pedagogical strategy for ensuring MLE students have access to science content. This is based in the Systemic Functional Linguistics theory. The chapter argued that model-based instruction allows more equitable access to science learning for MLE students. Additionally, it is argued that it allows students to engage in an inquiry process, important for both language learning and the scientific discipline.

This chapter helps me to recognize where I can include more model-based instruction into my own classroom. In my experience, modeling has been useful for helping newcomer students in science, because it allows them to represent what is happening without needing to use words. However, teaching students how to properly model can also be challenging when there is a language barrier. This chapter explained the need to clearly communicate expectations to students, which can improve their modeling skills and provide feedback for them on what specifically teachers are asking them to do.

Qi, Y., & Fang, Z. (2023). Teaching writing to English language learners: two science teachers' perspectives and practices. *Journal of World Languages*, *9*(3), 400–426. https://doi.org/10.1515/jwl-2023-0016

In this article, the researchers looked at two science teachers' perspectives and practices regarding the integration of science and writing instruction. The authors investigated this through a qualitative case study, by interviewing the teachers, observing the classes, and by analyzing student writing samples. Qi & Fang (2023) explored this topic through the lens of disciplinary literacy. The study found that though the teachers claimed to place importance on writing, very little instructional time was devoted to writing. The teachers also saw themselves as separate from the language arts teachers, who they believed should be teaching reading and writing. It was also found that the teachers held lower expectations of their ELL students' writing skills than of the rest of their students.

The case study presented by Qi and Fang (2023) is particularly impactful for me because it allowed me to analyze my own instructional practices to consider whether I am prioritizing writing in my own class. I wholeheartedly agree with the notion that literacy instruction is not just the job of the language arts teachers, but of all teachers. Specifically, being able to navigate scientific texts is a vital skill for students. As this study points out, these are also skills that need to be explicitly taught. It is not fair to assume that students already know how to do the writing tasks they are assigned in science class. Modeling and providing students with examples is also extremely important. Of course, this study is largely qualitative, and the sample size is extremely small, so the data cannot be generalized. However, it provides me with some important questions with which to analyze my own instructional tasks.

Reid, J. W., Smith-Walters, C., Mangione, K. A., Dorris, A., & Tharp, T. (2019). Supporting English Language Learners through Inquiry-Based Science: Three Strategies for your classroom. In *Teaching the content areas to English language learners in secondary schools* (pp. 199–214). https://doi.org/10.1007/978-3-030-02245-7_13

In this chapter, Reid et al. (2019) suggested that Inquiry Based Learning is an effective strategy for teaching MLE students in science class. Inquiry Based Learning is the idea that students engage in the scientific process in their learning. Not only are students engaged in scientific experimentation, but their curiosity and observations drive the scientific process (Reid et al., 2019). The authors used three specific strategies to engage MLE students in Inquiry Based Learning: short silent films, interactive word walls, and interactive notebooks for supporting this process. The authors explored this topic through the lens of social constructivism. The chapter discussed how to actually implement the three instructional strategies presented, and gave an example of each.

This chapter was particularly helpful because it provided specific examples of each of the strategies mentioned. This is unique among research looking at the integration of science and literacy. Additionally, with each of the three strategies came a list of modifications and limitations. This is helpful because it allows teachers to really have an idea of how to actually implement the strategies that are known to help improve student learning for MLE students. Overall, this chapter was very useful to me as a teacher, and I find that I can easily improve my teaching based on the examples shown in the chapter.

Relyea, J. E., Kim, J. S., Rich, P., & Fitzgerald, J. (2024). Effects of tier 1 content literacy intervention on early-grade English learners’ reading and writing: Exploring the mediating roles of domain-specific vocabulary and oral language proficiency. *Journal of Educational Psychology*, *116*(7), 1172–1195. https://doi.org/10.1037/edu0000882

This article looked at the effects of teaching thematic units with “complex informational texts” for both science and social studies on the reading and writing outcomes for 1st and 2nd graders. Both MLE and non-MLE students were included in the study (p. 1174). In this exploratory study, researchers used a randomized control treatment to assign half of the schools involved to a 1st grade treatment group, with 2nd grade being the control, and the other half of the schools were assigned to a 2nd grade treatment group with 1st grade serving as the control (Relyea et al., 2024). The guiding framework for this study was content literacy instruction, which supposes that instruction can and should combine content knowledge acquisition, reading comprehension, and writing (Relyea et al., 2024). This study found that the reading intervention had a significant impact on students’ ability to write argumentatively in both science and social studies.

While this study looks specifically at younger students, the idea that reading content specific texts can improve writing outcomes is encouraging for my own classroom. Because this is looking specifically at argumentative writing, which is what I use as a measurement of language and content learning in my own classroom, I am interested in being able to apply some of the principles of this study to my own class. As the article states, this finding “challenges pedagogical tendencies to delay the introduction of complex content until ELs reach an optimal English language proficiency level” (Relyea et al., 2024, p. 1190). Allowing students to participate in grade-level complex texts, regardless of their ELP level, is a form of justice-seeking, and something that is important to me within my own classroom.

Rodriguez, A. J., & Zozakiewicz, C. (2010). Facilitating the integration of multiple literacies through science education and learning technologies. In *Science Education as a Pathway to Teaching Language Literacy* (pp. 23–45). SensePublishers. https://doi.org/10.1163/9789460911316_005

This article explored how professional development can be used to help teachers integrate science and multiple literacies. In this study, Rodriguez & Zozakiewicz (2010) completed a 3-year long longitudinal "professional development research project" to provide teachers with support in implementing units that integrated science content and literacy (p. 28). The authors used sociotransformative constructivism as their guiding framework for the study. It was found that students were more engaged and enthusiastic about the science content when they did projects that integrated science and literacy. Additionally, they found that when students had a sense of agency in their work, and were able to use various learning technologies, performance was improved.

This article was unique in that there were no quantitative data shared– everything was qualitative. Additionally, there were several aspects that could have been explained more fully– for example, the authors only discussed one of the intervention strategies that they were employing, rather than all three intervention strategies. The authors also claimed that their project was studying how professional development would improve integration of science and literacy by teachers, but the evidence provided seemed to focus more on student engagement, rather than on the teacher implementation. There seemed to be a mis-match between the initial research question and the data provided. However, I did find their guiding framework compelling because it combines the principles of multicultural education with the learning theory of social constructivism (Rodriguez & Zozakiewicz, 2010). Overall, despite there being some unclear aspects of the study, the ideas are interesting.

Ryoo, K., Bedell, K., & Swearingen, A. (2018). Promoting linguistically diverse students' Short-Term and Long-Term understanding of chemical phenomena using visualizations. *Journal of Science Education and Technology*, *27*, 508–522. https://link-springer-com.wou.idm.oclc.org/content/pdf/10.1007/s10956-018-9739-z

Ryoo et al. (2018) studied how interactive visualizations of complex chemical phenomena improve MLE students' understanding of science. The article did not specify the authors' guiding framework, but it appears to be focused on the idea of comprehensible input and scaffolding material to ensure it is accessible to MLE students. This study was conducted with 152 8th grade students at two separate schools. In the study, students were pre-tested for their understanding of "energy and matter concepts during chemical phenomena" (Ryoo et al., 2018, p. 511). Teachers then taught two weeks worth of lessons using interactive visualizations, and students were then post-tested. The study found that using the interactive visualizations was extremely effective in helping MLE students improve their scientific understanding. They found that students were able to construct better written explanations of scientific concepts after the visualizations intervention as well (Ryoo et al., 2018).

This study is encouraging, because it provides support for the idea that increasing the amount of scaffolded scientific texts students are exposed to can improve their ability to communicate scientific concepts effectively. This study did not have a control group, which makes it difficult to say for sure whether this intervention was the key that allowed students to improve. However, it is still very encouraging. I can take the ideas presented here to add into my own classroom setting to ensure students are receiving comprehensible input that allows them to gain a deeper understanding of scientific phenomena.

Walqui, A., & Oliveira, L. C. (2019). Shifting from the teaching of oral skills to the development of oracy. In *The Handbook of TESOL in K-12* (pp. 258–281). Wiley Blackwell.

In this chapter, the authors look at current ideas surrounding oracy– a term coined by Andrew Wilkinson, which means “the ability to use spoken language across a wide range of situations” (Walqui & Oliveira, 2019, p. 264). The authors discuss how this fits under a sociocultural perspective– the idea that language is learned through context. The authors also discuss how oracy helps students develop not just language skills, but also analytic and conceptual processes (Walqui & Oliveira, 2019). This is different from just teaching oral drills, in which students are required to respond in certain ways to certain questions. Instead, oracy is more open-ended and allows for a broader range of skills and situations.

This chapter summarizes why it is so important for teachers of MLE students to engage in oracy practice in the classroom. Additionally, it explains the need to provide scaffolded oracy practice, to ensure that students of all levels can access the conversations (Walqui & Oliviera, 2019). Furthermore, the chapter goes into specific activities that a teacher can use within the classroom such as three-step interviews and text representation. This chapter gives me some ideas on how to include oracy practice within my own classroom in a scaffolded manner so that students can participate.

Summary

Clearly, there is a plethora of work that has been done in studying how to instruct MLE students in the science classroom– from vocabulary instruction to inquiry based methods of teaching, it is clear that disciplinary literacy is of utmost importance. Science as a discipline lends itself well to being a place for students to increase their language acquisition and literacy skills. Additionally, it is a great space for fostering social constructivism, as science lends itself to collaboration and co-construction of knowledge. However, there appears to be a gap in the literature that focuses primarily on newcomer students in the science classroom. Therefore, my work looking into how newcomer students can improve their English language acquisition in the science classroom is vital and contributes to the body of knowledge by helping fill this gap. My action research project will consider how newcomers increase their English language acquisition and ability to communicate critical thought through the use of space for co-construction of knowledge and scaffolded scientific texts. In the next chapter, I will present my methods for collecting and analyzing data to determine how increased use of scientific texts and structured student talk impacts students' ability to write Claim Evidence Reasoning paragraphs as they acquire the English language.

Chapter Three: Methods

Action research "is a disciplined process of inquiry conducted *by* and *for* those taking the action" (Sagor, 2000, p. 3, emphasis added). In other words, action research is a way for me, as a teacher, to look at a pedagogical strategy to see if and how it improves my instruction, as measured by student outcomes. It is conducted by me, and it is for my own purposes of improving the student outcomes in my own class. Action research is usually very impactful, because it is extremely relevant, given that the researcher decides what is important and moves forward with studying it (Sagor, 2000).

Action research involves choosing a focus that is meaningful and useful for the teacher/researcher. This can be done by keeping a reflective journal, having reflective interviews with colleagues, or simply by keeping track of patterns (Sagor, 2000). Next, the teacher/researcher needs to identify the theoretical lens and beliefs related to the focus of the study. Once this has been established, the researcher must identify the research questions. After the goal of the study is set up, the teacher/researcher will begin collecting data. This should come from multiple sources to ensure reliability and validity (Sagor, 2000). After data collection comes data analyzing and reporting the results of the research project. Lastly, the teacher/researcher uses what was learned from the research project to inform instruction. The ultimate purpose of the study is to improve instruction, so this may be the most important step (Sagor, 2000).

Action research is a proper method for my study because it allows me to study something that is relevant for my specific classroom and my specific students, ensuring that their learning outcomes are the central focus. Sagor (2000) discusses that classrooms are no longer "one-size-fits-all" and that action research is a necessary method for teachers to ensure that they are meeting students' needs. Additionally, as opposed to other methods, it allows me to use data that is already being collected (lesson plans, assessments, etc) to answer my research questions, thereby maximizing my time as a teacher.

As I have been working with my students and noticing patterns, I found that a newcomer science classroom is a great setting in which to conduct action research that focuses on the intersection of learning language and content. Therefore, in my action research project, I will be seeking to answer the following questions:

1) Does increasing scaffolded input through scientific texts empower MLE students to effectively communicate through Claim, Evidence, Reasoning paragraphs?
2) Does providing spaces for co-construction of knowledge with peers through structured student talk and collaborative learning activities improve students'critical thought and language acquisition?

Participants and Setting

This action research project took place at Scottsville High School, located in an urban area in the Willamette Valley. This is a very large high school, with about 2,500 students from various cultural and ethnic backgrounds. Many languages are represented at the school with English, Spanish, Russian, Chuukese, and Marshallese as the most common.

This study took place in a sheltered (meaning newcomer students only) biology class. Of the 29 students, 41.4% are 12th graders, 55.2% are 11th graders, and 3.4% are 10th graders. The variation in grades largely comes from the variation of science courses that students took in their home country, and what is required for graduation. 86.4% of the students are Hispanic, 6.8% are Pacific Islander, and 6.8% are Asian. 100% of the students are English language learners of various proficiencies, ranging from ELPA scores of 0 to ELPA scores of 2. 100% of the students in the class identify as either male or female, with no non-binary students. There is one student in the class with a diagnosed disability, who is on a 504 plan. The languages represented in the class are English, Spanish, Chuukese, and Pashto. All students have arrived in the United States within the last two school years, with the majority of the students from Mexico. However, there are also students from the Chuuk Islands, Marshall Islands, Afghanistan, and Colombia.

This group of students has so many academic assets and funds of knowledge. First and foremost, all of the students are emerging bilingual, which in and of itself is a huge asset, both academically and culturally, because it brings an important diversity of thought to the class. Furthermore, students are able to communicate in multiple languages. Most of my students speak Spanish, which is an asset for translanguaging. In science specifically, there are many cognates between Spanish and English, which allows students to be able to utilize translanguaging to communicate ideas. Additionally, students have learned how to navigate a new country and education system, which can be very challenging. However, students have become successful in navigating the new educational system, demonstrating their persistence and ability to face challenges. The students in this class are very collaborative and love working together. They are always willing to help one another, both with understanding the content, and with translations. Those who have more English proficiency can often be found explaining things to their peers, even before I ask them to.

Furthermore, this group of students has a great sense of humor. They love to joke around and have fun, making this a dynamic and entertaining learning environment. With this, there is also some healthy competition between friends within the class, again creating a positive and fun classroom culture. Many of the students have taken science classes before in their home country, so they have a level of content knowledge in their home language that is now being transferred into this context. In class, we often do quick writes, where students are asked to write in any language about what they know about a particular topic, as a way to activate their prior knowledge. Quick writes are used as a tool to leverage their prior knowledge before beginning a new topic in class. That way, students can think about what they already know about a topic before transferring that understanding into a new language.

I have had the pleasure of working with this group of students since school started in September 2025, as their full-time teacher. I have had the privilege to essentially build this class from the ground up, using the required curriculum as a base, but being able to really adapt it to the needs and interests of my students. Because of the uniqueness of the course, it has been extremely tailored to simultaneously teach both biology content and the English language. My strengths in teaching this class are the relationships that I have built with students, creating a collaborative and dynamic classroom culture, and creating a learning environment where students can use their innate social and competitive skills in the lessons to boost engagement and learning. Additionally, I have worked really hard to build cultural responsiveness into my classroom, and ensure that my students feel empowered to participate, regardless of English proficiency level. Lastly, I am responsive to formative data collection, working to make sure that my instruction meets the students' needs, and that students don't feel left behind if they do not understand something. However, some of the areas of improvement that I have is holding students accountable to the boundaries that are set in class. Additionally, I really want to improve the amount of disciplinary literacy that is practiced in class, especially as students are beginning to progress more in their language acquisition. This is where my action research project comes in.

Data Collection & Analysis

In this project, data was collected and triangulated from various sources, all coming from my sheltered biology class from January 2026-April 2026. The data was collected during three different units: a mini-unit on gene editing, which took place in early February 2026; the evolution unit, which took place in mid-February to April 2026; and the matter, energy, and climate change unit which took place in April-May 2026. The data collection was interrupted on a few occasions due to finals week in late January 2026, class forecasting and state testing in early March 2026, and parent-teacher conferences in mid-March 2026. Additionally, the students had spring break at the end of March 2026.

The data sources for this study included unit plans, lesson plans, teaching reflections, student assessment scores, feedback from my mentor teacher and field supervisor, observation from recorded video of instruction, and feedback from student surveys. I also looked at student English Language Proficiency Assessment (ELPA) results, comparing their scores from the 2024-2025 school year to the 2025-2026 school year. Using multiple data sources aligns with Sagor (2000), who states that data collected on student performance alone (i.e. grades) is not enough to improve instruction. Additionally, these multiple data sources helped ensure that my data was reliable and valid (Sagor, 2000).

After gathering all of my data sources, I analyzed my quantitative data. This largely consisted of student Claim Evidence Reasoning (CER) paragraphs. I looked at three CERs, one from the beginning of the gene editing mini-unit, one from the beginning of the evolution unit, and one from the end of the evolution unit. These assessments were graded using the CER rubric that was developed in conjunction with my Professional Learning Community (PLC) to ensure that CERs were graded in an equitable and reliable manner (Figure 1). With the support of my instructional coach, I was able to access student ELPA scores and also analyzed student growth for each of the four ELPA categories– reading, writing, speaking, and listening. This data was primarily used to help me understand the outcomes of my interventions. The CERs in particular were used to provide data to see whether students had improved in their ability to effectively communicate in English. However, because these assessments were more open-ended, they allowed me to also see students' critical thinking processes. The ELPA scores were used to gauge students' language acquisition in a more standardized manner.

Bellwork Rubric

	1	2	3	4
State Your Claim ☐ Describe the system being studied. ☐ Give a scientific reason for the phenomena	Description is not specific and reasoning is not given.	Description is somewhat specific and scientific reasoning for phenomena is not given.	Description would allow someone who hadn't seen the system to understand, and gives a scientific reason for the phenomena that may not make sense for the given phenomena.	Description would allow someone who hadn't seen the system to understand, and gives a scientific reason for the phenomena that makes sense for the given phenomena.
Gather Evidence Qualitative Evidence: ☐ Describe the scientific model Quantitative Evidence: ☐ Describe the data	Unable to describe data/model.	Able to cite data/model but does not fully describe, such as re-writing what is on the screen or incomplete explanation.	Able to describe the data/model in your own words.	Able to describe in detail the model/data with a loose connection to claim.
Explain Your Reasoning Scientific Model Reasoning: ☐ Explain how the scientific model supports/refutes the claim and explain why Data Reasoning: ☐ Explain how the data supports/refutes their claim and explain why	Reasoning is just restating evidence.	Reasoning is loosely connected to claim.	Reasoning is connected to claim, but not fully explained.	Reasoning is fully explained with added detail, uses evidence to revise claim (if necessary).

Figure 1: CER Rubric used to grade bellwork and CER paragraphs

After analyzing my quantitative data, I used open coding with an inductive approach to analyze my qualitative data, looking for patterns and themes, as outlined in Creswell's (2009) model for qualitative analysis. sorting it into whether it was related to the scaffolding of scientific texts or the co-construction of knowledge, which were the main pedagogical strategies I was looking at. From there, I was able to identify patterns related to these pedagogical strategies. Based on the combination of quantitative data (assessment scores) and qualitative data (unit and lesson plans, student survey feedback, observational data), I was able to draw conclusions that helped me answer my research questions. My data coding was then corroborated by my mentor teacher, as well as feedback from professors at Western Oregon University.

Researcher Positionality

As a middle class, young, White woman who is monolingual English speaking, but in the process of learning Spanish, it is important to me that I am not simply passing down my knowledge to students, which is limited by own lived experience, as well as my own cultural background and monolinguistic perspective. I want students to be able to make meaning from their own unique cultural and linguistic perspectives, and lived experiences, with me as a guide (Freire, 2018). However, from my experiences as a person who has benefitted from the privileges of white supremacy, I needed to be careful that my own biases, which are deeply ingrained in our educational system, do not interfere with the data collection and analysis that I used (Delpit, 2012).

On the other hand, I am committed to antiracism and to promoting multilinguicism. This is particularly important in my context working with students who are multilingual learners of English. My goal is to help support them as they acquire the English language, which will open up more opportunities for them, while also ensuring that students stay connected to their home languages and cultures. Often in schools, students are expected to assimilate in a way that “subtracts” their home culture and language (Valenzuela, 2005, p. 339). However, students who experience “additive” education, wherein bilingualism and biculturalism is highly regarded, experience better educational outcomes (Valenzuela, 2005, p. 339). I want to honor the experiences my students have, as well as their emerging bilingualism and biculturalism.

Additionally, I work hard to combat the “White savior” narrative by centering my students within my classroom (Helmick, 2022). The “White savior” idea is that students of Color need a White teacher to “save” them, such as through education that centers White perspectives. I believe that building a classroom culture where students are collaborating to construct their own knowledge alongside me as the teacher helps to oppose this narrative.

In this chapter, I have discussed how my data was collected and analyzed, as well as my own positionality. In the following chapter, I will explain the four major themes that emerged from my data.

Chapter Four: Findings

In this action research project that looked at the impact of increased scaffolded scientific texts and structured student talk on English language acquisition for newcomer students, I found three major themes as I analyzed the data. These themes were: scaffolded input through scientific texts empowered MLE students to effectively make scientific claims; co-construction of knowledge improved critical thinking and language acquisition; and students had an increased positive disposition toward using English. In this chapter, I will go into more detail about each of those themes, with supportive data.

Scaffolding Scientific Texts Empowers MLE Students to Communicate Effectively

Through my data, it became clear to me that providing more scaffolded scientific texts empowered students to be able to communicate scientific claims effectively, as measured by their Claim Evidence Reasoning paragraphs (CERs). In each of the three units used for the study, students had opportunities to read multiple scientific texts that were scaffolded in a variety of ways.

For example, in the gene editing mini-unit, students had the opportunity to read 3-5 scientific articles of their choice (from a curated set of 10 articles) about gene editing to prepare for the Socratic Seminar. These articles were scaffolded by ensuring that the language was appropriate for students at an English language proficiency level of 1-2, and vocabulary was briefly frontloaded before students read the articles (August et al., 2015).

In the next unit, students read texts during a jigsaw reading activity, which provided scaffolding through a lighter reading load (Aronson & Social Psychology Network, 2000). Additionally, the articles were scaffolded with photos, chunking, and through reading comprehension questions throughout. Each of these scaffolding strategies was also used with other scientific texts as well.

Students were also exposed to other forms of scientific texts throughout all three units such as graphs, models, and maps (Figure 2). Graphs, models, and maps are visual, which allows for scaffolded input to empower students as they learn the content. These types of visual aids are particularly useful for supporting MLE students in understanding complex informational texts (Ryoo et al., 2018).

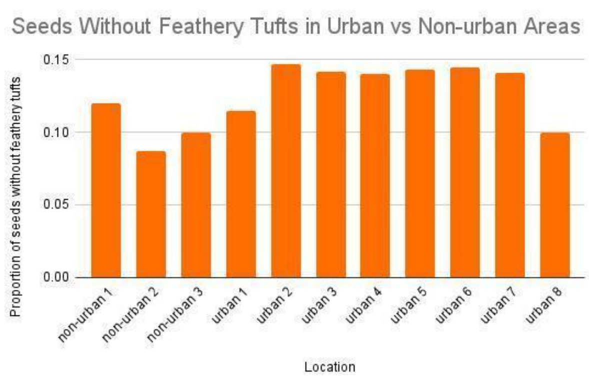
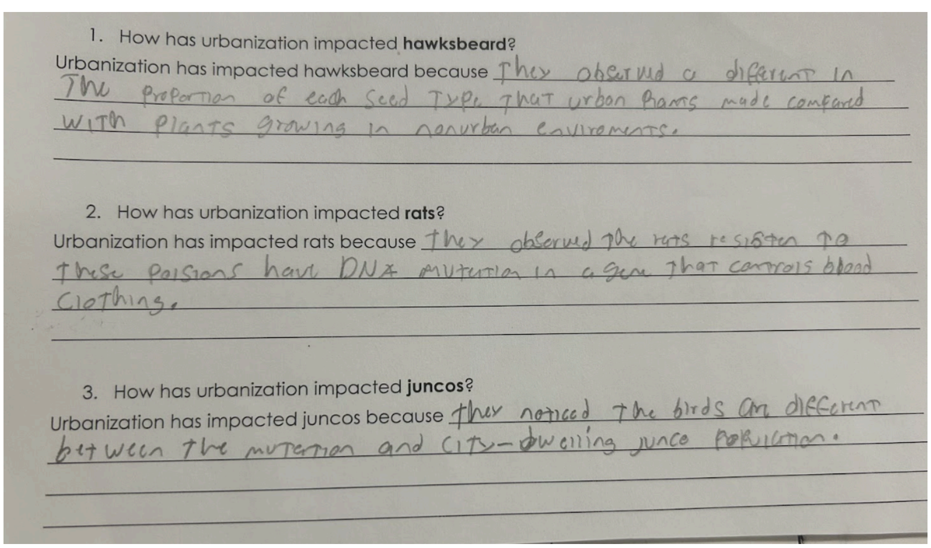


Figure 2: An example of a graph that students were exposed to during the evolution unit. (Cheptou et al., 2008).

Another way that I provided scaffolding through the reading of scientific texts was that students were required to read the articles out loud with one another. As I walked around the classroom and listened to students read aloud, I heard students pronouncing and speaking difficult words. I also heard students discussing complex topics, and using translanguaging to understand difficult concepts and ideas. After the reading, students then were able to use these complex vocabulary words to communicate when they submitted their reading comprehension questions and summaries of the articles. After the jigsaw activity, students completed an exit ticket to describe how urbanization impacted the three species they read about. While many students copied directly from the articles, they were able to successfully find the information they needed, showing that they may not be ready to produce language independently yet, but are still demonstrating reading comprehension. This aligns with English Language Proficiency (ELP) Standard #1 which states that a student at an ELP level 1 can “identify a few key words… in written texts,” while a student at ELP level 2 can “retell a few key details” (Oregon Department of Education, 2014, p. 168). Therefore, although the student is not yet independently producing, this ability to find key details in the text is appropriate for students at their ELP level. The student sample shown in Figure 3 demonstrates the student’s ability to find information in the text, showing reading comprehension. In each of the questions, the student was able to correctly identify how urbanization impacted each species. The sentences that the student wrote were copied directly from the article, rather than being summarized, but the student demonstrated that they could understand the article enough to be able to answer the question



1. How has urbanization impacted **hawksbeard**?
Urbanization has impacted hawksbeard because They observed a different in The proportion of each Seed Type that urban plants made compared with plants growing in nonurban enviroments.

2. How has urbanization impacted **rats**?
Urbanization has impacted rats because They observed the rats resisten to these poisons have DNA mutation in a gene that controls blood clothing.

3. How has urbanization impacted **juncos**?
Urbanization has impacted juncos because They noticed the birds are different between the mutation and city-dwelling junco population.

Figure 3: A student work sample showing the exit ticket after the jigsaw reading activity, that demonstrates the student’s reading comprehension.

Student answer 1: They observed a difference in the proportion of each seed type that urban plants made compared with plants growing in nonurban environments. Student answer 2: They observed the rats resistant to the poison have DNA mutation in a gene that controls blood clotting. Student answer 3: They noticed the birds are different between the mutation and city-dwelling junco population.

The students' CER scores also show how these texts are empowering them to be able to more effectively communicate scientific claims. Between the first and second CER, there was a 66% improvement in student scores, using the Claim, Evidence, Reasoning rubric (Figure 4). The first CER took place at the beginning of the gene editing unit, before students read any of the scaffolded scientific articles. The second CER took place at the beginning of the evolutionary unit, after students had been exposed to the gene editing articles as well as reading about how urbanization impacted various species at the start of the evolution unit. Between the second and third CERs (which took place toward the end of the evolution unit) there was a 33% improvement. While not as impressive, it still demonstrates sizable growth in student performance in this area. However, between these two CERs, students did not read any scientific articles– though they did look at other forms of scientific texts such as maps, graphs, etc. If we look at the difference from start to finish, the first and third CERs, there is a total of 44% improvement. This data is a bit skewed because of the number of students who did not turn in the third CER, which means their score ended up as a 0. However, it is clear to see the overall trend of improvement.

Bellwork Rubric

	1	2	3	4
State Your Claim ☐ Describe the system being studied. ☐ Give a scientific reason for the phenomena	Description is not specific and reasoning is not given.	Description is somewhat specific and scientific reasoning for phenomena is not given.	Description would allow someone who hadn't seen the system to understand, and gives a scientific reason for the phenomena that may not make sense for the given phenomena.	Description would allow someone who hadn't seen the system to understand, and gives a scientific reason for the phenomena that makes sense for the given phenomena.
Gather Evidence Qualitative Evidence ☐ Describe the scientific model Quantitative Evidence ☐ Describe the data	Unable to describe data/model.	Able to cite data/model but does not fully describe, such as re-writing what is on the screen or incomplete explanation.	Able to describe the data/model in your own words.	Able to describe in detail the model/data with a loose connection to claim.
Explain Your Reasoning Scientific Model Reasoning ☐ Explain how the scientific model supports/refutes the claim and explain why Data Reasoning ☐ Explain how the data supports/refutes their claim and explain why	Reasoning is just restating evidence.	Reasoning is loosely connected to claim.	Reasoning is connected to claim, but not fully explained.	Reasoning is fully explained with added detail, uses evidence to revise claim (if necessary).

Figure 4: CER Rubric used to grade bellwork and CER paragraphs

Furthermore, students themselves are stating that scientific texts are improving their English acquisition. In a survey given in class, 44% of students “agree” or “strongly agree” that reading scientific texts helps improve their writing in English. Only 11% disagree or strongly disagree, with the remaining 45% of students feeling “neutral.” While this 44% does not show a majority of students feel this way, it does provide support that many students perceive these learning activities as supporting their English language acquisition. Even though this is student perception and may not reflect actual learning, Athirathan (2025) demonstrated that a positive academic self-perception is associated with higher learning gains, suggesting that students having a positive view of these learning activities could actually be contributing to learning gains.

August et al. (2015) demonstrated that students can make gains in language acquisition simply from embedded vocabulary instruction. The results of my student outcomes, in part due to scaffolded scientific text use, demonstrate this. While we did some explicit vocabulary instruction at the beginning of each unit, the majority of the vocabulary instruction in this class is embedded. Furthermore, scientific texts not only promote scientific vocabulary, but also general academic vocabulary. Ardasheva et al. (2015) found that both types of vocabulary are important for MLE students. Through the use of scientific texts, students were not only exposed to science vocabulary that empowered them to write CER paragraphs, but also general academic vocabulary, syntax, and writing structure that further allowed them to improve their writing skills. For example, despite the fact that we did not explicitly discuss the vocabulary words: proportion, reproduce, survive, and compared to, these words showed up in students' CERs about seed dispersal, after reading an article that included all of these words. Additionally, students used complex sentence structures such as "This evidence proves… For example, in urban survive more feather seeds compared to non-uban." These sentence frames were not provided for students, nor were they explicitly taught, but there were similar sentence structures in the article, such as "They observed a difference in the proportion of each seed type that urban plants made compared with plants growing in nonurban environments" (Adapted from Cheptou, 2008).

Co-construction of Knowledge Improved Critical Thinking & Language Acquisition

CERs are important for not only measuring students' scientific knowledge, but they also allow the teacher to see students' critical thinking skills, because of the open-ended nature, in which students must make and defend a claim using evidence. Therefore, the improvement in the scores of CERs allows me to say that there is an improvement in students' critical thinking skills, in addition to their language acquisition. In between the first and second CERs, students participated in several structured student talk routines and collaborative learning activities that allowed them to work together to construct knowledge.

In these units, students practiced conversing in English in specific, structured ways that were built into the class and were content-specific. In the gene editing unit, students participated in a Socratic Seminar. In the evolution unit, students participated in four types of structured student talk activities– Driving Question Board, Jigsaw Reading, Think-Pair-Share, and Lines of Communication (Table 1). Students also participated in many more collaborative learning activities in the evolution unit such as stations and task cards. During these learning activities, students were expected to practice communicating in English at least some of the time, but it was not as structured as during the structured student talk activities. The structured student talk in the energy and matter unit came after data collection ended, and thus will not be discussed here. To compare, in the genetics unit, which was the last unit prior to starting data collection, students only participated in six structured student talk and collaborative learning activities. Therefore, the gene editing mini-unit and evolution unit show an increase in the number and types of structured student talk activities that students participated in (Table 2).

Structured Student Talk Routine	**Description**	**Rationale**
Driving Question Board	A collaborative activity in which students work together to generate questions (the first step of the scientific process) that are then used to guide their thinking throughout the unit (OpenSciEd, 2025).	• Generates questions for investigation • Connects to students' prior knowledge on the topic (OpenSciEd, 2025).
Jigsaw Reading	A reading activity in which different members of a "home group" read a different text with an "expert group" and then take the information back to teach their home group (Aronson & Social Psychology Network, 2000).	• Shares the reading load • Allows students to practice collaboration and working together to solve a problem (Aronson & Social Psychology Network, 2000).
Think-Pair-Share	A student talk activity in which students	• Quick way to assess student thinking

	have some time to think independently about a question, talk to one another about their ideas, and then share their ideas with the class (EL Achieve, 2024).	• Breaks up periods of direct instruction • Facilitates connection to prior knowledge (EL Achieve, 2024).
Lines of Communication	A student talk activity in which students line up across from a partner, share their thinking, and then move to a new partner to answer a new question, or add to the previous question (EL Achieve, 2024).	• Allows students to refine thinking before being asked to write or produce work • Practice active listening (EL Achieve, 2024).
Socratic Seminar	A class-wide discussion in which students take a stance on a controversial topic and/or ask questions about the topic, and support their ideas with evidence (Davenport, 2016).	• Allows for deeper learning because students have to justify their position on a controversial topic • Exposes students to different perspectives (Davenport, 2016).

Table 1: The name of the structured student talk routine utilized in class, a description of what it is, and the rationale behind the routine.

Unit	# of Structured Student Talk/Collaborative Learning Activities
Genetics (control unit)	6
Gene editing mini-unit	2
Evolution	11

Table 2: Data showing the number of structured student talk & collaborative learning opportunities students had in the control unit compared to the units in this study.

On February 18, students participated in a Driving Question Board, in which students work collaboratively in groups to generate questions we need to investigate to help us figure out a scientific phenomena (Table 1). During this activity, I did not specify that students needed to speak in any particular language, but through the use of a mix of drawing and writing, students were spontaneously discussing ideas about pollution and contamination in cities in English. In my teaching journal I wrote that “having them draw before writing was helpful, and it allowed students who normally don’t participate because of their lack of confidence using English to participate also.” Because students have various levels of English proficiency, using a mix of visual/speaking in groups allows more students to be able to fully participate.

Another teaching reflection shows how structured student talk was beneficial. On February 25, I wrote, “for the Think-Pair-Share, they did pretty well. I was surprised that they gave each other the full 30 seconds to think. They had good ideas about fragmentation. Students were also able to identify the word fragmentation from their vocabulary list from the start of the unit so that was exciting.” It was surprising to me that students gave each other the full 30 seconds to think because they typically process more by speaking with one another. But, by utilizing the full 30 seconds of think time, students were prepared to be able to share with one another in English. Additionally, they were able to use this time to make connections to prior knowledge, including a complex vocabulary word from earlier in the unit.

The activity Lines of Communication was also a success. In this activity, I was able to partner with some students due to us having an odd number. This allowed me to really assess student understanding as well as their English language production. On this day, February 27, I wrote that “based on our discussion, it seemed like the kids I talked to were understanding when the hawksbeard would use different seed dispersal strategies.” I also had noted that students were improving at doing this structured student talk routine, likely due to the repetition, so they are already familiar with the expectations of the routine. Similar to the Think-Pair-Share, I always provided sentence frames for the Lines of Communication activity. For example, “The data shows _____,” “One piece of evidence that supports this is ____.” In addition to allowing all students to access the conversation, it is also a way to model sentence structure for students, which they can then use in their own writing and speaking.

Finally, on the student survey, students are sharing that they believe structured student talk is improving their language acquisition. 50% of the students stated that they “agree” or “strongly agree” that talking with their classmates in English helps them improve their writing in English. In the survey, students were given an opportunity to share other thoughts with the open-ended question, “Is there anything else you want me to know?” One student responded by stating, “I believe that having debates in class helps a lot in our learning of English.” While not specified, this was likely in reference to our Socratic Seminar, that we did while discussing gene editing.

Another encouraging trend that showed improvement in English acquisition was in student English Language Proficiency Assessment (ELPA) scores. This is a standardized test that all Multilingual Learners of English are required to take by the state. Students typically take the test once upon entering the school system, and take it yearly until they score “proficient” (a 3 or above) in all 4 categories– reading, writing, speaking, and listening (Oregon Department of Education, n.d.). ELPA scores from the 2024-2025 school year to the 2025-2026 school year, showed that 26% of students in my class increased in their reading score, 47% increased in their writing scores, 63% increased in their listening scores, and 57% increased in their speaking scores. One student even showed an improvement of 3 points in the speaking category, moving from a 1 to a 4, indicating the reaching of proficiency in that category. 79% of the students showed growth in at least one of the four categories! This is exciting because while the ELPA is not a full picture of what students can do, as goes for any standardized test, it is a measurement that the school system and state looks at to help determine student placement. This also demonstrates that students having an opportunity to practice with these four domains has been beneficial for them. Instead of just having the practice be within their English Language Development classes, they have had the opportunity to practice these skills within the science class as well.

In addition to this quantitative data that uses two measurements of English language proficiency, there is also some qualitative data that supports the idea that students have made gains in their English language acquisition. In particular, in a student survey, most students, 83%, marked “true” when asked if they believe they are improving at writing in English. In informal conversations with students, they have also expressed this idea to me. Through my teaching journals and class observations, I have also noticed that during student work time on CERs, students have become less likely to participate in distracting behaviors such as wandering around the classroom, talking to peers, or putting their heads down to avoid doing the writing activity. This was very common at the start of the school year, but has become less common as the year has gone on. This indicates to me that students are feeling more confident and less overwhelmed in their abilities to write a CER paragraph.

Many of my journal entries discuss how much improvement I am seeing in the students, both in their written English, but also in their spoken English with each other and with me. On 2/13/26, I wrote “students are definitely improving with this [writing CERs].” On the same day, I also wrote that students were able to utilize a new vocabulary word, urbanization, in context, with some prompting. Later journal prompts from April 2026 have also shown the improvement in students. On April 24, 2026, I wrote that students “were able to read the cards [for a task card activity] without using translate, despite them being much longer than usual.” An example of this is shown in Figure 2, which shows an example of a task card that students had, that included a lot of text with no visual aid. Although in the past, students have utilized Google Translate to translate these large blocks of text, I noticed that most students were not doing that during this class period. Instead, they were working together to find the words they knew and constructing the meaning of the task card together. This aligns with the idea that learning, and the constructing of meaning, occurs in collaboration with each other (Vygotsky, 1978). This may also indicate that the increased number of collaborative tasks we've done in class has allowed students to learn important skills about working together to solve a problem, instead of relying on outside resources.

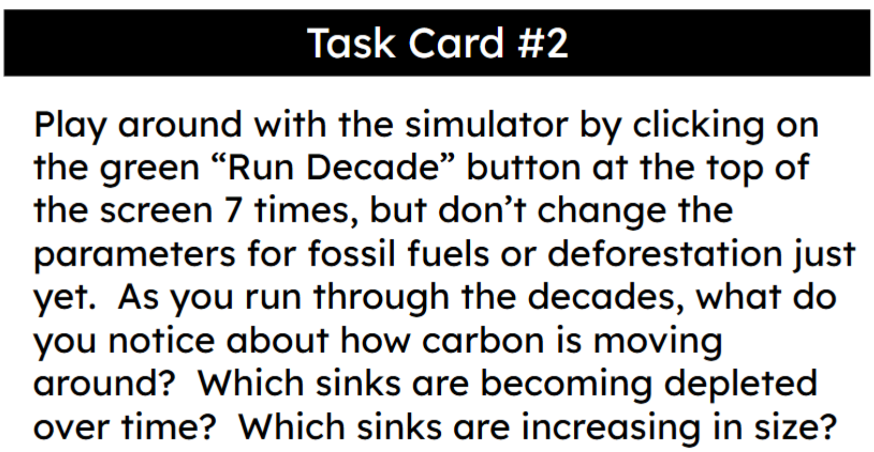


Figure 2: Example of a task card from the matter, energy, and climate change unit that most students were able to read without using translate.

Overall, the improvement in both students' critical thinking skills and English language acquisition shows that the structured student talk routines and collaborative learning activities were beneficial for students' improvement.

Increased Positive Dispositions Regarding the Use of the English Language

The final theme that I found within the data is that students are showing an increased positivity around the use of English. While students still primarily communicate in Spanish when talking with each other, I have seen an increase in students talking to one another in English spontaneously. Because I only have four students in class who do not speak Spanish, I try to group students heterogeneously to promote practicing English, however, based on the numbers, there does end up being groups of students who are all Spanish speakers. Nonetheless, students can occasionally be heard discussing with one another in English, spontaneously, without teacher direction. In one class period, on April 8, I tallied the amount of times I heard students speak a phrase or more in English without prompting, and I found that this happened 10 times. Typically, it was more social in nature than academic, but this was still an encouraging trend.

From journal prompts, I also found that students enjoy hearing and repeating phrases in English. Some of their favorites have been “easy peasy, lemon squeezy;” and “working hard or hardly working?” In my journal entries, I noted that students are starting to enjoy working with plays on words, which has been fun to observe, and also demonstrates a deeper understanding of the language. In listening to students, I also am starting to commonly hear more “Spanglish” where students will use a mix of Spanish and English to communicate their ideas.

In casual conversations with students, I have asked them how they feel about learning English, and how they think it is going. Several students have expressed that they enjoy learning English and would like to have more practice. One student has asked me if there is anywhere else he can take English classes in addition to at school. Currently, I am working with a couple of students who want more practice with English to offer a weekly lunch session that would be an English-Spanish conversation circle, to help students who are learning English and for students and teachers who are learning Spanish.

In this chapter, I demonstrated data from my newcomer science class, which showed students' improvement in their English language acquisition, specifically through the use of scientific texts and structured student talk. In the next and final chapter, I will be discussing the connections between my action research project and existing literature. I will also discuss the limitations of my study.

Chapter Five: Discussion & Limitations

Discussion

Within the existing literature regarding language acquisition, the idea of collaboration with peers is particularly important for language development. The social constructivist theory states that knowledge is constructed, not passively obtained; learning is an active, not passive, process; knowledge (and language acquisition) is not obtained in isolation– it is socially constructed within groups to make meaning (NU, 2023). In this study, I have created learning experiences in which students are constructing knowledge actively through the use of reading scientific texts, speaking and collaborating with one another, and then writing to demonstrate their learning.

Additionally, the exploration of how scaffolded scientific texts impact students' ability to communicate demonstrates the benefit of embedded vocabulary instruction, in line with the research by August et al. (2015). My study also showed a benefit to using embedded vocabulary instruction, which is helpful, because content area teachers often do not have time for extended vocabulary instruction.

An important aspect of my study is that it allowed students to construct knowledge in conjunction with one another, rather than simply asking them to memorize and regurgitate facts that I as the teacher deem important. In this way, I am empowering these students, in a way that seeks justice and equity for students who have typically been oppressed by the current systems in place (Freire, 2018). For example, students are not just assessed on recall of facts, but on their critical thinking skills. Each of the CERs allowed students to explain their reasoning. Many times, I was able to see science content from a new perspective because of this type of assessment. Furthermore, by ensuring that all of my students had access to the content through scaffolding also empowers students who may not always have access to grade-level content.

Limitations

A theoretical limitation of this study is that I do not believe that all aspects of the social constructivist theory were followed. For example, the social constructivist theory posits that knowledge is constructed, not passively obtained (NU, 2023). In an ideal socially constructivist classroom, students would get to work on more of what they are interested in and would likely more resemble a project based learning classroom.

Another tenet of social constructivism is that knowledge is not obtained in isolation (NU, 2023). Again, this was largely followed in my class with group work and collaboration being key. However, students were required to complete their CER assessments independently so that I could assess students individually. Doing CERs as a collaborative activity before students were assessed on them may have promoted a deeper understanding of how to use English to effectively make an argument and communicate thinking. I believe that this aspect of learning could have been enhanced through collaborative practice, and students may have had more success with their CERs.

The methodological limitations of this study include the issue of timing. There were a few interruptions to the study, as discussed in Chapter 3. For example, in the middle of the evolution unit, students had two days of state testing, no school for parent-teacher conferences, and then spring break a couple weeks later. It is possible that these interruptions influenced the outcomes of the study.

This study was also relatively short, about two months long. Had the study continued for a full year, the results would likely have been more accurate. Additionally, more quantitative data could have supported the study, such as tracking the amount of time students actually spent reading and/or speaking with one another. For example, I did not have a tool for tracking the actual amount of time students spent on structured student talk and collaborative activities. This type of tool would have been beneficial in comparing these units to the control unit. Additionally, I could have had a tool for tracking the amount of time students spent actually using English in collaborative learning tasks, compared to their home languages.

Lastly, a practical limitation of this study is that it took place in a sheltered class, where all students were newcomers. This may not be possible in other contexts, depending on the number of students. Therefore, in a class with students of more variable English language proficiency levels, the results may also be different. Lastly, this study took place in a classroom setting where most students' home language is Spanish. All of my students except for 4 speak Spanish. Spanish and English have more similarities than other languages. For example, my students who speak Pashto tend to have a more difficult time because the languages are much less similar. Particularly in science, there are many cognates between English and Spanish. If the study took place in a classroom setting where more students had various home languages that are more different than English, or are more mixed, the results could also be influenced.

Conclusion

In this action research project, I studied the implications of using scientific texts and structured student talk as a mode to improve English language acquisition for newcomer students in a biology class. For data collection, I used a mini-unit on gene editing, a unit on evolution, and the beginning of a unit on energy and matter. Students were exposed to multiple scientific texts throughout the unit, including readings, graphs, and maps. While these readings were scaffolded, they were more rigorous than previous readings throughout the year. Additionally, students had opportunities to engage in several types of structured student talk including a Socratic Seminar, Think-Pair-Share, Lines of Communication, and Driving Question Board. In addition to these structured activities, students also participated in many collaborative activities that were less structured such as the task cards, stations activities, and reading activities. Through the use of these pedagogical strategies, students showed improvement in their English language acquisition as measured by their Claim, Evidence, Reasoning paragraphs and ELPA scores. Additionally, students showed increased positive dispositions around the use of English. From these results, it is demonstrated that utilizing a social constructivist approach to integrating science and English instruction, through the use of specific pedagogical strategies, is beneficial in student English language acquisition.

References

Ardasheva, Y., & Tretter, T. R. (2015). Developing science-specific, technical vocabulary of high school newcomer English learners. *International Journal of Bilingual Education and Bilingualism*, *20*(3), 252–271. https://doi.org/10.1080/13670050.2015.1042356

Aronson, E. & Social Psychology Network. (2000). *The jigsaw classroom*. Jigsaw Classroom. https://www.jigsaw.org/

Athirathan, S. (2025). Relationship between academic self-perception and academic performance. *International Journal of Research and Innovation in Social Science*, *4*, 5877–5887. https://rsisinternational.org/journals/ijriss/articles/relationship-between-academic-self-perception-and-academic-performance/

August, D., Artzi, L., & Barr, C. (2015). Helping ELLs Meet Standards in English Language Arts and Science: An intervention focused on academic vocabulary. *Reading & Writing Quarterly*, *32*(4), 373–396. https://doi.org/10.1080/10573569.2015.1039738

Callahan, R. M., Sampson, V., & Rivale, S. (2019). Activating bilingual English language learners' strengths in Science: The Pedagogy of Argument Driven Inquiry (ADI). In *Teaching the content areas to English language learners in secondary schools* (pp. 183–197). https://doi.org/10.1007/978-3-030-02245-7_12

Cheptou, P. O., Carrue, O., Rouifed, S., & Cantarel, A. (2008). Rapid evolution of seed dispersal in an urban environment in the weed Crepis sancta. Proceedings of the National Academy of Sciences, 105(10), 3796-3799.

Council of Chief State School Officers. (2013). INTASC model core teaching standards and learning progressions for teachers 1.0. In *Council of Chief State School Officers*. https://753a0706.flowpaper.com/INTASCLearningProgressionsforTeachers/#page=1

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* (3rd ed.). Sage Publications.

Davenport, M. (2016, September 22). *Socratic Seminars: Building a Culture of Student-Led Discussion*. Edutopia. https://www.edutopia.org/blog/socratic-seminars-culture-student-led-discussion-mary-davenport

Delpit, L. (2012). *Multiplication is for white people: raising expectations for other people's children*. The New Press.

EL Achieve. (2024). *Structured student talk* [Slide show; Google Slides]. https://docs.google.com/presentation/d/129yJ09mDXT-424TxeXIZAr37XksPQq8DSoYo1_9NyVs/edit?slide=id.g2657ac11154_5_44#slide=id.g2657ac11154_5_44

Freire, P. (2018). *Pedagogy of the oppressed: 50th anniversary edition.* Bloomsbury Publishing.

Helmick, L. (2022). White saviorism: An insider perspective. Art Education, 75(3), 9–13. https://doi.org/10.1080/00043125.2022.2027722

Idaresit Akpan, V., Angela Igwe, U., Ijeoma Mpamah, I. B., & Onyinyechi Okoro, C. (2020). Social constructivism: Implications on teaching and learning. In *British Journal of Education: Vol. Vol.8* (Issue Issue 8, pp. 49–56). ECRTD- UK. https://www.eajournals.org/wp-content/uploads/Social-Constructivism.pdf

Llosa, L., Lee, O., Jiang, F., Haas, A., O'Connor, C., Van Booven, C. D., & Kieffer, M. J. (2016). Impact of a Large-Scale Science Intervention focused on English Language learners.

American Educational Research Journal, *53*(2), 395–424. https://doi.org/10.3102/0002831216637348

Lyon, E. G., Stoddart, T., Bunch, G. C., Tolbert, S., Salinas, I., & Solis, J. (2018). Improving the preparation of novice secondary science teachers for English learners: A proof of concept study. *Science Education*, *102*(6), 1288–1318. https://doi.org/10.1002/sce.21473

National University & NU Editorial Contributors. (2025, October 21). Constructivism in education: What is constructivism? *National University*. https://www.nu.edu/blog/what-is-constructivism-in-education/

OpenSciEd. (2025, June 18). *Driving Question Board - OpenSciEd*. https://openscied.org/professional-learning/driving-question-board/

Oregon Department of Education: English Language Proficiency Assessment: Student Assessment: State of Oregon. (n.d.). English Language Proficiency Assessment : Oregon Department of Education. https://www.oregon.gov/ode/educator-resources/assessment/pages/english-language-proficiency.aspx

Oregon Department of Education. (2014). English Language Proficiency Standards with Correspondences to K–12 English Language Arts (ELA), Mathematics, and Science Practices, K–12 ELA Standards, and 6-12 Literacy Standards. In *English Language Proficiency (ELP) Standards*. https://www.oregon.gov/ode/students-and-family/equity/EngLearners/Documents/ELPStandardsFinal.pdf

Pando, M., & Aguirre-Muñoz, Z. (2019). Engaging English Language learners in Model-Based Science instruction. In *Teaching the content areas to English language learners in secondary schools* (pp. 215–230). https://doi.org/10.1007/978-3-030-02245-7_14

Qi, Y., & Fang, Z. (2023). Teaching writing to English language learners: two science teachers' perspectives and practices. *Journal of World Languages*, *9*(3), 400–426. https://doi.org/10.1515/jwl-2023-0016

Reid, J. W., Smith-Walters, C., Mangione, K. A., Dorris, A., & Tharp, T. (2019). Supporting English Language Learners through Inquiry-Based Science: Three Strategies for your classroom. In *Teaching the content areas to English language learners in secondary schools* (pp. 199–214). https://doi.org/10.1007/978-3-030-02245-7_13

Relyea, J. E., Kim, J. S., Rich, P., & Fitzgerald, J. (2024). Effects of tier 1 content literacy intervention on early-grade English learners' reading and writing: Exploring the mediating roles of domain-specific vocabulary and oral language proficiency. *Journal of Educational Psychology*, *116*(7), 1172–1195. https://doi.org/10.1037/edu0000882

Rodriguez, A. J., & Zozakiewicz, C. (2010). Facilitating the integration of multiple literacies through science education and learning technologies. In *Science Education as a Pathway to Teaching Language Literacy*, 23–45. SensePublishers. https://doi.org/10.1163/9789460911316_005

Ryoo, K., Bedell, K., & Swearingen, A. (2018). Promoting linguistically diverse students' Short-Term and Long-Term understanding of chemical phenomena using visualizations. *Journal of Science Education and Technology*, *27*, 508–522. https://link-springer-com.wou.idm.oclc.org/content/pdf/10.1007/s10956-018-9739-z

Sagor, R. (2000). *Guiding school improvement with action research*. ASCD.

Valenzuela, A. (2005). Subtractive schooling, caring relations, and social capital in the schooling of US-Mexican youth. In *Beyond silenced voices: Class, race, and gender in United States schools,* 83-94.

Van Le, H., & Nguyen, L. Q. (2024). Promoting L2 learners' critical thinking skills: the role of social constructivism in reading class. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1241973

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.

Walqui, A., & Oliveira, L. C. (2019). Shifting from the teaching of oral skills to the development of oracy. In *The Handbook of TESOL in K-12* (pp. 258–281). Wiley Blackwell.