Teaching Academic Writing for Engineering Students:

An Embodied, Rhetorical Approach

by

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ABSTRACT

This dissertation details an action research study designed to teach engineering students enrolled in a First Year Composition course understand and learn to use effective conventions of written communication. Over the course of one semester, students participated in an intervention that included embodied and constructive pedagogical practices within a rhetorical framework. The theoretical perspectives include Martha Kolln's rhetorical grammar framework, embodied cognition, and Chi's ICAP hypothesis. The study was conducted using an explanatory multi-methodological approach. The majority of students demonstrated that in their post-intervention writing samples, their ability to use effective conventions had improved. Over the course of the study, students' attitudes about writing improved as did their self-efficacy about their writing ability.

DEDICATION

To

Kevin, my incredible husband and greatest friend

Ben and Jena, Connor, Levi, Ian, and Maren, my beloved children

Jane and Larry Okasaki, my loving parents

Delbert and MaryLou Ellsworth, my inspirational parents-in-law

All my siblings and siblings-in-law

You have given me of your strength and support so that I could achieve this dream.

I love you all!

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LIST OF ACRONYMS

ABET	Accreditation Board for Engineering and Technology
ATEG	Assembly for the Teaching of English Grammar
CCCC	Conference on College Composition and Communication
CWPA	Council of Writing Program Administrators
DAE	Dominant American English
EWE	Edited Written English
EC2000	Engineering Criteria 2000
FYC	First-Year Composition
ICAP	Interactive, Constructive, Active, Passive
NCTE	National Council of Teachers of English
SE	Standard English
STEM	Science Technology Engineering Mathematics
SRTOL	Students' Right to Their Own Language
WPA	Writing Program Administrators

CHAPTER 1

Leadership Context and Purpose of the Study

This dissertation will explore the impact and possible implications of an intervention designed to help undergraduate engineering majors understand and correctly use Edited Written English (EWE) grammar and syntactical constructs effectively in their First-Year Composition (FYC) course. The intervention was developed as a means to address and resolve concerns that arise from complex larger and local contexts that impact writing instruction for engineering students. Embedded within those contexts are four considerations: a) issues related to grammar instruction in FYC courses, b) engineering program accreditation criteria regarding student writing competencies, c) student preparation for, and attitudes toward, academic writing, and d) the adaptability of the intervention for educators and students in different contexts. My pedagogical responsibility and privilege to teach courses that prepare students for personal, civic, academic, and professional success demand that I consider the above-mentioned issues individually and collectively. Taken together, these considerations have created for me a compelling problem of practice that I have enthusiastically engaged with over the course of my doctoral education. My problem of practice can be simply understood as follows: "How can I most effectively teach conventions of academic writing to engineering students?"

To provide the requisite background to more fully understand the genesis of my problem of practice, Chapter 1 will explore the larger and local contexts that contribute to the environment in which I teach FYC courses. This chapter will also include a

description of the first two rounds of action research conducted in preparation for the third and final round of action research, which was carried out in the Fall of 2019. The chapter will conclude with the research question that has emerged from the consideration of the combined concerns and problem of practice that has guided the direction of my dissertation research.

Larger Context

Two national entities, the National Council of Teachers of English (NCTE) and the Accreditation Board for Engineering and Technology (ABET) together influence the larger context in which FYC faculty work to educate engineering students.

NCTE

As the largest organization dedicated to the professional development of K-16 English/language arts teachers, the NCTE issues policy statements that provide guidance for classroom practice. The NCTE supports multiple groups, including regional affiliates of the NCTE and member groups based on teaching context. Of these groups, the Conference on College Composition and Communication (CCCC), has great influence on teaching practices in FYC courses, including whether and how grammar should be taught.

The predominant attitude regarding grammar instruction—that grammar should only be taught when necessary and always within the context of writing instruction—has been informed by decades of acrimonious debate among writing theorists, rhetors, compositionists, and teachers of English. The NCTE's most current position statement regarding grammar instruction states that teachers should "frame instruction in grammar

and usage conventions with ongoing discussion of the inherently dynamic and evolving nature of language, rather than asserting, implicitly or explicitly, that grammar and usage rules are timeless, universal, or absolute" (National Council of Teachers of English, 2018). The literature review (Chapter 2) will provide an examination of that debate that has culminated in the 2018 position statement. In the context of this debate, my position is to make grammar instruction an integral part of my teaching practice.

ABET

Since the late 1990s, ABET has required that accredited engineering programs document student outcomes related to their ability to communicate effectively (Lattuca et al., 2006). The most recent iteration of ABET's accreditation criteria states that programs must document students' "ability to communicate effectively with a range of audiences" (ABET, Criterion 3.3, 2019-2020). Although Criterion 3.3's verbiage has been adjusted periodically since its initial wording in 1996, "communication" has historically meant written and oral communication, as evidenced by multiple articles found in ABET-affiliated journals and other ABET publications (ABET, 1995; ABET 1997; Boyd & Hassett, 2000; Plumb & Scott, 2002; Shuman et al., 2005; Yalvac et al., 2007; Paretti, 2008; Leydens & Schneider, 2009; Conrad, 2017; Howard et al., 2017; Passow & Passow, 2017). Regarding effective written communication, these articles cover a range of topics including industry's need for engineers to write effectively, efforts to improve engineering students' writing outcomes, and strategies for effective discipline-specific writing instruction in engineering courses. The impetus for these topics emerged from ABET's work to strengthen writing instruction for engineering undergraduate students.

As outlined in Lattuca et al.'s 2006 report, beginning in the 1980s, numerous scientific and technological institutions (e.g. the National Science Board, the American Society for Engineering Education, and the National Science Foundation) called for improved alignment between undergraduate engineering curricula and industry and societal needs. Given the United States' shift from defense to commercial projects, engineering employers consistently reported that although they possessed discipline-specific technical skills, new graduates lacked critical professional skills. The consistent findings regarding the misalignment between engineering undergraduate programs and industry needs prompted the ABET, in collaboration with industry leaders and post-secondary institutions, to radically change its accreditation criteria.

In 1997, after a two-year "comment period," ABET adopted new accreditation standards called "Engineering Criteria 2000" (EC2000). In a move from reporting primarily on curricular offerings, the new standards required undergraduate engineering program directors to demonstrate that students achieved specific learning outcomes in technical as well as professional competencies. The adoption of EC 2000 signaled engineering educators' and industry's recognition of the inherent importance of "Professional Skills" such as effective oral and written communication as central to an appropriate engineering education in an increasingly globalized world (Lattuca et al., 2006).

ABET continued to evaluate the impact of EC2000 on engineering programs and conducted studies to determine whether engineering employers reported that new engineers' "Professional Skills" (EC2000, Criterion 3) had improved after the adoption of

the new standards. The 2004 article titled *Engineering Change: A Study of the Impact of EC2000,* by Frederick Volkwein and his associates, all of whom were professors and researchers affiliated with ABET and the Center for the Study of Higher Education at Pennsylvania State University, detailed the methods by which they would collect and analyze data from engineering programs to determine the effects of EC2000 on engineering education and industry. Two years after the publication of *Engineering Change,* ABET published an "Executive Summary" regarding Volkwein's et al. findings (Lattuca et al., 2006). Survey data from the "Executive Summary" showed that 75% of employers agreed that engineers who graduated after 2004 demonstrated that they had at least adequate communication skills (Lattuca, et al., 2006, p. 11). Questions remained, however, about which professional competencies required for ABET accreditation should be considered most important in developing engineering curricula.

A systematic review carried out by Dartmouth professor Honor Passow and mechanical engineer Christian Passow (2017), examined 52 studies (25 qualitative studies and 27 quantitative studies) and over 36,000 engineering job postings to determine the relative importance of the professional competencies. Regarding "effective communication," the study found that engineers spent between 15% and 30% of their work time writing. Additionally, the study revealed that all 52 studies determined that effective communication was a vital competency in the engineering field. The 2017 review is a recent example of studies and articles attesting to the importance of effective communication in professional engineering practice, but many articles have been written about this topic as well as engineering writing instruction for professional preparation for

decades (Eddy, 1897; Roland, 1907; Waddell, 1918; Kettering, 1937; Wall, 1943; Michaelson, 1949).

Local Context

The local context for this study is limited to Arizona State University and the Polytechnic campus, where I teach English 101—the university's FYC course. My students and my background and teaching practices play a central role in this context.

Arizona State University

Arizona State University is home to numerous Science, Technology, Engineering, and Mathematics (STEM) programs spread across four campuses. Students in these programs study applied mathematics, computer science, natural and applied sciences and all fields of engineering. The Ira A. Fulton Schools of Engineering, the largest of the STEM programs, enrolls over 16,000 undergraduates. Some of those students are majors in the Polytechnic School, which is located at the university's Polytechnic campus.

Polytechnic Campus

Approximately 5,200 students, many of whom are undergraduate majors in the Polytechnic School, study at the Polytechnic campus. The campus, located on the site of the former Williams Air Force Base, houses multiple laboratory spaces that support the applied nature of many programs offered at the campus. Students can also major in education and business. The College of Interdisciplinary Sciences and Arts (CISA), the campus' liberal arts college, offers majors in English, history, technical writing, and applied biological sciences. All composition courses are offered through CISA.

Student Demographics[1]

Most of the students at the Polytechnic campus are Arizona residents (70%). Of the remaining students, 19% are from other states, and 12% are international students. The Polytechnic School's programs enroll the majority of students (60%). CISA students represent 25% of the student population, and the business school enrolls 10% of the campus' students. The smallest number of students are enrolled in education college (3.7%) and the Sustainability program (0.2%). There are nearly twice as many male students (66%) as female students (34%) on campus. Most students are White (male = 48%, female = 47%, overall = 48%). Hispanic/Latinx students constitute the largest minority demographic (male = 21%, female = 25%, overall = 23%).

Within the Polytechnic School, student demographics closely resemble those of the Polytechnic campus. There are nearly twice as many men (66%) as women (34%) enrolled in the majors offered through the engineering school, however, not all majors in the school are traditional engineering majors (i.e. aviation programs and graphic information technology). Most students are Arizona residents (64%), and 22% come from other US states. International students make up 15% of the student body. Racial and ethnic demographics within the Polytechnic School are similar to that of the campus. Most students are White (male = 47%, female, 40%, overall = 46%), and Hispanic/Latinx students make up the largest minority group (male = 20%, female = 22%, overall= 21%). The demographic data for the Polytechnic School shares some trends with engineering

[1] Student demographic information reflects Fall 2019 registration and includes both undergraduate and graduate students. This information was provided by the office of the Vice Provost for ASU's Polytechnic campus.

programs nationwide as shown in the most recent data from the American Association for Engineering Education's publication, *Engineering by the Numbers* (Roy, 2019). For example, nationwide, many more men enroll in engineering majors as women, and white students constitute the majority of students.

Students in my classes come from diverse backgrounds. Every semester, including the semester that this study was conducted, my students represent various cultural, racial, and economic backgrounds. In class discussions, many of my U.S. students self-identify as Latinx, African American, Asian American, or Native American. For many of my students, English is not their primary language. Some of my Latinx students divulge in class that they are heritage language learners who understand Spanish but do not speak it fluently. I teach many first-generation college students who also self-identify as belonging to racial/ethnic minority groups. Additionally, many of my White students tell me that they are first-generation college students. Often my classes also include international students. I have taught students from Saudi Arabia, Jordan, India, Uganda, Botswana, China, Korea, the Philippines, Mexico, and Brazil. These students all possess advanced English skills that allow them to fully participate in class.

As an instructor in a culturally diverse classroom, I strive to incorporate practices consistent with culturally sustaining pedagogy to support all my students. Because I also teach grammar and mechanics in my classes, it is even more imperative that issues regarding educational equity are addressed openly in class discussions. Practices inspired

by the theory of culturally sustaining pedagogy inform how I approach teaching in a racially and culturally diverse context[2].

Progression of my Interest in Writing Instruction for Engineering Students

I began teaching FYC courses at the Polytechnic campus in the Fall of 2014. Most of my students were first-year students majoring in one of the many engineering programs offered on campus. Soon after arriving at the Polytechnic campus, I realized that I needed to rethink my approach to writing instruction. Two decades had passed since I had last taught FYC courses at another university. During my previous teaching experience, I worked with many students for whom writing was a challenge, so when I encountered students at the Polytechnic campus who struggled to write effectively, I assumed that my tried and true teaching methods would work. I was wrong.

I quickly realized that issues and attitudes that were foreign to me contributed the engineering students' writing struggles. For example, I learned through numerous class discussions that many of my engineering students conflated undergraduate education with job training, and my students frequently expressed the opinion that engineers do not need to write. While I was aware that attitudes about higher education had been shifting increasingly in the direction of professional preparation, I was new to teaching in an environment where this attitude was so pervasive. Additionally, in the intervening years since I had taught at a university, STEM education had become an increasingly important focus in the United States, and I had little experience teaching engineering majors.

[2] A short discussion of culturally sustainable pedagogy and its relevancy to my classes is located in the Appendix.

My Engineering Students Attitudes Toward Academic Writing

My engineering students often express surprise and frustration when they discover that they must complete general education courses, including FYC courses, to earn a bachelor's degree. Each semester, many of my engineering students tell me that they dislike writing classes, and they argue that because they wrote papers in high school, they should not be required to take composition courses. At the same time, many of the students who claim that high school writing and English classes should be considered sufficient writing instruction, report that they are "terrible writers." Each semester, multiple students tell me that they dislike writing because there are "no right answers" as there are in other subjects such as math. These students also express that they do not believe FYC courses will add value to their academic or personal lives, much less help them in their future vocations.

In light of attitudes and practices that marginalize grammar instruction, it is unsurprising that many of my students demonstrate that they have limited experience engaging with the grammar and syntax of written language. For example, many of my students cannot identify or define basic parts of speech. When I introduce the concept of deliberately choosing among numerous grammatical and syntactic structures to effectively communicate specific ideas, students tell me that they do not know what I mean and that they have never heard about using grammar in this way. My students' limited exposure to language awareness issues, including grammar and syntax, combined with their proclaimed dislike of academic writing, prompted me to investigate how I

could teach academic writing conventions, including grammar and syntax, to help my engineering students produce effective written communication.

Initial Pedagogical Approaches

The first few semesters I taught at the Polytechnic campus, I approached the challenge of teaching grammar in ways consistent with NCTE guidelines. I taught grammar when I considered it necessary to address specific errors made by multiple students. Grammar lessons were always situated within the context of writing instruction and typically consisted of verbal instruction accompanied by examples of mechanically sound sentences. However, my instructional practices failed to improve students' use of grammar, therefore, after a few semesters, I implemented a new strategy to help students use EWE conventions.

Like my initial teaching method, my second instructional approach consisted of lessons covering a grammar usage problem common among my students. However, rather than merely providing students with examples of correct sentences, I gave students exercises in which they analyzed sentences and corrected mistakes. As with my first attempts to teach grammar, these efforts did not result in students' improved use of EWE conventions. Finally, in a subsequent semester, I required students to use an FYC textbook that included an integrated computer program designed to teach conventions. Although students completed the assigned exercises, many still continued to struggle to use appropriate EWE conventions in their essays.

Because none of the measures I took to teach EWE conventions was successful, I decided to create a program for my students based on information they shared with me

regarding their preferred learning environments and learning strategies. For example, over the course of numerous semesters, many engineering students described themselves in class discussions as "hands-on" and "visual" learners. When engineering students brought their engineering projects to class, I would ask them to share with me and their classmates, information about what they had built. I learned through listening to what they said and how they expressed themselves that they enjoyed the design process and building things. Often the engineering students enrolled in my classes would talk together about their engineering projects.

After talking with and observing my engineering students and learning about their interests and abilities, I determined that a successful intervention designed to help them incorporate effective EWE convention in their writing required the following components: a) an overarching rhetorical perspective that would help students learn that grammatical choices impact meaning, and b) tangible and visual representations of linguistic concepts. Later, as will be discussed in this chapter's section on early rounds of action research, I discovered that the intervention needed an additional component that would address my students' preference for kinesthetic learning activities.

Development of the Intervention

My choice to create a rhetorically-based grammar intervention repositioned the place of grammar instruction from the periphery of my teaching practice to a more central location. This move, which is at odds with the predominant practices and theories regarding grammar and writing instruction, allows me to present grammatical concepts within the context of meaning, not merely as editorial tools or rules governing "correct"

writing. I believe that this pedagogical stance makes explicit grammar instruction a viable and valuable contribution to writing instruction because once students learn how grammar and syntax impact meaning, they are prepared to think critically about which grammatical and syntactic structures might most effectively communicate their thoughts in writing to meet the needs of specific audiences. To implement the rhetorical element of my intervention, I chose Martha Kolln's (1981, 1984, 1990, 1995; Kolln & Gray, 2017) rhetorical grammar as the foundation upon which to build the rest of the intervention.

Understanding that grammar and syntax impact meaning does not necessarily help students understand the function of specific grammatical elements or how to create syntactic structures. To create those aspects of the intervention, I added two components that would also address my students' preferences for kinesthetic and visual learning activities. First, to help students internalize the function of grammatical and syntactic concepts, I developed physical activities for students to perform that were inspired by aspects of Lakoff's and Johnson's (1980) embodied cognition. After students have internalized the grammatical concepts through engaging in the embodied activities, they utilize and deepen their linguistic knowledge by participating in the intervention's second phase.

To help students work with written language conventions through tactile and visual means, I developed an activity using LEGOs that I coded to correspond to punctuation marks and parts of speech. The creation of the "LEGO activities" was informed by Chi's (2009; Chi & Wylie, 2014) ICAP hypothesis, which delineates between variations of active learning. The students' engagement with the LEGO

activities corresponds to the constructive learning description outlined in the ICAP hypothesis.

During the intervention's second phase, students practice "building" and manipulating sentences and syntactic structures using the coded LEGOs. As they rearrange the blocks, students visualize how grammatical elements work together to create syntactic structures. They also see how moving grammatical elements of a sentence impacts its meaning. The activity reinforces the concept that grammar and syntax can be used as rhetorical tools to influence meaning in written language. As students choose which "tool" will best express their ideas, they engage in critical and rhetorical thinking, which again, are foundational outcomes of FYC courses. As with rhetorical grammar, embodied cognition and the ICAP hypothesis will be discussed in greater detail in Chapter 2.

Previous Cycles of Action Research

The intervention was refined over the course of two rounds of action research. During the first cycle, the intervention consisted of the rhetorical underpinnings and the constructive LEGO activities. I collected student data related to their experiences with that iteration of the intervention. The primary purpose of the first round of action research was to test data collection methods, engage in data analysis, and to refine my understanding of my problem of practice. The data showed that while students enjoyed the LEGO activities and credited them for their improved ability to articulate concepts related to sentence structure, overall, their writing lacked evidence that students were able to transfer what they had learned to their use of grammar and syntax.

For the second round of action research, I refined the LEGO activities by reducing the number of parts of speech they needed to work with. As will be discussed further in Chapter 3, I evaluated which parts of speech were most important for students to know to correctly identify and create certain syntactic structures. Then I eliminated some parts of speech from the LEGO activity, such as determiners (a, the, an) by incorporating them into related parts of speech. I expected that students' ability to identify and use EWE grammar would improve. However, the results were similar to those found at the end of the first round of action research—students' ability to identify and define parts of speech improved as did their ability to verbally describe which grammatical components were needed create certain syntactic structures, such as independent clauses. However, students' ability to incorporate that knowledge to their writing did not improve.

In preparation for the final round of action research, I met with cognitive psychologist and head of Arizona State University's Laboratory for Embodied Cognition, Arthur Glenberg (2008, 2015), to discuss with him my intervention and data findings. He suggested that to improve students' ability to transfer grammatical knowledge to their writing, that I incorporate elements of embodied cognition into the intervention. The embodied activities that I developed were created and incorporated into the intervention as a result of my conversation with Dr. Glenberg and the subsequent study I undertook of Lakoff's and Johnson's (1980) early work regarding language and embodiment.

The final round of action research, carried out during the Fall of 2019, was conducted using the intervention's current iteration—a rhetorical framework that includes two types of activities: a) embodied activities to teach the function of grammatical and

syntactic constructs, and b) constructive activities to help students visualize how grammar and syntax impact meaning in written language as well as help students learn how to create those syntactic structure. As mentioned earlier, my problem of practice, "How can I most effectively teach conventions of academic writing to engineering students?" informed the development of the intervention. Additionally, engaging with my problem of practice over the first two rounds of action research led to the development of the research question that guided all aspects of the research process carried out in the final round of action research

Research Question

RQ: In what ways might explicit instruction involving embodied and constructive pedagogical practices within a rhetorical framework help engineering students understand and apply effective conventions of written communication?

The research question includes language similar to that found in the 2019-2020 ABET student outcome Criterion 3.3. As discussed earlier, the criterion states that accredited engineering programs must document student outcomes related to their ability to "communicate effectively with a range of audiences." The question then arises, "What constitutes 'effective communication'?"

Effective communication—whether oral or written—is accomplished through the combination of many practices including semantic choices appropriate for a specific audience, inclusion of logical transitions between ideas, and use of straightforward syntax. As a composition teacher, I have chosen to focus my research on methods of

teaching grammar because I believe that clear syntax is especially foundational to clear and effective writing, and this is an area in which my students struggle.

Chapter 2

Literature Review and Conceptual Frameworks

Chapter 2 is divided in two parts: Part 1 contains the literature review, and Part 2 centers on a discussion of the three conceptual frameworks (rhetorical grammar, embodied cognition, and the ICAP hypothesis) that have been combined to create the intervention central to this study. The literature review will address two primary issues, (a) the scholarly debate regarding the appropriateness of grammar instruction in the United States and (b) writing instruction in engineering programs. Because my study involves weaving these two concerns together, I will refer to them as "Strands." Strand 1 refers to grammar instruction and Strand 2 refers to writing instruction in engineering programs. Each strand evolved separately, and in the case of Strand 1, the history that informs how grammar instruction is viewed and practiced in the United States is particularly complex. Strand 2 has a shorter history that evolved in part from industry concerns.

Part 1: Literature Review

Strand 1: Grammar Instruction in the United States

To appreciate the significance of the research detailed in this dissertation, one must understand the history and current place of grammar instruction in the United States. This history consists of numerous smaller strands, including (a) definitions of grammar, (b) positions against grammar instruction, (c) compromises in grammar instruction, (d) positions in favor of grammar instruction, and (e) practices that grew out

of those positions. Plied together, these smaller strands have created Strand 1: the history of writing and grammar instruction in the United States.

Definitions of Grammar

Discussions regarding grammar are complicated by the fact that historically, "grammar" has multiple definitions. Linguist W. Nelson Francis (1954) stated that "grammar" could be understood from three perspectives: Grammar 1--the language of native speakers of all languages; Grammar 2-- linguists' study and description of language; Grammar 3-- rules governing "proper" usage. Grammar 2 includes structural linguistics, transformational/generative grammar, cognitive linguistics, and applied linguistics etc. Francis called Grammar 3 "etiquette" (p. 299) because it focused on judging whether speakers and writers followed conventions of a language's dominant dialect. Francis' conceptualization invited further investigation. Hartwell (1985) built upon Francis' work and defined five types of grammar relevant to writing instruction. Grammars 1-3 corresponded to Francis' delineations. Grammar 4 referred to the type of grammar taught in school, and Grammar 5 applied to grammar as it pertained to writing style.

Francis' 3 has played an important role in discussions about language instruction in the United States. The rules of Grammar 3 are based on usage in a language's dominant dialect. In the United States, the dominant dialect has been called by various terms, including Standard English (SE) and Dominant American English (DAE). As with other languages, the U.S. dominant dialect is an idealized form of language associated with the cultural and ethnic majority. Colloquially, SE grammar is often referred to as

"Latin-based grammar," "school grammar," "traditional grammar," or a combination of these names.

When "grammar" is undefined in conversations about its inclusion in English/language arts curricula, misunderstandings arise (Dunn & Lindblom, 2003; Kolln, 2010). Van Gelderen (2010) articulated the problem as follows:

> The teaching of grammar in primary and secondary schools is a controversial issue in countries all over the world. It is not easy to explain why this issue is so controversial, because the debate is rather fuzzy. The main reason for this fuzziness is that the concept of "grammar teaching" is not well defined. Many people refer to grammar as the traditional practice in which students label word classes and parts of speech. This is certainly the most popular meaning of "grammar teaching." (p. 109)

"Grammar teaching" as defined by van Gelderen, corresponds to traditional, Latin-based grammar taught in schools. It is precisely this type of grammar at the center of controversy about language instruction in schools. The division between those who oppose grammar instruction and those who advocate it is exacerbated by the failure to adequately define "grammar" in the debate (Kolln, 2010).

Attitudes Toward Grammar Instruction

I begin this portion of the literature review with arguments against grammar instruction because this attitude has been the most prominent for decades in the United States and has profoundly impacted teaching practice. Arguments in favor of teaching grammar have developed in response to the widespread denouncement of grammar

instruction. Therefore, the significance of pro-grammar stances are clarified when presented against the backdrop of arguments against grammar instruction.

Arguments Against Grammar Instruction. As stated by Tchudi and Tchudi (1991), "Over the years, grammar has probably generated more discussion, debate, acrimony, and maybe even fistfights than any other component of the English/language arts curriculum" (p. 164). For over a century, educators' concerns about deleterious effects of grammar instruction on children have impacted whether and how the subject is taught in schools (Wilson et al., 1915; Hartwell, 1985; Kolln & Hancock, 1985). Early concerns included questions regarding children's cognitive readiness for the subject. While some scholars advocated grammar instruction as an aid to improved writing skills, others claimed that grammar instruction stultified students' writing skill and creativity. By the late twentieth century, concerns about possible damage inflicted on minority children who had limited exposure to EWE, and the right of all students to speak and write in their own English dialects became prominent arguments for discontinuing grammar instruction. More recently, critical composition pedagogies have impacted teaching practice and assessment of student writing by rejecting the power of SE and advocating socially just pedagogical practices (Inoue & Poe, 2012; Inoue, 2015, 2019; Havard et al., 2019).

Age Appropriate Instruction. Early in the twentieth century, scholars applied experimental methods to language arts. Hoyt's (1906) work had a profound and lasting impact on grammar instruction in the United States (Kolln & Hancock, 2005). Hoyt conducted research to discover reasons teachers gave for teaching grammar. Later he

tested the validity of the reasons the teachers provided. Of the three main reasons teachers gave, the claim that studying Latin-based grammar strengthened students' intellect and therefore was an appropriate exercise (Wilson, 1915), contradicted Hoyt's understanding of children's cognitive development. As an advocate of Thorndike's theories of psychological development, Hoyt did not believe that young children were capable of learning from the exercises used in teaching grammar (Wilson, 1915; Kolln & Hancock, 2005). After conducting research comparing writing samples of students who received grammar instructions and those who did not, he determined that grammar instruction did not improve student writing outcomes. Therefore, he recommended that teachers discontinue teaching grammar.

Hoyt's research was replicated by Rapeer (1913), who similarly determined that grammar instruction was of no use to school children. His study also demonstrated that grammar instruction failed to improve student writing outcomes. The Hoyt and Rapeer studies swayed opinion against grammar instruction for school children (Braddock et al., 1963; Loban, 1963, 1976; Elbow, 1973/1998, 1981/1998; Elley et al., 1976; Hartwell, 1985; Hillocks, 1986).

Negative Impact on Writing. While Hoyt and Rapeer argued that grammar instruction did not improve student writing outcomes, later scholars claimed that it actually had a negative impact on student writing ability. The 1963 publication of Braddock, Lloyd-Jones, and Schoer's *Research in Written Composition* provided English and writing instructors with a strongly-stated justification for abandoning explicit, traditional school grammar instruction. Braddock et al. claimed that,

> In view of the widespread agreement of research studies based upon many types of students and teachers, the conclusion can be stated in strong and unqualified terms: the teaching of formal grammar has a negligible or, because it usually displaces some instruction and practice in actual composition, even a harmful effect on the improvement of writing. (p. 37)

Braddock's declaration profoundly influenced the conversation about grammar instruction nation-wide (Hartwell, 1985; Kolln & Hancock, 2005). Finally, in 1985, the NCTE published a resolution opposing grammar instruction that was not connected to writing. The statement referred to "ample evidence from 50 years of research has shown the teaching of grammar in isolation does not lead to improvement in students' speaking and writing, and that in fact, it hinders development of students' oral and written language" (1985).

Process Theory of Writing. Process theory first came to prominence in the 1970s with the publishing of Emig's (1971) study detailing how eight 12th grade students approached various writing assignments. Her work was in direct response to Braddock's (1963) call for compositionists to engage in empirical research on writing (Voss, 1983). Out of Emig's study grew a systematic way to present the "writing process." Process theory, a student-centered approach to teaching, was promoted by influential writing theorists such as including Murray (1968) and Elbow (1968, 1973, 1981).

In his books *Writing Without Teachers* (1973) and *Writing with Power* (1981), Elbow encouraged students to focus on their own experiences as writers. His ideas regarding freewriting and journal writing were also included as components of the

writing process (Kolln, 2005). In *Writing with Power*, Elbow (1981) expressed his disdain for grammar instruction,

> Learning grammar is a formidable task that takes crucial energy away from working on your writing, and worse yet, the process of learning grammar interferes with writing. . . . For most people, nothing helps their writing so much as learning to ignore grammar as they write. (p. 143)

Elbow's recommendation to "ignore grammar" reflects his expressionist views of writing. For Elbow and other writing theorists (Murray, 1985; Coles, 1967) the personal, emotive value of writing was hindered by concerns about correctness.

As a learner-centered pedagogical approach, process theory emphasizes process over product. Therefore, the process through which students write is considered of greater value than the final documents students produce. Once students complete the recursive steps involved in the writing process, they turn their attention to the last of the WPA Outcomes, "Understanding Conventions," which states that students will "Develop knowledge of linguistic structures, including grammar, punctuation, and spelling, through practice in composing and revising" (WPA Outcomes, 2014). Although this portion of the "Understanding Conventions" may appear to support teaching grammar, this is not the case. Editing is presented as a lower-level cognitive skill intended to correct surface problems. This attitude toward grammar and conventions, which is firmly embedded in educators' practice and teaching, perpetuates the attitude that grammatical concerns are tangential to higher-order thinking skills. To assist students with the editing process,

composition textbooks routinely include a "handbook" containing information on grammar and usage.

The Council of Writing Programs Administrators (CWPA), the professional organization for college and university writing program administrators, advocates the writing process model for teaching composition. The most recent update of the Writing Program Administrators outcomes for First-Year-Writing programs (2014) states that by the time students complete their required university composition courses, they will be able to compose documents by applying the process model of writing. The WPA outcomes are firmly embedded composition textbooks, so process theory is taught in writing courses across the United States. The most recently published composition textbooks attest to this uniformity of approach (Roen et al., 2016; Johnson-Sheehan & Paine, 2019; Taylor, 2019; Lunsford et al., 2020).

Political and Cultural Concerns. Coinciding with pedagogical practices that focused on students and their experiences, efforts to address racial discrimination and provide equal political and educational access extended to concerns about linguistic hegemony (Gold et al., 2012). Furthermore, structural linguistics also influenced understanding of language. As they became increasingly aware of how language is structured, some people came to understand that non-SE dialects are not deficient (Gold et al., 2012).

The Students' Right to Their Own Language (SRTOL) movement emerged in the early 1970s as a declaration that speakers of non-dominant variations of English had the right to express themselves authentically without interference from educators and others

who would seek to impose "proper" English on students (Murphy, 2001). The NCTE's 1974 position statement, which was reaffirmed in 2003, on SRTOL stated:

> A nation proud of its diverse heritage and its cultural and racial variety will preserve its heritage of dialects. We affirm strongly that teachers must have the experiences and training that will enable them to respect diversity and uphold the right of students to their own language (p. 1).

Respect for linguistic diversity, including various registers of English, would suggest that imposing SE on all students undermines not only the personhood of each student, but also destabilizes the integrity of the United States as a culturally diverse nation.

Scholars such as Gee (1989) argued that educators harm children of color and other disadvantaged youth when they promote DAE in their classrooms. Students, he stated, who experience prejudice based on their language usage suffer a profound loss of self-esteem and identity when they are implicitly and explicitly told that their discourse practices are not "standard" and need to be changed. Schools promote what he termed the "Dominant discourse" to the students' detriment. Therefore, he argued, children from such backgrounds should not be subjected to language arts instruction that privileges the dominant culture. Traditional school grammar reflects Dominant discourse patterns, and therefore would be considered suspect by those who advocate against prescribing DAE or EWE in writing instruction. Such a stance runs counter to teaching grammar and conventions in composition courses.

Critical Pedagogies. Compositionists concerned with social justice in writing instruction and assessment have asserted that requiring students to adopt SE and other

dominant discourse conventions perpetuates racism and inequality in the classroom and beyond (Inoue & Poe, 2012; Inoue, 2015, 2019; Havard et al., 2019; Lisabeth, 2019). To mitigate the effects of pervasive injustice borne of deference to SE standards and to empower students to write in their authentic voice, some scholars and teachers have adopted labor-based grading contracts to make assessment of student writing transparent and unbiased (Danielewicz & Elbow, 2009; Inoue & Poe, 2012; Inoue, 2015, 2019). Teachers who incorporate labor-based contracts in their practice evaluate student work based on completion of assignments, not on the qualities of what students write. While students receive feedback on their writing, their adherence to any specific writing standards, including EWE or SE standards are not evaluated.

Compromises on Grammar Instruction. Despite education researchers' push to constrain grammar instruction in schools, their attempts were not entirely successful. Local control of schools and the lack of a national curriculum meant that there was no mechanism to ensure the discontinuation of stand-alone grammar classes.

NCTE Position Statements. In 1935, the NCTE published *An Experience Curriculum in English*, which based on the recommendations of a committee appointed with making curricular recommendations, stated that grammar should no longer be taught as a stand-alone subject. When grammar instruction was deemed necessary, it should be taught while students were working on writing assignments (as cited in Farrar, 1937). This recommendation sounds much like the guidelines in place today.

Fifty years after *An Experience Curriculum in English* was published, the NCTE published a new resolution in response to the fact that many children were still receiving

stand-alone school grammar lessons complete with rote learning and worksheets. Efforts to eradicate these practices had not been successful. The 1985 resolution invoked "fifty years of research" that showed that grammar taught in isolation did not help students write more effectively. Additionally, the resolution stated that such instruction "hinders development of children's oral and written language" (NCTE, 1985). Additionally, the resolution stated that, "class time at all levels must be devoted to opportunities for meaningful listening, speaking, reading, and writing; and that NCTE urge the discontinuance of testing practices that encourage the teaching of grammar rather than English language arts instruction" (NCTE, 1985). The resolution did make allowances, however, for grammar instruction that was "supported by theory and research" (NCTE, 1985). No guidance was provided about what types of grammar might fit those parameters.

With the expectation that grammar instruction would be provided on an as-needed basis in English and writing classes, teachers needed resources to help in this endeavor. Constance Weaver (1979, 1996, 2007, 2008) wrote books that outlined effective practices to help teachers gain confidence mixing writing and grammar instruction. Like Weaver, Amy Benjamin (2007) has written multiple books and currently maintains a website dedicated to helping teachers incorporate grammar and language awareness in the language arts curriculum. She also has written extensively on the Writing Across the Curriculum (WAC) movement in which writing instruction is provided in all disciplines. The latest offerings to help teachers incorporate grammar in

their language arts classes focuses on grammar usage in the "real world" (Crovitz & Devereaux, 2017, 2020).

A complication of combining grammar and writing instruction has become evident: many teachers, including English/language arts teachers, are unfamiliar with English grammar. Many researchers have written about teachers' lack of confidence teaching grammar (Hudson, 2010; Jones et al., 2013; Myhill & Watson, 2014). Watson (2015) linked teachers' insecurity about teaching grammar to English and language arts curricula that do not contain grammar instruction: "A lack of linguistic knowledge, accompanied by the lack of a well-theorised, empirically grounded pedagogy, has rendered grammar a particular challenge for teachers" (p. 333). In cases where teachers were expected to teach grammar, they did not teach the concepts or frameworks because they did not receive instruction on how to do so (Savage, 1972; Gartland & Smolkin, 2016).

Support for Grammar Instruction. Despite extensive opposition to grammar instruction, not all educators or scholars agreed with this point of view. As will be discussed below. Delpit (1992) supported grammar instruction for students of color to better ensure that these students had access to the economic and social capital. Metalinguistic awareness and grammar knowledge and its impact on, and relationship to, to the development of writing skills has been the focus of some researchers (Myhill, 2000 2003, 2005, 2010, 2020; Myhill & Watson, 2014). Other scholars (Francis, 1954; Kolln, 1981, Kolln & Hancock,1985; Kolln & Gray, 2017) promoted grammar instruction based

on principles of functional, structural grammar that helped students use language to communicate effectively.

Teaching the Dominant Discourse. Lisa Delpit (1992), herself a woman of color, questioned Gee's (1989) assertions about teaching Dominant discourse practices to disadvantaged students. She countered Gee's argument that discourse practices cannot be overtly taught. Rather, she stated that not only could they be taught, but that children who are able to switch between discourse practices enjoy many advantages to those who cannot. She also argued against Gee's point that when people who are disadvantaged learn the Dominant discourse, they lose important aspects of their identity. Delpit countered as follows, "Acquiring the ability to function in a dominant Discourse need not mean that one must reject one's home identity and values, for Discourses are not static but are shaped, however reluctantly, by those who participate within them and by the form of their participation" (p. 300).

Explicit Grammar Instruction. Fries (1940, 1952) structural grammar, which was promoted by linguists Francis (1954) and Allen (1958), seemed poised to impact grammar instruction in schools. Fries' book (1952), *The Structure of English: An Introduction to the Construction of English Sentences*, described the categories of English on their own terms, rather than applying Latin grammar to English linguistic structures. Instructing English speakers that their native language was not deficient, and that its inherent structures merited study was a major step toward a pedagogical shift away from rote memorization of ill-fitting grammatical structures based on Latin grammar.

Regarding structural linguistics, Francis (1954) wrote that "Writers will find it easier to avoid such troubles [grammatical] if they know about the forms of English and are taught to use the form to convey the meaning, instead of setting up tensions between form and meaning" (p. 311). Despite the high praise for Fries' work, structural grammar never made an impact on grammar instruction. Scholars' interest in Chomsky's transformational grammar pushed the Fries work into the shadows (Kolln, 2005; Gold et al. 2012). One educator, Martha Kolln, worked to make Fries work accessible to teachers. She called her approach to grammar instruction "rhetorical grammar."

***Rhetorical Grammar*.** In an article that marked her public entry into the fight about the place and appropriateness of grammar instruction in U. S. schools, Kolln (1981) chronicled the history of the repudiation of this once central curricular offering. In so doing, she argued that educators and writing theorists applied a narrow view of grammar, one based on traditional, Latin-based, prescriptive grammar, in their evaluation of language instruction. As mentioned earlier in this chapter, Kolln and Hancock (2005) pointed to Braddock's (1963) declaration that grammar instruction takes important time from writing instruction and poses a "harmful effect on the improvement of writing" (p. 37) as the one comment that has continued to fuel the position against grammar instruction in the schools. She claimed that educators' renunciation of grammar instruction, a direct consequence of that narrow view, would leave students without an understanding of the basic elements of written English.

Kolln agreed with those who inveighed against grammar instruction on one important point, that prescriptive, rule-based grammar was not a useful approach to

language instruction. By focusing on correct usage based on Latin grammar, writing instructors failed to engage students in meaningful discussions about how understanding English syntactic structures function allows writers to manipulate and use language effectively in varying rhetorical contexts. Micciche (2004), argued that "the chief reason for teaching rhetorical grammar in writing classes is that doing so is central to teaching thinking" (p. 719).

Assembly for the Teaching of English Grammar (ATEG). A few educators who were alarmed by the tone of the criticism about language-based instruction, formed the Assembly for the Teaching of English Grammar (ATEG) in 1979, which eventually became an official assembly in the NCTE (Kolln & Hancock, 2005). Of great concern to ATEG's founders was the fact that in all the debates about grammar instruction and its inclusion in the curriculum, no mention of the possible use of structural or functional grammars were made (Kolln & Hancock, 2005).

Lack of professional support for those who wished to include explicit grammar instruction in their language arts courses also prompted the founding of the ATEG. MacDonald (2007) and Blaauw-Hara (2007) each documented the steep decline of published research in NCTE journals and conference presentations on topics about language instruction and sentence level instruction in writing pedagogy and practice. Kolln ended her contribution to the 2005 cowritten article with Hancock with a call for inclusion of theoretically and pedagogically sound grammar instruction in schools and the acceptance of papers and presentations on grammar in NCTE conferences and publications:

> Until grammar is seen as a legitimate part of the Language Arts curriculum that goes beyond an aid to writing, until the advocates for teaching grammar in a systematic way are invited into the NCTE inner circle, until the conversation begins again, our students and our teachers in training will miss out on the subject that remains the most humanistic of the humanities and the most social of the social sciences. (p. 20)

In calling for a renewed discussion about grammar instruction in schools, she did not advocate that traditional grammar be part of English/language arts curricula. Rather, she declared the need for a "systematic" approach to grammar instruction based on the functional, rhetorical grammar that had informed her work since the early 1980s. The results of my study support Kolln's contention that grammar instruction, when carried out as she advocated, enriches students' understanding of language and helps them use it in ways that help them express their thoughts more clearly and effectively.

Strand 2: Writing Instruction and Engineering Students

Defining the Problem

As discussed in Chapter 1, engineering professional organizations and university faculty have identified ineffective written communication skills of new engineers as an area of concern. The 1996 publication of EC 2000 resulted in the prioritization of writing competency in undergraduate engineering education (Leydens & Schneider, 2009). The National Academy of Engineering (2004), stated, "We envision a world where communication is enabled by an ability to listen effectively as well as to communicate through oral, visual, and written mechanisms" (as cited in Leydens & Schneider, 2009, p.

256). Boyd and Hassett (2000) commented on the Society of Manufacturing Engineers (SME) 1997 "Manufacturing Education Plan" stating, "These SME findings suggest that students in Manufacturing Engineering and Technology curricula are graduating without having learned to write well within their disciplines" (p. 409).

In her study comparing engineering undergraduates' and practicing civil engineers' writing, Conrad (2017) analyzed the differences between student and professional writing. She found that in comparison to professional writing, student writing lacked coherence, concision, and contained numerous grammatical errors and inaccurate word choices. Problems with organization also were common in student writing. According to Conrad, "Underlying the student writing problems were misconceptions about effective writing, ignorance ofgenre expectations, weak language skills, and a failure to appreciate that written words, not just calculations, express engineering content (p. 191). Leydens (2008) found that students' lack of rhetorical understanding prevented them from producing appropriate writing samples. Finally, other researchers have reported that engineering students failed to transfer skills and knowledge they gained in First-Year Composition courses to writing assignments for engineering classes (Cross et al., 2013).

Solutions

Universities have taken a few approaches to address ABET's concerns about writing outcomes for engineering students, including technical writing and communication departments' involvement in teaching engineering disciplinary writing,

the creation of specialized writing centers and inclusion of substantial writing assignments in engineering courses.

Technical Writing and Communication and Composition Courses. The field of technical communication is linked to the rise of professional engineering programs (Kynell, 1999; Staples, 1999). Technical engineering expertise is insufficient for engineers to succeed in completing projects. They must communicate effectively in writing to successfully complete projects for a variety of audiences. Engineering students require training in disciplinary writing, but that type of instruction is not included in FYC courses. Therefore, engineering and technical communication programs may partner to provide specialized writing instruction suitable for engineering students. As explained by Eggleston and Rabb, (2018)

> Traditional, humanities-based writing courses are often the sole formal writing preparation provided for engineering students. While the humanities offer courses that mandate expository, argumentative, and analytical writing, engineering students often overlook similar reasoning styles between engineering and the humanities due to the stark difference in content discussed. (p. 1)

This statement indicated that if engineering programs rely solely on FYC courses to provide writing instruction for their students, they will not receive adequate training prior to entering professional practice. Therefore, engineering students require discipline-specific writing instruction.

Because FYC courses are intended to provide more generalized writing instruction, little research has been carried out to examine how to tailor FYC courses to

meet the needs of engineering students as they prepare for their disciplinary writing courses. One case study, however, detailed an experiment in which ABET and WPA Outcomes guided teaching practices in an FYC class for engineering students. Researcher Marie Paretti et al. (2007) explained that,

> The goals of this course were to: 1) help students develop a rhetorical framework for communication practices that builds transferable skills, 2) build a curriculum that effectively crosses disciplinary boundaries, 3) help students see how non-engineering disciplines can help them be better engineers, and 4) initiate and test a pedagogical approach explicitly intended to adopt both humanities and technology perspectives on a range of issues. (p, 2)

The course used the WPA Outcomes of 2000 as a guide to consider how students could strengthen rhetorical skills including those related to understanding conventions.

Writing Centers. The creation of specialized writing centers designed for engineering and other STEM programs requires significant resources, including properly trained writing faculty or tutors to assist students as they learn to incorporate appropriate conventions in their writing assignments for engineering courses. In some cases, engineering faculty and writing center personnel work together to ensure that students receive effective writing instruction (Walker, 2000; Leydens & Schneider, 2009; Conrad, 2017). Writing theories, such as genre theory, have been implemented in some writing centers (Walker, 2000).

Writing Assignments in Engineering Courses. Moving writing instruction into the engineering classroom requires that faculty learn and implement new teaching

methods to support student learning (Boyd & Hassett, 2000). Paretti (2008) explained that faculty play a critical role in communicating to students the importance of effective writing in the engineering process. Simply including substantial writing assignments in engineering classes does not result in improved student writing outcomes. She emphasized that faculty must clearly explain to students why effective written communication plays a role in the assignment. To help students grasp the importance of communication, written assignments must be associated with meaningful engineering projects.

Other researchers interested in improving engineering students' writing outcomes have focused on the merits of various writing pedagogies and cognitive skill building approaches. Boiarsky (2004) taught students metacognitive strategies to help them transfer knowledge gained from writing in one engineering genre to another. Even when students had not mastered genre conventions for a particular writing assignment, they had learned important information. For example, they understood that different types of documents required a different approach to writing.

Other models of incorporating writing instruction using a rhetorical approach in engineering courses have included providing writing instruction at the beginning of the semester during the lab portion of an engineering course (Kim & Olson, 2015). Yet other researchers emphasized the similarities between the writing process and the design process as a means to strengthen critical thinking skills in writing and engineering (Wheeler & McDonald, 2000). My study attests to the place of design processes in writing as well. Through engagement with the intervention, students learn that they can

choose from numerous grammatical elements to "design" a sentence that effectively communicates their thoughts.

Part 2: Conceptual Frameworks

Rhetorical Grammar

Whereas discussion of rhetorical grammar in the literature review concerned Kolln's support for grammar instruction in schools, the following discussion will focus on rhetorical grammar's theoretical underpinnings.

Kolln (1996) explained that rhetorical grammar is descriptive, functional, and not based on traditional Latin-based rules. Additionally, grammar operates as a tool in the service of rhetoric, which gives grammar and writers power to communicate effectively within a specific rhetorical context. This means that linguistic structures impact meaning. In a later publication, Kolln and her collaborator, Loretta Gray (2017), explained that rhetorical grammar was based on one central tenet: "Understanding rhetorical grammar means understanding both the grammatical choices available to you when you write and the rhetorical effects those choices will have on your reader" (pp. 2-3). She further explained that "To study grammar in this way—that is to consider the conscious knowledge of sentence structure as your toolkit—is the essence of rhetorical grammar" (p. xii, 3). This rhetorical approach places the writer in a position to consider alternative constructions to communicate an idea and reinforces the fact that those different constructions create varied nuanced meanings.

A few scholars, including Gold et al. (2012), Micciche (2004), Amare (2005) and Rule (2017), credited Kolln with reviving interest in functional grammar and English conventions as expressed in the following statement,

> In 1991, Martha Kolln published Rhetorical Grammar, now in its sixth edition, which by closely examining how rhetorical purposes can be addressed through attention to linguistic structures, word-level phrasing, and even punctuation, helped reanimate interest in exploring the links between grammar, style, and rhetoric. (Gold et al., p. 267)

As writers consciously consider how to arrange phrases and clauses, they learn more about the unique qualities of linguistic structures and the relationships between those structures. Gold et al.'s reference to Kolln's work having rekindled interest in the relationships between "grammar, style, and rhetoric" serves as an acknowledgment that rhetorical grammar is a powerful and necessary approach to writing instruction and the study of language.

Grammar taught rhetorically strengthens critical thinking skills, argued one of Kolln's most prominent advocates (Micciche, 2004). As students consider how syntax and its attendant punctuation impacts meaning, issues related to writing conventions move well beyond the realm of editing mistakes. Rhetorical grammar places linguistic structures and knowledge of how to use them effectively squarely in the center of writing practice. This is where I work to place linguistic concerns in my FYC courses**.**

To help students receive the most benefit from writing instruction guided by principles of rhetorical grammar, I have embedded aspects of embodied cognition into the intervention.

Embodied Cognition

Embodied cognition theory is a vast, multi-disciplinary and multi-faceted construct that arises from fields such as linguistics, psychology, education, computer science, robotics engineering, and neuroscience. Its foundational premise rests on the argument that all cognition arises from and is inextricably bound in the interplay between the mind and body (Lakoff & Johnson, 1980; Clark, 1997; Dodge & Lakoff, 2005; Gallese & Lakoff, 2005; O'Loughlin, 2006; Lakoff, 2012; Johnson, 2015). As acknowledged by researchers working on embodied theories and projects since the 1960s, embodied cognition is not an entirely new concept. For example, as explained by Johnson (2015), Kant reasoned that a connection exists between body and mind, although his conceptualization was not as integrated as twenty and twenty-first century philosophers and researchers involved in embodiment studies have claimed. Other researchers have pointed to Dewey's pragmatism and Merleau-Ponty's phenomenology as precursors to modern embodiment theory (Varela et al., 1991/2016; Nguyen, D. J., & Larson, J. B., 2015). Beginning in the mid-1960s, those phenomenological, and pragmatic theories of mind-body connections became increasingly relevant as Lakoff & Johnson (1980) and others began publishing work that questioned Cartesian thought, the dominant paradigm of human cognition and being that dominated Western philosophy for centuries.

The work of George Lakoff in particular serves as the foundation for the embodied portion of the intervention. As a student of Noam Chomsky, Lakoff and other graduate students at MIT during the early 1960's, and together they worked on projects related to generative-transformational grammar. When Lakoff and other junior scholars recognized the ubiquity of metaphors related to physicality in everyday language and began categorizing those metaphors by theme, they began to question the legitimacy of the Cartesian paradigm as well as the validity of transformational grammar and its deep structures. For these cognitive linguists, metaphorical language provided evidence that humans think in embodied terms and that metaphor structures language. Eventually Lakoff collaborated with researchers from computer science, neuroscience, and experimental psychology, and together they developed a neural theory of thought and language (NTTL) which continues to advance knowledge about the body-mind connection in all cognition (Lakoff, 2012).

Lakoff's theory that cognition and language emanate from bodily experiences would suggest that it is possible to understand mental concepts through physical enactment of the concept's function. Glenberg (2015) pointed to research that showed how understanding of abstract symbols, including words and mathematical symbols, is dependent on the body. Although Glenberg's research on language and embodiment focuses on how embodied activities impact reading comprehension and understanding of received language, his work lends insights about the possibility of using embodied activities to understand the function of language symbols and syntax.

Embodied Cognition and Writing

Accessing the meaning of intangible linguistic concepts through movement potentially makes written conventions real for students. Incorporating knowledge into the body is intended to help students connect mental constructs of syntax and punctuation to their linguistic functions. Little research has been conducted regarding embodiment and writing, but the extant literature falls in two camps: composition studies and cognitive linguistics. Work by those who seek to apply concepts from cognitive linguistics to composition studies potentially has more promise to impact student ability to incorporate EWE conventions in their writing than does the work of compositionists involved in ethnographic research (Huck, 2015). Huck's contention emanated from his belief that a scientific approach to understanding what makes for clear, effective writing, such as that provided by linguists, can reveal practices used by those writers who communicate their ideas clearly in ways not possible for those not trained in or familiar with this type of linguistic analysis.

Linguistics and Writing Instruction. Writing program administrator, Geoffrey Huck (2015) approached writing instruction from the perspective of his academic training as a theoretical linguist. He observed that while linguists were familiar with issues that concern scholars in rhetoric and composition studies, the reverse did not appear to be true. He argued that writing instruction would be more effective should compositionists apply concepts from cognitive linguistics to their research and teaching practices. He recommended that research into the work of cognitive linguists, including Lakoff and Johnson, could positively impact writing instruction and student writing outcomes.

Cognitive linguist Jean-Remi Lapaire's (2006, 2007) work to explore through embodiment the meaning of modal verbs (e.g. might, should) and morphemes (e.g. -un, able-) resulted in his formulation of a pedagogical tool he called "kinegrams." Lapaire created kinegrams by videotaping actors who simulated the meaning of grammatical structures through physical action. Lapaire's work inspired Marcello Giovanelli (2015), a language arts educator in the United Kingdom, to incorporate movement in his writing classes to help students understand more deeply the meaning of abstract classes of words. Giovanelli described kinegrams as "an explicitly metaphorical gesture that presents grammatical and semantic structures and concepts in imagistic terms, giving a physical and concrete shape to that which is inherently abstract" (p. 54). Kinegrams serve much the same purpose as the embodied activities I developed for my intervention. However, my embodied activities have been developed with the intention of teaching the function rather than the meaning of grammatical elements of written language.

Recent examinations regarding embodiment and writing have centered on coming to agreement about the terminology used by composition scholars to discuss issues pertaining to the body and writing. Knoblauch's (2012) definitions of three concepts appears to have provided direction to other scholars. She defined "embodied language" as writing about the body. "Embodied knowledge" refers to knowledge stored in the body, and "embodied rhetoric" pertains to the writer's body and how it impacts the processes and positions of the writer. Knoblauch's definitions have assisted other scholars as they have worked to expand the discussion of embodiment and writing.

LeMesurier (2014, 2016) has explored how pedagogy and practices in dance education might provide understanding about the body and its role in writing and composition. She advocated for increased scholarship investigating whether metaphor might "reactivate embodied knowledge to serve rhetorical goals" (2014, p. 366).

In an article related to writing and embodied simulation, a theory related to embodied cognition, Rule (2017) explained how she combined embodied simulation rhetorical grammar to help students write effectively. She described how writing instructors struggle to discuss student writing at the sentence level and then followed with a short aside about whether focusing on sentences is an acceptable practice for teachers. Rule responded to that concern by teaching students about language via rhetorical grammar and embodied simulation. Rule applied Bergen's (2012) conceptualization of embodied simulation: "Meaning is a creative process in which people construct virtual experiences—embodied simulations—in their mind's eye" (Bergen, as cited in Rule, 2017, p. 22).

Rule expressed that rhetorical grammar when combined with embodied simulation strengthens the utility and effectiveness of the grammar instruction. She explained that,

> Embodied simulation invigorates rhetorical grammar instruction by attuning writers to the felt effects of written language, prioritizing how syntactical structures move, look, and adjust meaning in fine-tuned ways. Simulation methods thus help ease a central concern of writing teachers: they bridge the gap between knowing about grammar and knowing how to do grammar. (Rule, p. 19)

Rule's addition of embodied simulation to rhetorical grammar is intended to help students learn how to use, and perhaps create, grammatical structures, not just understand their significance.

Embodied Cognition and Curriculum

As embodied cognition theory has continued to gain greater recognition in educational contexts, education researchers have added to the scholarship on the integration of learning theories and embodiment. Recent articles re-envision pedagogy as mind-body centered rather than mind-centered with the body either on the periphery or simply not considered at all (Nguyen & Larson, 2015; Wang & Zheng, X, 2017). Claxton (2012) advocated for embodied pedagogy to replace traditional theories that promote and reward students for sitting still and being quiet. He wrote derisively of outmoded pedagogical practices:

> Seen from the perspective of contemporary cognitive science, and the discipline of embodied cognition in particular, much of education now looks partial, dysfunctional and anachronistic, predicated on a model of the mind that is well past its sell-by date. (p. 83)

This pronouncement invites critiques of the structures that inhibit pedagogical changes. For example, so long the physical environment of classrooms creates a barrier to embodied teaching practices (e.g. immovable tables and desks and auditorium seating), teachers may be less inclined to update their teaching methods, to the detriment of students and educators.

ICAP Hypothesis

Chi's (2009) work delineating the variations of active learning has refined educators' perceptions of student participation in the classroom. This framework is far more nuanced that the traditional conceptualization that learning is either active or passive. ICAP is the acronym for the various levels of learning (Interactive, Constructive, Active, and Passive). Chi (2009) and Chi and Wylie (2014) have expressed the relative levels of active learning thusly: Interactive > Constructive > Active > Passive, meaning that interactive learning is more active than constructive and so on. Furthermore, the more active the activity, the greater the learning outcomes. Therefore, educators who subscribe to the ICAP hypothesis strive to incorporate activities with higher activity levels.

Chi (2009) and Chi and Wylie (2014) provided guidance to help teachers determine where on the framework activities fell. Determinations are based on students' observable behavior. Teaching methods that result in passive learning include lecturing where students only listen to the instructor. Active learning includes behaviors such as taking notes during a lecture, underlining reading material, and answering questions that do not require students to predict outcomes. Constructive learning occurs when students generate new knowledge based on what they have been taught. Examples of constructive behaviors include drawing concept maps, integrating or synthesizing information, and taking notes in one's own words. Finally, interactive learning is demonstrated as students work together constructively to generate new knowledge. Student pairs also must engage in dialogue as they work together.

Most recently, Morris and Chi (2020) described how in some circumstances, learning gains between constructive and interactive activities may not be as great as earlier hypothesized. As an example, when teachers asked students questions in which there was no manageable way for students to respond interactively, their constructive responses indicated high levels of learning gains.

Engineering Education and Active Learning. Studies related active learning in the context of engineering education consistently show that students benefit from increased engagement in the classroom. Numerous articles have been written detailing the application and usefulness of the ICAP hypothesis in engineering education since 2013 (Menekse et al., 2013; He et al., 2015; Burgher et al., 2016; Ing & Victorino, 2016; DeMonbrun et al. 2017; Wiggins et al., 2017; Menekse & Chi, 2019). In each instance, researchers found that applying principles of the ICAP hypothesis improved student learning outcomes. In one case (He et al., 2015), improved student outcomes linked to student attendance was discussed within the context of having modified course activities to correspond with higher levels of active learning components.

In addition to articles specifically citing the usefulness of the ICAP hypothesis in improving learning outcomes in engineering courses, active learning in general has been advocated in engineering education, as demonstrated in the 2014 meta-analysis of 225 studies comparing student outcomes in engineering courses that utilized active learning activities or a lecture format. Researchers found that students performed better in courses with active learning components (Freeman et al., 2014). Based on their findings, the authors strongly recommended that engineering faculty replace lecture-style instructional

methods with active learning opportunities in their courses. Freeman et al. (2014) recognized an important limitation in their analysis: the lack of consensus about what constitutes active learning.

Application to the Intervention. The LEGO activity portion of the intervention conformed predominantly to the constructive aspect of the ICAP framework. Although students worked together in pairs and engaged in dialogue about the way in which they individually mapped sentences using LEGOs, they did not take that information and build upon it. They did, however, predict how internal punctuation would be affected by changes in syntax. Additionally, as a whole class, students answered questions I posed that required them to build on information they had already learned. The purpose of the LEGO activities did not support students engaging in interactive learning.

Concluding Thoughts Regarding the Theoretical Frameworks

The three frameworks, rhetorical grammar, embodied cognition, and the ICAP hypothesis, were systematically combined, as described in Chapter 1, to enhance the potential effectiveness of the intervention. Rhetorical grammar served as the means to help students reflect on how syntax impacts meaning and how to create those syntactic structures in part by using internal punctuation correctly. Activities informed by embodied cognition theory were designed to help students internalize the function of syntactic structures and punctuation. Finally, once students had physically incorporated knowledge about syntax and punctuation, they were prepared to engage in constructive activities with LEGOs that allowed them to manipulate language to see relationships

between syntactic structures. The goal of this intervention was to help students learn to accurately use conventions of effective writing.

CHAPTER 3

Research Design

Chapter 3 contains two sections: a) a description of the intervention and b) a detailed account of the study's design. Included in the discussion of the study design is information regarding the study's setting, participants, the role of the researcher, and a brief description of the data collection instruments. Additionally, this chapter will provide information about how the intervention was implemented. All activities pertaining to this portion of the study were guided by the research question posited in Chapter 1: In what ways might explicit instruction involving embodied and constructive practices in a rhetorical framework help engineering students understand and apply effective conventions of written communication?

Part 1: Intervention

Helping my engineering students apply effective conventions in their writing necessitated that I determine which aspects of grammar, syntax and punctuation merited instructional attention. I reflected on my experience reading student writing and identified features that do not conform with effective professional writing practices. I identified comma splices and sentence fragments as common constructions students include in their papers. Additionally, students commonly misused commas both in compound and complex sentences (sentences that include combinations of independent clauses, phrases, and coordinating conjunctions; and sentences that include both independent and dependent clauses). Students also frequently omit commas after introductory prepositional phrases, so that sentence type was also included in the intervention.

Understanding of the above concepts and constructs could contribute to students' ability to write effectively for a range of audiences in accordance with ABET's accreditation criterion 3.3. Both constructions signal a potential lack of awareness of what grammatical features are required to write a complete sentence. Based on years of speaking with students about sentence construction, I knew that many were unaware that complete sentences contain a subject and verb. However, unless students can identify the subject of a sentence, they will struggle to determine whether a group of words functions as a complete sentence.

Based on numerous class discussions about syntax in semesters prior to conducting this study, I knew that many of my past students could not differentiate between subjects and objects. To these students, both words were simply nouns. These students commonly indicated that the subject was whichever word seemed to them the most important. However, subjects were not the only grammatical concept students struggled with. Many students were unsure whether a sentence such as "I am" was a complete sentence because they did not know that "am" is a verb. So, in addition to learning to differentiate between subjects and other nouns in a sentence, students needed to learn about verbs of being. However, to compose sentences that effectively expressed their ideas, students need to have facility with compound and complex sentence structures. Again, based on my experience reading student writing, I knew that students often incorrectly punctuated compound and complex sentences. Through discussions with students, I learned that many could not identify coordinating and subordinating conjunctions, both of which are integral components of these sentence types.

Sequence of Activities

As outlined in Chapter 1, many of my students have had negative experiences in writing classes and are not enthusiastic about the university requirement that they take FYC courses. Students commonly express in class or to me privately that they are not "good" at writing. Knowing that students are easily overwhelmed by the presentation of too much information, I was careful to introduce material pertaining to academic writing conventions in small doses throughout the semester. I purposefully chose to focus on one concept at a time and help students gain proficiency identifying and correctly punctuating targeted syntactical structures before preceding to the next concept. Preceding in this manner was intended to increase student self-efficacy.

Pre-Intervention Preparation

The first three weeks of the course were spent laying the foundation for the intervention by discussing rhetoric, liberal and general education, and university and program accreditation criteria. I introduced students to the concept of, and requirements for, university and program accreditation. During those presentations, I provided students with copies of ABET's student outcomes criteria. In earlier rounds of action research, I found that students more readily accepted the value of English 101 once they learned that educators and industry professionals together influence the creation of the accreditation standards, including those related to written communication. This information has provided engineering students with motivation to engage in the intervention and with academic writing assignments.

Pre-Intervention Activities

Following the preparatory activities, students completed the pre-intervention components of the study. In week 4 of the semester, students completed three pre-intervention activities: (a) a one-paragraph writing sample, (b) the pre-intervention survey, and (c) the pre-test. All the activities took place in class on paper so that students had no access to grammar checkers or definitions of grammatical terms. For the writing sample, students wrote an initial paragraph of a cover letter for a job application. Students were instructed to write using their best academic conventions including grammar and punctuation. The pre-intervention survey consisted of three constructs asking students to rate their agreement on a 5-point Likert scale with statements regarding their attitudes toward academic writing and ability to identify and use SE grammar and punctuation. The post-test included three sections of multiple-choice questions covering internal punctuation.

Intervention

The intervention began during week 5 of the semester. First, students engaged in numerous embodied activities in which they learned about the function of various parts of speech including subjects, objects, coordinating and subordinating conjunctions, and prepositions. Additionally, students learned through embodied activities the function of commas, semicolons, and colons. Once students had completed the embodied activities, they started the constructive learning activities.

The constructive learning activities promoted rhetorical awareness by having students build sentences with LEGO blocks and then manipulating pieces so that students

could learn how changing the syntax of a sentence impacts its meaning. The constructive activities were designed to allow students to visualize how elements of a sentence work together to impact meaning.

Post-Intervention Activities

At the conclusion of the intervention, students completed the post-intervention writing sample, the post-test, and the post-intervention survey. The writing sample was completed under the same conditions as the post-intervention sample. Students were instructed to write one paragraph about the impact of persistence on successful academic writing. The post-intervention survey included the original three constructs plus additional constructs in which students responded to statements regarding their experiences with the embodied activities and the constructive learning activities.

Selection of Conventions

After teaching six semesters and numerous sections of English 101, I identified which grammatical elements to teach in the activities. Initially, I included too many grammatical concepts in the activities. Students became overwhelmed by the number of elements and were unable to determine which ones to pay attention to. Students do not need to know the names of all the parts of speech to correctly punctuate sentences. They do, however need to be able to identify both coordinating and subordinating conjunctions to know whether and where to place commas. To determine whether a clause is a sentence or a sentence fragment, they need to be able to identify subjects, verbs, and subordinating conjunctions. Students who do not know that subordinating conjunctions turn independent clauses into dependent clauses will be confused by the fact that the

latter still contains a subject and verb. Too often, students cannot distinguish between subjects and objects. Students who cannot identify verbs of being as verbs may not recognize that a sentence such as "I am" is indeed an independent clause.

Other common errors included creating comma splices, a result of not understanding how to properly connect two independent clauses. Students also were prone to place semicolons between sentence fragments and independent clauses. Students needed to learn the differences between semicolons, commas and periods. Semicolons proved to be the most elusive to explain their function. All students were able to explain the purpose of periods.

Embodied Activities

Before having students engage in the embodied activities, I provided them with a brief introduction to the concept of embodied cognition. I explained that according to Lakoff's and Johnson's (1980) research on language and embodied cognition, we think in metaphors that are based on the way human bodies are constructed. For example, we are bipeds whose heads face what we call forward. We typically move in that direction. So, for example, if we say that a project we are working on is "going backwards" we understand that to mean that the project is not progressing or that it is regressing. "Going backwards" is negative. If we moved normally in a backwards direction, something going backwards would not be considered problematic. If necessary, I share with students additional examples of how our embodiment organizes our thoughts, expressions, and worldviews.

The following descriptions provide details of how the embodied activities that were included in the intervention worked.

Introductory Embodied Activity

To introduce students to the concept of embodied cognition and how our bodies help us understand concepts, I shared with students an example Arthur Glenburg (2015) shared about students in a physics class who were having difficulty understanding the concept of movement though an angle. I had my students perform the action Glenburg described. Students lined up side by side. They were about arms' distance apart. One of the students on an end was the pivot, and the other students walked and rotated the line. The students maintained a straight line, and those who were farther from the pivot had to walk much faster and farther than those who were closer to the pivot. Students who engaged in the activity performed better on a test that covered the topic of movement through an angle better than those who did not have the experience of walking through the angle.

A simplified version of this activity required no additional space in the classroom. Students bent their arm at a ninety-degree angle and placed their elbow on the palm of their other hand. They kept their hand open and slowly moved their bent arm so that their open hand was moving toward their opposite arm. Students were instructed to observe various points on their moving forearm so that they could compare how much more their fingers moved through space than did the points on their arm closer to their elbow.

Once students understood the concept of embodied cognition, I explained how this concept can be applied to our understanding of the function of parts of speech and

punctuation marks. I explained that when we act in ways that mimic the function of these grammatical concepts, we can better understand the reasons and logic behind the rules that have been applied to EWE.

Subject-Object

Grammatical subjects function as the actor or agent in a sentence. Objects either directly or indirectly receive the subject's action.

Students worked in pairs. One student was assigned to be the subject, and the other was assigned to be the object. The subject gently nudged the object. Then the students traded roles. The students felt what it meant to be the subject, or the actor. They also experienced what it meant to be acted upon, or the receiver of an action.

Figure 1

Subject/Object Embodied Activity

Verbs of Being

Verbs of being, unlike verbs that represent obvious action, indicate existence and the state or quality of the referent.

I gave each student a card with “I am” written on it. Students placed the card in front of them on their desks and silently looked at the card. The students experienced the act of existing as a verb.

Figure 2

Verbs of Being Embodied Activity

Coordinating Conjunctions

Coordinating conjunctions join grammatical elements such as nouns in a list or independent clauses.

Students worked in groups of three. Two students held paired objects such as a fork and a spoon. The third student had a card with a coordinating conjunction written on it paper-clipped to his or her shirt. The student with the coordinating conjunction card stood between the students who were holding the paired objects. The student with the coordinating conjunction was asked to either hold a hand of each student at their side. If students were uncomfortable with physical contact, then the student in the middle could hold one end of each object that the other two students were holding. The student holding the coordinating conjunction card embodied the function of a coordinating conjunction: joining words, clauses, or phrases.

Figure 3

Coordinating Conjunctions Embodied Activity

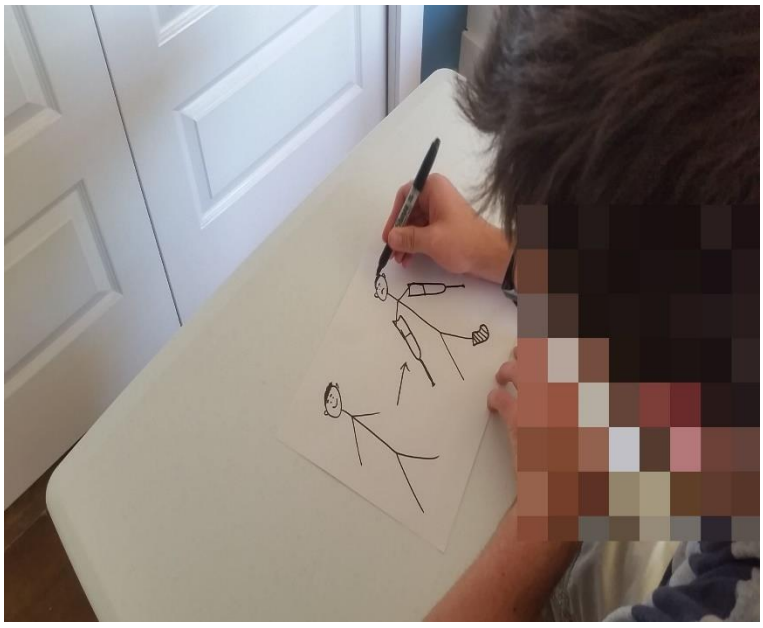
Subordinating Conjunctions and Dependent Clauses

Subordinating conjunctions change an independent clause into a dependent (subordinating) clause. Dependent clauses contain a subject and verb but cannot stand alone. They are dependent on independent clauses to complete an idea.

Students drew a picture of time that they lost independence and were dependent on something or someone. An example includes breaking a leg, losing freedom to play outside, and being dependent on crutches. The function students were to learn about is how one thing (a subordinating conjunction) renders a once independent entity (independent clause) dependent on another entity to function.

Figure 4

Subordinating Conjunctions and Dependent Clauses Embodied Activity



Commas

Commas function to separate things such as items in a list, two independent clauses that have been joined by a coordinating conjunction, or an introductory dependent clause from an independent clause in a sentence. The act of separating items results in clarifying meaning.

A sentence containing a list of items but without commas separating the items was written on the board. Each student was given a bundle containing all the items on the written list. They were told that they had been presented with the item written on the board. As the students separated the items and laid them out on the table in front of them, they embodied the function of separating and clarifying meaning.

Students embodied commas by separating office supplies that I had bound together with a rubber band. I wrote the following sentence on the board, "Go to the desk and bring me a pencil pen marker paper clip binder clip." I handed each student a bundle of the items in the list and told students that I had created the item I asked them to bring me. We discussed how I did not mean for students to provide me with the bundled item. Students separated the items and laid them in a line on their desks. As they separated the items, they embodied the function of a comma.

Figure 5

Commas Embodied Activity

Prepositions

Most often, prepositions function as indicators of location.

I directed students to place one hand where I directed relative to their desks. For example, when I would say “over,” students put their hand over their desks. When I said “under,” students put their hand under their desk.

Figure 6

Prepositions Embodied Activity

Constructive activities

Prior to introducing the constructive activities to students, I determined which parts of speech or grammatical concepts to include in the activities. Then I determined which blocks would be used and which part of speech or punctuation mark the block would represent. I created sentences that included the targeted elements, and printed sufficient copies so that each student would have their own copy. Punctuation was left out of the sentences so that students could determine based on the configuration of the blocks whether punctuation was needed. Because students worked on their own initially to build the sentences, they needed their own set of blocks. To keep blocks organized, they are stored individual sets in separate resealable bags or small containers with lids. I also created a legend for the blocks and provided a copy for each student to reference during the activity. Table 1 and Figure 1 presents the components that I used and what each block corresponded to.

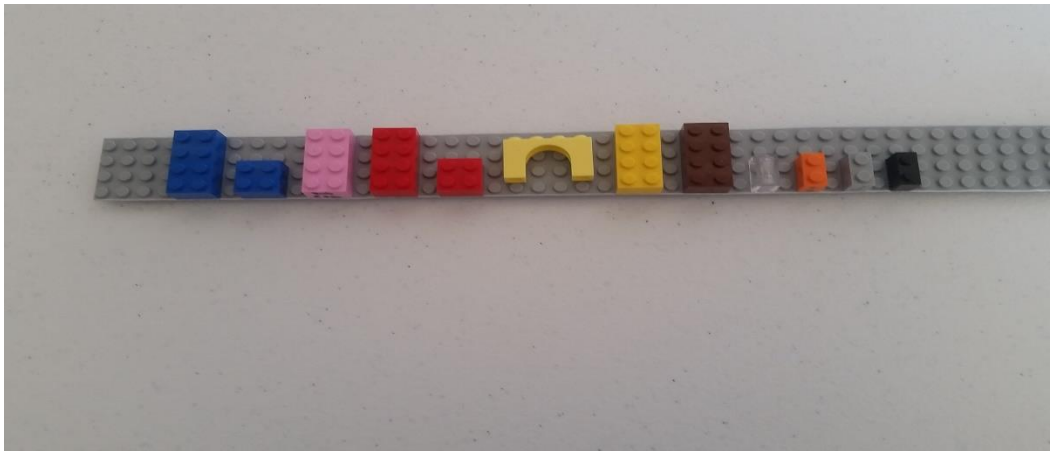
Table 1

Parts of Speech and Corresponding LEGOs

Part of Speech	LEGO
Subject	Dark Blue 4x2
Object (Direct and Indirect)	Dark Blue 2x2
Action Verb	Red 4x2
Verb of Being	Red 2x2
Coordinating Conjunction	Yellow Bridge
Subordinating Conjunction	Yellow 4x2
Preposition	Brown 4x2
Comma	Clear 2x1
Colon	Orange 2x1
Semicolon	Gray 2x1
Period	Black 2x1
Subject Complement	Pink 4x2

Figure 7

Parts of Speech and LEGOs



Students worked individually and in pairs during this portion of the intervention. When working individually, students built the sentence and then discussed their work with a classmate. When students worked together in pairs to map the sentences, they discussed possible solutions and then built their sentences. Once the students built their sentences, the students and I engaged in a short discussion about various LEGO sentence models. Students learned that as they rearranged LEGOs, they created nuanced differences in the meaning of the sentence. These subtle changes reflected their rhetorical choices. In this way, students practiced communicating effectively with different audiences.

This activity provided students an interactive learning environment in which they participated in a low-stakes activity intended to make writing less anxiety-inducing and provided them an opportunity to reflect in a group on the process of creating sentences that adhere to academic writing conventions. I used LEGOs to create this activity because my students associated LEGOs with happy memories. Many of my students have told me that they still build with LEGOs. I also chose LEGOs (other similar building systems could work just as well) because I wanted components that come in various sizes and colors that could function to show the relationship between parts of speech. I also wanted components that could interconnect and could be secured to a base.

Procedure

Students follow multiple steps when engaging in the constructive activities.

1. Students receive a handout that has multiple sentences written on it. The sentences focus on a concept that I want to focus on.

2. Individually, students identify and label target parts of speech in a sentence.
3. Individually students select the blocks that correspond to the labels they put on the sentence.
4. Individually students arrange the blocks to match the syntax of the written sentence.
5. Once the students have arranged their blocks, they compare their LEGO sentences to a classmate's. Students discuss any differences between their LEGO sentences and discuss which solution they think accurately represents the written sentence.
6. The instructor or a student shares with the class the correct LEGO sentence and explains why the example accurately represents the written sentence.
7. The instructor may ask students to explain why they chose specific blocks to represent words in the written sentence.
8. For complex and compound sentences, the instructor should not include commas in the written sentences. Students should look at the blocks on the block tape to determine whether the syntax on either side of a coordinating conjunction, for example, warrants the use of a comma.

Figure 8 shows students working together on the LEGO activity.

Figure 8

Students Engaged in Constructive Activity

Part 2: Method

I designed a sequential explanatory study to gather data on my engineering students' ability to correctly use and punctuate dependent and independent clauses in their English 101 writing assignments.

Setting

This study took place during the Fall 2019 semester at Arizona State University's Polytechnic Campus. All study activities occurred in my English 101 classrooms.

Participants

Students

The study began with thirty-six participants enrolled in two sections of English 101 taught by me. Both sections meet twice a week for 75 minutes. Not all students enrolled in the classes participated in the study. All the student participants were majors in the Polytechnic School, and all but two were enrolled in ABET accredited programs. Thirty-six students (male = 32, female = 4) started the study. One female participant started the study but then stopped attending class, and one male participant asked to discontinue providing data. Of the remaining students (n = 34), some did not complete all of the study components. Of the original participants, most students were from Arizona (n = 18) followed by California (n = 9). Three students were from other Western states, and four were from Eastern states. One student was from a Southern state, and one was from the Midwest. None of the students were repeating the course. All student participants were at least eighteen years old; at the conclusion of the study, the median age was 18. The student demographics were similar to those of students in previous semesters.

Role of the Researcher

During the study, I interacted with all study participants. As the course instructor, I functioned as an insider-participant for the duration of the study. Except for the pre-test and post-test, I created all instruments used in the study and analyzed all data.

Data Collection Phases

I collected quantitative and qualitative data in three phases: (a) pre-intervention; (b) mid-intervention; and (c) post-intervention. During the pre-intervention phase, I collected the information from the following data sources: (a) Student Information Sheet "Getting to Know You: English 101," (b) one-paragraph writing sample, (c) pre-intervention survey measuring students' attitudes toward academic writing, self-reported ability to identify syntactical structures, and self-reported ability to use internal punctuation, and (d) pre-test covering internal punctuation.

During the intervention, I collected additional data from the following sources: (a) student journal entries, (b) student sentence samples, (c) my observation notes, and (d) student interviews.

After the intervention concluded, I collected the following data: (a) one paragraph student writing samples, (b) post-test covering internal punctuation, and (c) post-intervention survey that included two additional constructs measuring students' attitude toward the intervention. All study instruments, protocols, and instructions are included in the Appendix.

Instruments: Quantitative Data

Pre-Intervention and Post-Intervention Survey. Students (n = 36, male = 31, female = 5) completed a pre-intervention survey containing three constructs that measured the following: (a) students' attitudes about academic writing (Construct 1), (b) students' self-assessment of their ability to correctly use SE grammar and identify syntactic structures (Construct 2), and (c) students' self-assessment of their proficiency

using internal punctuation (Construct 3). Each construct contained five statements to which students indicated their level of agreement on a Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree). The survey also included demographic questions regarding gender identification, age, and class standing. Of the thirty-six participants, males outnumbered females (male = 31, female = 5), and the mean age was 18.3 years. Nearly all were first-year students (first-year = 34, second-year = 2).

The post intervention survey included the same three constructs as well as two additional constructs and six free-response questions. Using the same Likert scale, students were asked in Constructs 4 and 5 to indicate their level of agreement with statements about the embodied and constructive activities respectively.

To determine the reliability and internal consistency of both surveys, Cronbach's alpha tests were conducted on the individual constructs and then on the overall instruments. The pre-test alpha scores were as follows: Construct 1 ($\alpha = .745$), Construct 2 ($\alpha = .856$), Construct 3 $\alpha = .891$), Combined Constructs ($\alpha = .888$) Construct 1's score fell in the acceptable range, and the remaining scores fell in the good range. The post-intervention Cronbach's alpha scores also feel in the acceptable and good ranges: Construct 4 ($\alpha = .873$), Construct 5 ($\alpha = .801$), Combined Constructs ($\alpha = .897$).

Pre-Test and Post-Test. Before and after the intervention, students took a test by a doctoral candidate (van Horn Howard, 2012) as part of her doctoral dissertation. I used this instrument in my study because it was the sole instrument I found that measured only student ability to correctly use internal punctuation. Standardized tests were cost-

prohibitive, and I could not locate one that was limited to the parameters I planned to measure. I was unwilling to use a test that had not undergone reliability testing, because I wanted to ensure that any instrument I used measured what it purported to assess.

Student Practice Sentences. Students practiced using syntax and internal punctuation in sentences they generated themselves. The purpose of these assignments was to gauge student learning and effectiveness of the intervention. The sentences were written in class on paper. Students worked alone on the assignment. Sentences were analyzed for adherence to the required syntax and punctuation, not for content.

Instruments: Qualitative Data

Qualitative data, including student journal entries, student interviews, and student written comments on the post-intervention survey regarding the embodied and constructive portions of the intervention were coded using inductive, open-coding processes as described by Brinkmann and Kvale (2015). No a priori codes were used in the analysis of the qualitative data. As themes emerged through the analysis of the data, memos generated regarding those themes were used to generate more refined codes. All qualitative data was triangulated with the other qualitative data sources. NVivo 12 coding software was used to assist with coding all the qualitative data.

Student Journal Entries. Over the course of the semester, students responded to three sets of journal prompts that I provided. Prompts included topics such as defining grammatical terms that we had not covered in class to gauge student familiarity with the concepts, student recollection of previous grammar instruction, and sentence writing practice. All journal writing activities took place during class, and students wrote their

responses in a dedicated folder in Canvas. Each journal writing activity took between two and four minutes. Journals were not graded, but students received class credit for their submissions. The data was used to help establish a baseline of student understanding of grammatical concepts and their attitudes toward grammar instruction.

Student Written Comments on the Post-Intervention Survey. The post-intervention survey contained two constructs used to solicit feedback about students' experiences with the embodied and constructive portions of the intervention.

Student Interviews. Near the end of the semester, students were informed in class that I would be conducting interviews with volunteers who were already participating in the study. Eight students participated in the semi-structured interviews which were audio-taped and transcribed using an online transcription service. Seven males and one female participated in the interviews. Students were asked questions about their experiences in high school English and writing classes, their experiences with the study intervention, and whether they believed that the intervention impacted their academic writing abilities.

Instructor Observational Notes. Throughout the study, I documented my observations of students' responses to the intervention as well as their level of participation in the activities.

Instrument Used Quantitatively and Qualitatively

Student writing samples were analyzed using both quantitative and qualitative methods. For the first writing sample, students were instructed to write the opening paragraph of a cover letter for a fictitious job advertisement. For the second sample,

students were asked to write one paragraph in which they discussed the importance of persistence in completing academic writing assignments. For both samples, students were not given advanced knowledge of the prompt. Both samples were written by hand in class. Students were not permitted to utilize grammar checking programs, dictionaries or any other writing aids. Students produced only one draft of both samples.

Quantitative Analysis of Student Writing Samples. Correct and incorrect use of internal punctuation was tallied for both the pre-intervention and post-intervention writing samples. Percentage of correct comma usage for each student's pre- and post-intervention writing samples were compared. Word counts for each sentence and mean sentence lengths for each sample set were computed to determine whether sentence length impacted ability to correctly use commas. Finally, a paired-sample t-test was used to compare the means of the appearance of comma splices in the samples.

Qualitative Analysis of Student Writing. After the samples were analyzed quantitatively, each set of writing samples were placed in one of three groups based on the changes in correct comma usage: (a) positive change; (b) no change; and (c) negative change. Then the samples were analyzed qualitatively to describe and compare the syntax of sentences containing comma errors versus those without comma errors.

Limitations

My students arrive at the university with divergent educational experiences with regard to writing instruction. For some of my students, their first semester of college presents numerous challenges. Some adjust well, and other do not. Many of my students shared with me their struggles with anxiety, insomnia, and depression. Some of my

students told me that they are on the autism spectrum. In one of the FYC classes, six students were regularly disruptive. Many of these students were registered with Arizona State University's Disability Resource Center for issues for issues related to attention difficulties. Periodically, other students would express to me their frustration with these class members. At times, the students' disruptive behaviors made it difficult for me to cover class material related to the intervention.

Some students who divulged to me their diagnoses of depression also missed numerous class sessions. A few failed the course as a result of absenteeism and failure to submit work. These students exhibited difficulties participating in the constructive phase of the intervention.

Another limitation pertained to the amount of time spent on the intervention. During the fifteen-week semester, four weeks were spent preparing for the intervention, and eight were spent actively engaging in the intervention. During those eight weeks, material unrelated to the intervention was also covered. Periodically, time constraints cut short the time I had intended to dedicate to the intervention.

Suggested Changes for Future Research Cycles

I intend to continue my work with this research. I will revise some of the embodied cognition activities including the verbs of being, coordinating conjunctions, and dependent/independent clauses activities. Students indicated that those activities were the least helpful in helping students internalize the function of those grammatical structures.

One semester does not provide sufficient time for students to practice using the constructive portion of the intervention. I have taken steps to address this problem. In Fall 2020, I will teach one cohort of engineering students who will take English 101 and English 102 with me. I will carry out the study with them and compare results with these study results.

I will also change the pre-and post-test to include the survey information that is included in the original version of the test. I removed that portion of the test because I was concerned that students would not answer the questions honestly since their names are attached to that data. However, I will continue to administer the anonymous survey as well. Although the surveys are different, they will provide me with additional information that might provide important insights about students' self-perception of their ability to use internal punctuation.

Finally, I will consult with engineering faculty and other relevant resources to further align the intervention with the specific interests of engineering students. This refinement will hopefully result in a more meaningful intervention for this student population. As part of this refining process, I expect to learn which types of adjustments may yield the most positive results.

Chapter 4

Data Results and Analysis

Chapter 4 presents the data findings followed by an analysis of the data. First, pre-intervention data establishing baselines of students' attitudes toward academic writing and their pre-test data will be presented. Data collected during the intervention will be presented next, and finally the post-intervention data will be presented.

Pre-intervention Data

Participants' Attitudes Toward Academic Writing

Table 2 and Figure 9 present descriptive statistics for Construct 1. Table 1 includes mean scores and standard deviations, and Figure 9 presents the percentage distribution of students' responses for each Likert scale option. The statements in Table 1 have been ranked from the highest to the lowest mean to highlight students' relative agreement with the statements. To maintain consistency with the Table 2, Figure 9 presents the data in the same order. The data for Constructs 2 and 3 are also presented in order from the highest to lowest mean.

Table 2

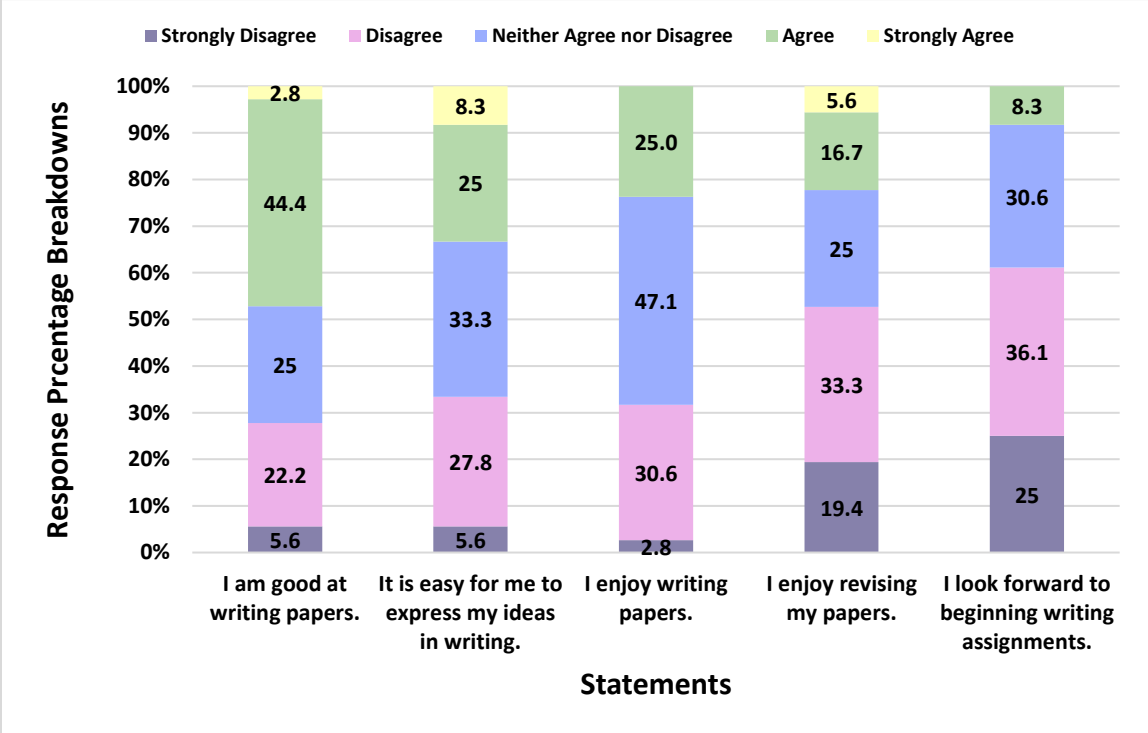
Pre-intervention Survey Construct 1: Attitudes Toward Academic Writing

Statement	Mean	SD
I am good at writing papers.	3.17	1.00
It is easy for me to express my ideas in writing.	3.03	1.06
I enjoy writing papers.	2.89	0.82
I enjoy revising my papers.	2.56	1.16
I look forward to beginning writing assignments.	2.22	0.93

Note. N = 36

Figure 9

Pre-intervention Survey Construct 1: Attitudes Toward Academic Writing



A brief discussion of the data pertaining to selected statements will follow.

I Am Good at Writing Papers. A majority of students (47.2%) indicated on the Pre-Intervention Survey that they either agreed or strongly agreed that they were good at writing papers. This was the only statement in Construct 1 where students expressed more positive agreement with a statement than neutral or negative agreement. However, enough students had either neutral or negative feelings about whether they wrote well that the mean score corresponded to the "Neither Agree nor Disagree" category.

No data from other sources indicated that many students felt positively about their ability to write well. The most positive comment provided on the Student Information Sheets was tempered by a mildly negative self-assessment about grammar: "I'm not the strongest grammatically but I do manage to come up with some creative ideas" (Student 4). More commonly, students expressed negative opinions whether they wrote well. One student included the following on their Student Information Sheet: "I am not good at writing" (Student 36). Students were not asked during class discussions whether they felt they wrote well, however, some students would matter-of-factly share with the class that they were poor writers.

It Is Easy for Me to Express My Ideas in Writing. The mean score for the statement, "It is easy for me to express my ideas in writing" (M = 3.02) indicated that students felt neutral about this ability. Figure 1 shows that responses were divided in thirds between positive, negative, and neutral responses. During class sessions, students who felt confident about their ability to express themselves in writing did not share that opinion in class. Likewise, no student expressed that opinion on the Student Information Sheet. However, the Pre-Intervention Writing Sample provided evidence that some

students struggled with written expression. For example, one student wrote the following, "One small release I did all the design for titled (name deleted) actually won a national award at a business conference in (location and year deleted)" (Student 1). In this case, convoluted syntax obscured the main point the student wished to express. Another student wrote the following:

> In addition, to the innovation and changes I might bring, I also entail a series of soft and technical skills that will also become a huge asset to whoever may hire me. My qualifications match and even succeed company standards, if you hire me I promise you a more Innovative work environment along with new ideals and devices that can become revolutionary. (Student 2)

Incorrect word choices ("entail," "succeed," and "ideals") and comma errors have prevented the student from clearly communicating the intended information.

I Enjoy Writing Papers. Student responses to the statement "I enjoy writing papers" (M = 2.89) aligned closely with comments that they included on their information sheets and with in-class remarks. As discussed previously, students' comments on the Student Information Sheets demonstrated that many disliked writing and English classes.

I Look Forward to Beginning Writing Assignments. No student strongly agreed with the statement, and only slightly over eight percent agreed with it. Conversely, over half the respondents (61%) indicated that they either disagreed or strongly disagreed with the statement. This attitude was demonstrated by the many students (25%) who

submitted drafts of their first essay, a personal narrative detailing an educational obstacle that they faced or were currently addressing. Thirteen students (36%) detailed their struggles with procrastination or similar issues, including apathy and lack of time-management skills. When asked why they failed to submit their work on time, common responses included prioritizing homework for major courses, forgetfulness, and time-management problems. These behaviors aligned with negative attitudes toward writing.

Self-Assessment of Ability vs. Evidence of Ability

Students' beliefs about their ability to identify syntactic structures, their overall ability to use EWE grammar, and use internal punctuation were measured in Constructs 2 and 3 of the pre-intervention survey. Evidence of students' abilities in these areas was measured in the pre-test, the pre-intervention writing sample, journal entries, and sentence writing exercises.

Pre-Intervention Survey: Construct 2. With the exception of the statement regarding prepositional phrases, all the response means fell in the "Neither Agree nor Disagree" category. Conversely, their professed ability to identify independent and dependent clauses was not corroborated by statements students made in class. Disagree" category as shown in Table 3 and Figure 10. Students' self-assessment of their ability to identify prepositional phrases was consistent with their demonstrated ability.

Table 3

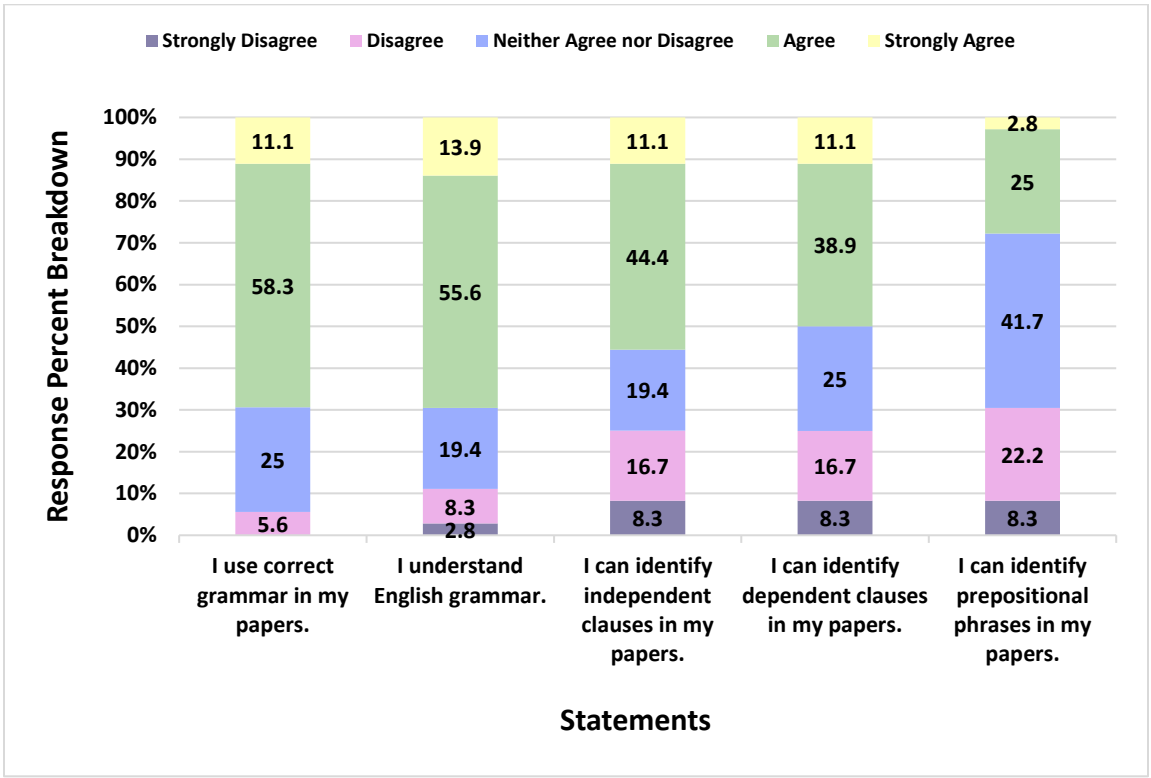
Pre-intervention Survey Construct 2: Syntax Identification

Statement	Mean	Standard Deviation
I use correct English grammar in my papers.	3.75	0.73
I understand English grammar.	3.69	0.92
I can identify independent clauses in my papers.	3.33	1.15
I can identify dependent clauses in my papers.	3.28	1.14
I can identify prepositional phrases in my papers.	2.92	0.97

Note. N = 3

Figure 10

Pre-intervention Survey Construct 2: Syntax Identification



Corroborating evidence. The mean score for the statement, "I can identify prepositional phrases in my papers" (M = 2.92) fell in the "Disagree" category, which was consistent with students' demonstrated ability. When asked in class prior to receiving instruction about prepositional phrases, most could neither name nor identify any prepositions.

Conflicting Evidence. The mean scores for the statements regarding independent and dependent clauses (M = 3.3 and M = 3.28 respectively) suggested that students tended to be unsure about whether they could identify these syntactic structures. However, two weeks after completing the pre-intervention survey, students were asked in a class discussion to define dependent and independent clauses. Most students responded, "I don't know." One week prior to this discussion, many students demonstrated a lack of knowledge about subjects and verbs, two parts of speech that must be present in all clauses. Data regarding their misunderstanding about subjects was located in the students' journals. Class discussions revealed students' difficulty identifying verbs of being.

Student journal entries from September 26, 2019, showed that many (72%) could not explain accurately how to identify the grammatical subject of a sentence. Many students conflated grammatical subject and topic: "A subject in a sentence is the person, place or thing the author is talking about. A subject is what help carries on the sentence, it's like the pivot point" (Student 5), and "A subject is something that generalizes a large amount of information into something small and concise. Subjects help to bring out the key concepts of what someone is trying to get across, [*sic*] but are typically not used by

itself" (Student 7). Other students explained that they relied on context to identify the grammatical subject: "You identify the subject of a sentence by what the sentence is about. If it is about your dog Doug, then Doug is the subject" (Student 26), and "The subject contextualizes the sentence" (Student 30). Finally, some students confused subject and object as demonstrated in the following examples, "Subjects receive an action" (Student 24), and "It is the recipient of action and description" (Student 36).

While students could easily identify action verbs, many did not know that "verbs of being" ("am," "is," "are," "was," "were," "be," "being," "been") are also verbs. As they frequently demonstrated in class even after participating in the verbs of being embodied activity and having the material retaught many times, this concept eluded many students. Students who forgot that verbs of being are considered verbs struggled to identify clauses during the constructive activities. So, although 55.5% of students responded affirmatively on the pre-intervention survey that they could identify independent clauses, and 50% responded positively that they could identify dependent clauses, problems with subject and verb identification would suggest that students were overly confident in their self-assessment about their ability to identify either type of clause. The same conclusion could be reached about students' self-assessment regarding their ability to understand grammar based on their difficulties understanding rudimentary concepts about subjects and verbs. Possible relationships between students' self-assessment of their ability to use EWE grammar in their writing and their understanding of the nature of grammatical concepts and syntactic structures were not clear, however.

Pre-Intervention Survey: Construct 3. Table 4 reports mean scores for students' responses to the statements regarding their perceived abilities to use internal punctuation. The scores demonstrated that students' overestimated their proficiency. The mean scores demonstrated that students' Pre-test mean scores, the number of errors made for each punctuation type on the pre-test, and their pre-intervention writing samples attested to this tendency. Figure 11 presents the percentage breakdown of students' responses to each statement in Construct 2. A brief discussion of the pre-test will precede an examination of the discrepancies between students' self-assessments and their demonstrated abilities.

Table 4

Pre-intervention Survey Construct 3

Statement	Mean	Standard Deviation
I understand how to use commas.	4.17	0.70
I understand how to use colons.	3.33	1.04
I can correctly punctuate a sentence that starts with an independent clause.	3.25	0.10
I understand how to use semicolons.	3.17	1.06
I can correctly punctuate a sentence that starts with a dependent clause.	3.17	1.00

Note. N = 36

Figure 11

Pre-intervention Survey Construct 3 (percentages)

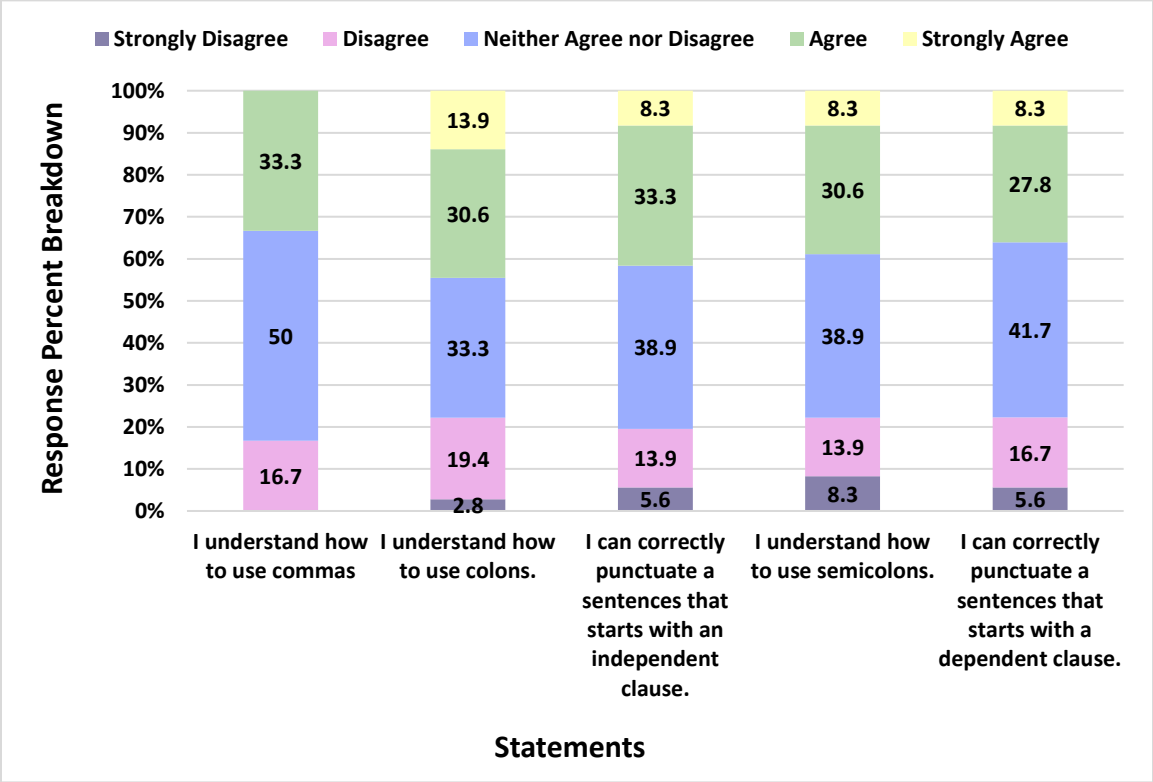


Table 5 presents the mean and percentage scores for each pre-test section and for the overall test. The mean and percentage scores reflect correct responses; they do not report the types of punctuation errors students made. The mean scores for each test sections corresponded to percentages between 72.5% and 74%. These scores indicated that on the test, students' ability to use internal punctuation was average.

Table 5

Pre-Test Mean and Percent Scores

Section	Maximum Points	Percentage	Mean Scores	Standard Deviation
1	12	72.5	8.7	2.11
2	11	73.5	8.09	1.89
3	11	74.1	8.15	1.56
Total Score	34	73.4	24.94	4.71

Note. N = 33

To account more fully for students' ability to accurately use internal punctuation, the instances that students selected the correct punctuation for each type was calculated and the percentage correct was reported in Table 6. The data in Table 6 indicated that correct comma usage (70%) was similar to the undifferentiated percent scores for the pre-test. Students' score for semicolon use was higher (82.4%) than the undifferentiated scores reported. They used colons less accurately (54.5%) than the undifferentiated scores indicated.

Table 6

Internal Punctuation Total Correct Frequencies: Pre-Test

Punctuation Type	Total Possible	Number Correct	Percent Correct
Commas	594	415	70.0
Semicolons	165	136	82.4
Colons	66	36	54.5

Note: N = 33

Comma Usage. The highest mean score in Construct 3 was for the statement, "I know how to use commas (M = 4.17). A combined 83% of students agreed and strongly agreed that they knew how to use commas. Despite the similarity between the percent scores on undifferentiated pre-test data and the percent correct score for comma usage as reported in Table 6, students' demonstrated understanding and ability to use commas in their writing during the pre-intervention phase did not match the differentiated comma use score.

Conflicting Evidence. According to their responses (n = 33) to the October 8, 2019 journal prompt "What do commas do?" 79% were unfamiliar with the function of commas. Students wrote that commas link ideas or indicate a place to breathe in a sentence. The seven students who correctly identified the purpose of commas wrote that commas separate ideas or parts of a sentence to clarify meaning. Students' pre-intervention writing samples also showed that many struggled to properly use commas.

Thirty-six pre-intervention writing samples were collected from participants. However, only samples from students who completed both the pre- and post-intervention

assignment were analyzed (n = 30). Students' difficulties using commas was evident in their samples. For example, eight samples (27%) contained comma splices. This usage reflected students' belief that commas are used to link sentences. Of the students who included comma splices in their samples, six (75%) wrote in their journals that commas are used to link sentences or to indicate where the reader should breathe. Representative samples included the following comma splices: "I'm often described as determined and hardworking, I also work well in a team, having extensive experience in such from my years on a robotics team" (Student 22), and "I believe I am very capable of performing this job, I possess all necessary skills, technical and soft, that this job requires" (Student 8). Comma usage problems were also evident in compound and complex sentences.

Students tended to incorrectly punctuate sentences that included combinations of independent clauses, dependent clauses, and coordinating conjunctions. Of the twenty-seven samples that contained these syntactic structures, twenty (65%) contained comma errors and seven (35%) did not. Fewer students used introductory prepositional phrases in their samples, but of those twenty students who did, seven (35%) contained errors, and thirteen did not (65%). Students who included subordinating conjunctions in their samples (n = 7) were slightly more likely to punctuate those sentences correctly. In this case, four (57%) students correctly used commas while three (43%) did not.

Colon Usage. Students did not use colons in their pre-intervention writing samples often enough to detect trends in their ability to use them. However, students' perceptions of their ability to use them can be compared to their demonstrated ability in the pre-test. The mean score for the statement "I understand how to use colons" (M =

3.33) reflected a neutral attitude. Despite the fact that, many students (44.5%) agreed or strongly agreed that they could accurately use colons, the pre-test scores for colon usage (54.5%) aligned more closely with those students who were unsure about their ability (33.3%) and those who disagreed and strongly disagreed (22.2%) with the statement.

Semicolon Usage. As with colons, students rarely used semicolons in their pre-intervention writing samples, therefore that data will not be presented. The mean score for students' belief about their ability to use semicolons (M = 3.17) was not supported by the pre-test data. In this case, that data did not align with students' performance on the pre-test. The beliefs of students who agreed and strongly agreed that they could accurately use semicolons (39%) were more closely aligned with the results for correct semi-colon usage on the pre-test (82.4%).

Summary of Pre-Intervention Baseline Data

The pre-intervention data showed that overall, students' attitudes about writing fell in the negative to neutral range. Regarding their perceived ability to use commas correctly, students tended to overestimate their ability, most notably in their pre-intervention writing samples. Conversely, students underestimated their ability to use semicolons as demonstrated by the pre-test semicolon scores. However, insufficient use of semicolons in the pre-intervention writing sample prevented a more thorough discussion of that issue. Likewise, students' use of colons in their pre-intervention writing samples resulted in the same inability to examine their ability to use them when writing. The test scores and self-assessment their ability to use colons did not closely align, however.

Mid-Intervention and Post-Intervention Data

This section of the chapter will report on the mid and post- intervention data and compare the post-intervention data to the pre- intervention data. I discuss these data patterns more fully in Chapter 5.

Participants' Attitudes Toward Academic Writing and Self-Assessments

The difference between the number of students who completed the pre-and post-intervention surveys does not support a comparison of the mean scores (pre-intervention survey = 36, post-intervention survey = 13). Therefore, the discussion of the differences between the surveys will be based on percentage breakdowns rather than mean scores. This discussion includes only Constructs 1-3. Data from Constructs 4 and 5 will be presented in conjunction with data pertaining to the pre-and-post intervention writing samples and the student interviews. Figure 12 and Table 7 present the data for Construct 1.

Figure 12

Construct 1: Pre-and-Post Survey Responses

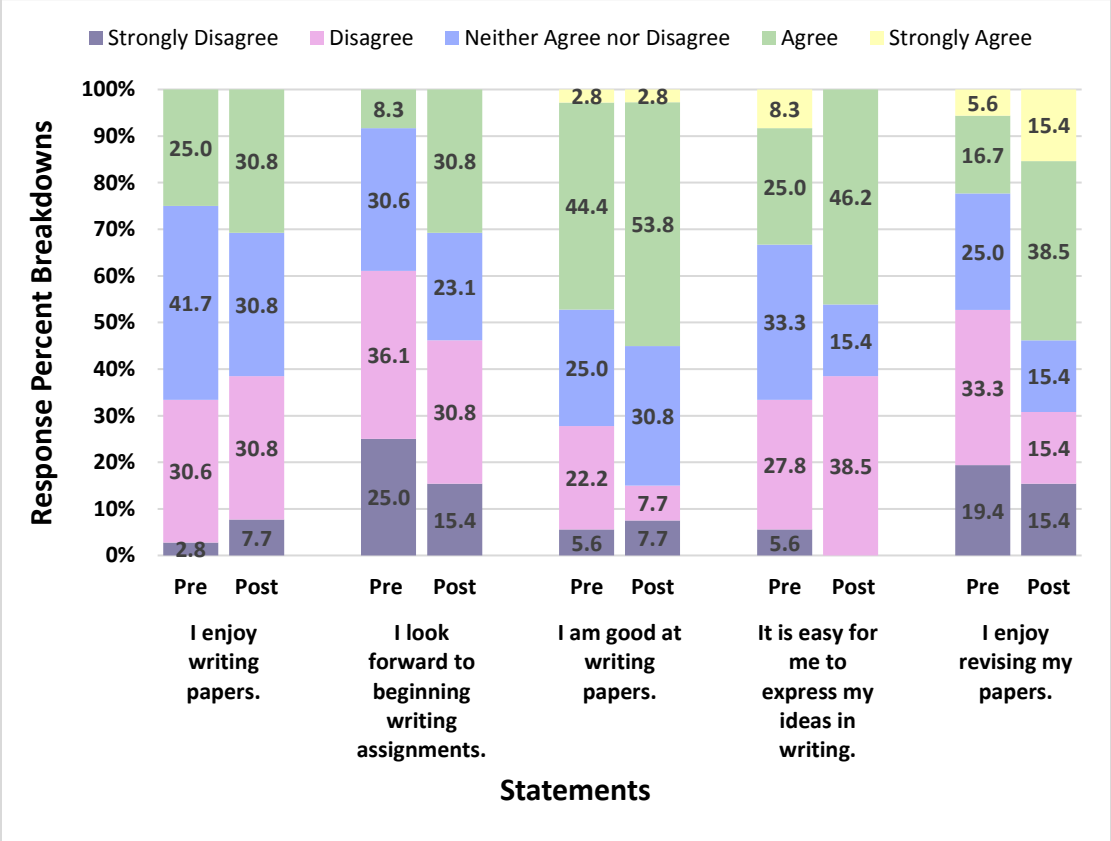


Table 7

Construct 1: Pre-and Post-Intervention Student Responses (Percentages)

Statement	Survey and Change	Strongly Disagree	Disagree	Neither Agree not Disagree	Agree	Strongly Agree
I enjoy writing papers	Pre	2.8	30.6	41.7	25.0	0.0
	Post	7.7	30.8	30.8	30.8	0.0
	Positive			10.9	5.8	
	Negative	4.9	0.2			
I look forward to beginning writing assignments.	Pre	25.0	36.1	30.6	8.3	0.0
	Post	15.4	30.8	23.1	30.8	0.0
	Positive	9.6	5.3	7.5	22.5	
	Negative					
I am good at writing papers.	Pre	5.6	22.2	25.0	44.4	2.8
	Post	7.7	7.7	30.8	53.8	2.8
	Positive		14.5		9.4	
	Negative	2.1		5.8		
It is easy for me to express my ideas in writing.	Pre	5.6	27.8	33.3	25.0	8.3
	Post	0.0	38.5	15.4	46.2	0.0
	Positive	5.6	10.7	17.9	21.2	
	Negative					8.3
I enjoy revising my papers	Pre	19.4	33.3	25.0	16.7	5.6
	Post	15.4	15.4	15.4	38.5	15.4
	Positive	4.0	17.9	9.6	21.8	9.8
	Negative					

Construct 1. As shown in Figure 12 and Table 7, students' attitudes about writing tended to improve over the course of the semester. Some of the most pronounced positive changes were in students' attitudes about beginning writing assignments and revising papers. The data showed negative changes as well. For example, a higher percentage of students indicated that they disagreed with the statement "It is easy to express myself in

writing" at the end of the semester (38.5%) than had prior to beginning the intervention (27.8). However, no student indicated that they strongly disagreed with the statement after participating in the intervention, while 5.6% strongly disagreed with it prior to the intervention.

Despite the net negative change in attitudes about the ease of expressing themselves in writing, a higher percentage of students also agreed that they could easily express themselves in writing post intervention. These changes appeared to result from the decline in the percentage of students who expressed ambivalence about their ability to express themselves in writing (17.9%).

The change corresponded to the percentage of students who reported that they agreed that they looked forward to beginning writing assignments. Prior to the intervention, students most disagreed with this statement. After the intervention there was a 22.5% increase in the percentage of students who agreed with the statement. The percentages of students who either "Strongly Disagreed" or "Disagreed" with the statement decreased as did the percentage of those who expressed ambivalence about beginning writing assignments.

Improved attitudes toward revising was also evident in the data. The percentage of students who either "Strongly Disagreed" or "Disagreed" with the statement "I enjoy revising my papers" declined and the percentages of those who either "Strongly Agreed" and "Agreed" increased by 21.8% and 9.8% respectively. As with the previously examined changes in responses to the statements, the decline in students' ambivalence regarding their abilities appeared to reflect an increase in their confidence as writers.

Construct 2. Participants' level of agreement with statements regarding their ability to understand English grammar and identify targeted syntactic structures increased for each statement over the course of the semester. Figure 13 and Table 8 report that for each statement, the percentage of students who "Strongly Disagreed" or "Strongly Disagreed" with the statements declined. The percentage of students who expressed uncertainty about their abilities also declined for each statement. In some cases, the percentage of students who "Agreed" with the statements after completing the intervention was lower than it was prior to completing it. However, in each of those cases, the percentage of those who indicated strong agreement with the statements was higher.

Figure 13

Construct 2: Pre and Post-Intervention Student Responses (Percentages)

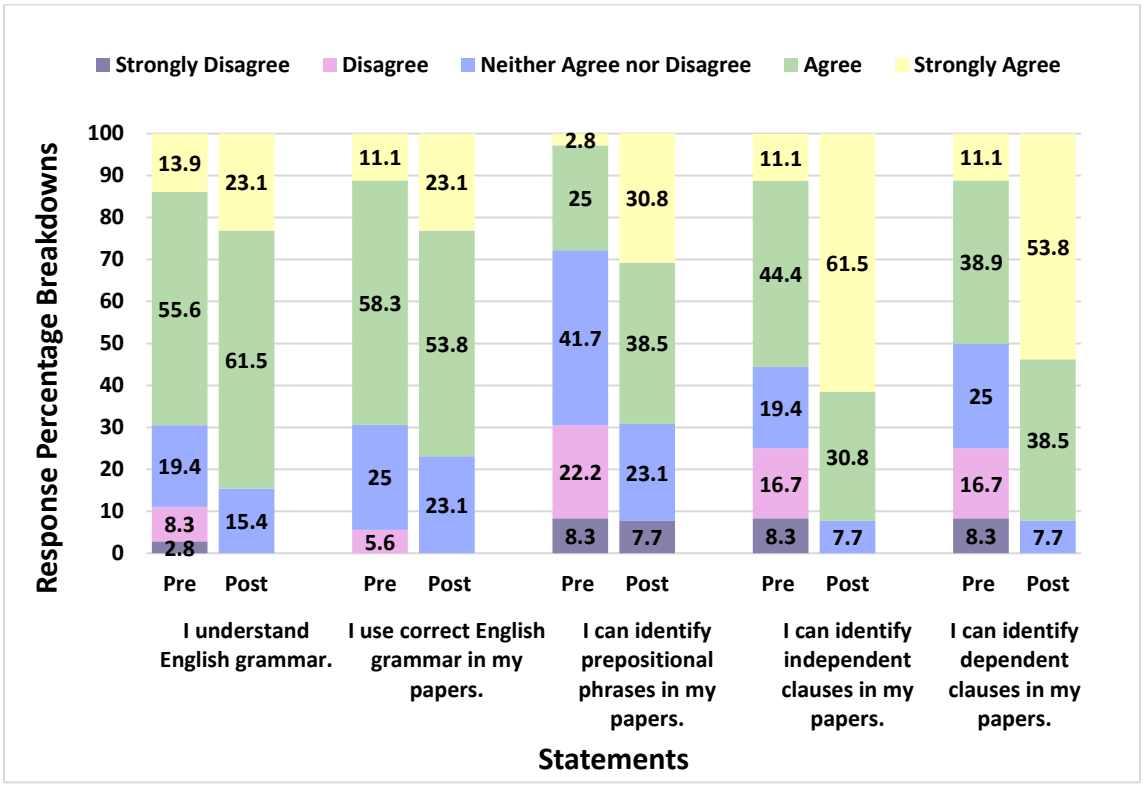


Table 8

Construct 2: Changes in Pre-and Post-Intervention Student Responses (Percentages)

Statement	Survey and Change	Strongly Disagree	Disagree	Neither Agree not Disagree	Agree	Strongly Agree
I understand English grammar.	Pre	2.8	8.3	19.4	55.6	13.9
	Post	0.0	0.0	15.4	61.5	23.1
	Positive	2.8	8.3	4.0	5.9	9.2
	Negative					
I use correct English grammar in my papers.	Pre	0.0	5.6	25.0	58.3	11.1
	Post	0.0	0.0	23.1	53.8	23.1
	Positive		5.6	1.9		12.0
	Negative				4.5	
I can identify prepositional phrases in my papers	Pre	8.3	22.2	41.7	25.0	2.8
	Post	7.7	0.0	23.1	38.5	30.8
	Positive	0.6	22.2	18.6	13.5	28.0
	Negative					
I can identify independent clauses in my papers.	Pre	8.3	16.7	19.4	44.4	11.1
	Post	0.0	0.0	7.7	30.8	61.5
	Positive	8.3	16.7			50.4
	Negative			11.7	13.6	
I can identify dependent clauses in my papers.	Pre	8.3	16.7	25.0	38.9	11.1
	Post	0.0	0.0	7.7	38.5	53.8
	Positive	8.3	16.7	17.3		42.7
	Negative				0.4	

The data for Construct 2 was corroborated by students' demonstrated increased ability to identify clauses and prepositional phrases as they continued to work with the LEGO activity. However, more students struggled to identify prepositional phrases than they did identifying clauses. This behavior mirrored their beliefs about their abilities to identify these syntactic structures.

Construct 3. Compared to the Pre-Intervention Survey, a higher percentage of students indicated confidence that they could use internal punctuation accurately. Additionally, the percentage of students who reported a belief that they could use internal punctuation in sentences containing independent and dependent clauses also increased. Students' self-perceptions of their ability to correctly use internal punctuation did not, however, match the post-test results or the comparison of means for the pre-and-post tests. Figure 14 and Table 9 present the data for Construct 3.

Figure 14

Construct 3: Pre-and Post-Intervention Student Responses (in percentages)

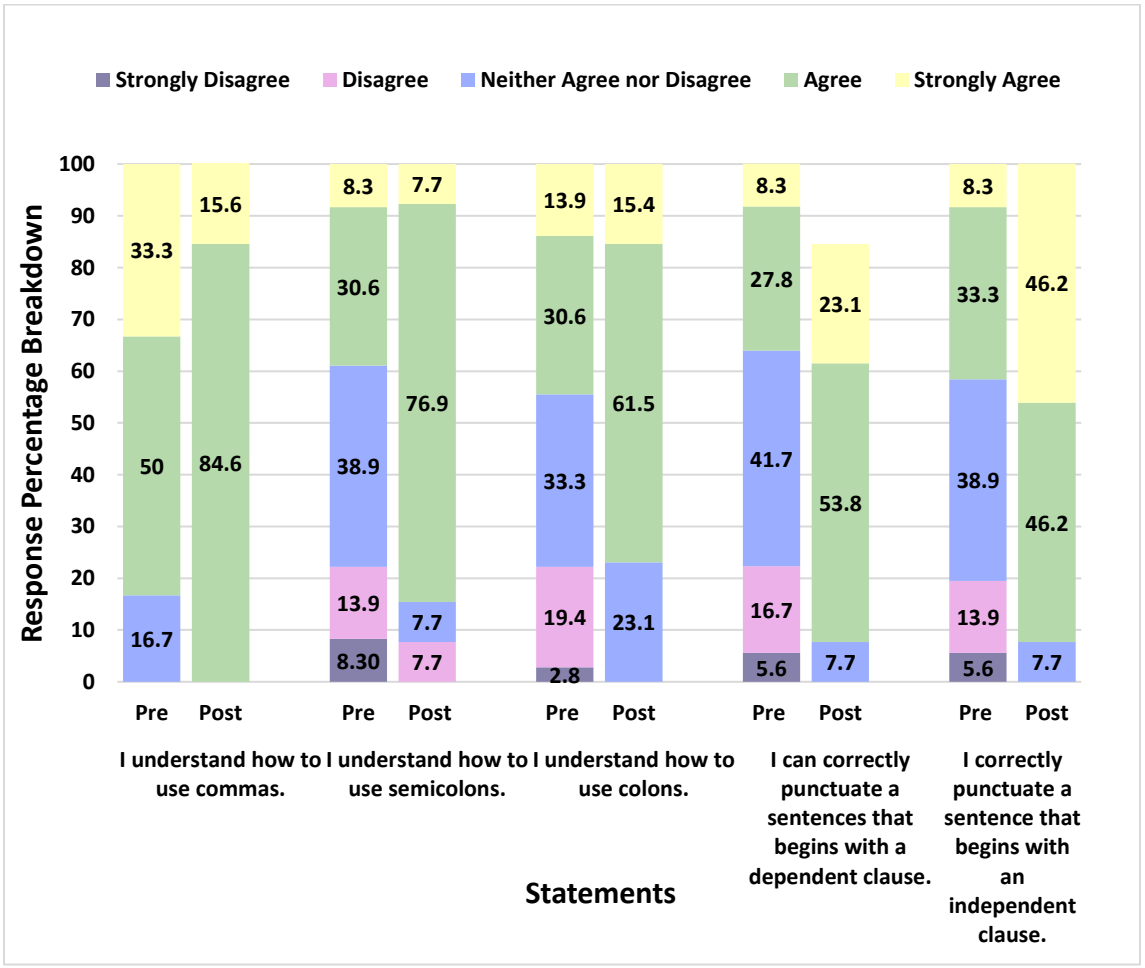


Table 9

Construct 3: Changes in Pre and Post-Intervention Student Responses (in percentages)

Statement	Survey and Change	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I understand how to use commas.	Pre	0.0	0.0	16.7	50.0	33.3
	Post	0.0	0.0	0.0	84.6	15.4
	Positive			16.7	34.6	
	Negative					17.9
I understand how to use semicolons.	Pre	8.3	13.9	38.9	30.6	8.3
	Post	0.0	7.7	7.7	76.9	7.7
	Positive	8.3	6.2	31.2	46.3	
	Negative					0.6
I understand how to use colons.	Pre	2.8	19.4	33.3	30.6	13.9
	Post	0.0	0.0	23.1	61.5	15.4
	Positive	2.8	19.4	10.2	30.9	1.5
	Negative					
I can correctly punctuate a sentence that starts with a dependent clause.	Pre	5.6	16.7	41.7	27.8	8.3
	Post	0.0	0.0	7.7	53.8	23.1
	Positive	5.6	16.7	34.0	26.0	14.8
	Negative					
I can correctly punctuate a sentence that starts with an independent clause.	Pre	5.6	13.9	38.9	33.3	8.3
	Post	0.0	0.0	7.7	46.2	46.2
	Positive	5.5	13.9	31.2	13.5	36.5
	Negative					

Pre-and Post-test Scores

Table 10 reports the mean scores for students who completed the pre-and post-tests (n = 33). As reported earlier, the maximum score for the test was 34 points. Pre-test

scores ranged from 14 to 31 points ($\sigma^2 = 17$), and post-test scores ranged from 12 to 34 points ($\sigma^2 = 22$). While no student earned a perfect score on the pre-test, three did on the post-test. Nineteen students performed better on the post-test, and nine students' scores were lower on the post-test. Five students' scores remained the same. The results of the pre-test (M = 24.94, SD = 4.71), and post-test (M = 25.64, SD = 25.64) indicated that the difference between the means, as indicated by the one-tailed t-test, was not significant, and therefore, the null hypothesis was not rejected, $t(32) = 0.91$, $p < 0.05$.

Although the test results demonstrated that participation in the intervention did not lead to higher test scores, the analysis of correct internal punctuation usage indicated that students were slightly better at determining when and when not to use commas on the test. Table 10 presents the frequencies and percent improvement on the pre-and-post tests.

Table 10

Comparison of Correct Internal Punctuation Usage on Pre-and-Post Test

Punctuation Type	Total Possible	Number Correct Pre-Test	Percent Correct Pre-Test	Number Correct Post-test	Percent Correct Post-test	Percent Difference
Commas	594	415	70.0	438	73.7	+3.7
Semicolons	165	136	82.4	129	78.2	-4.2
Colons	66	36	54.5	36	54.5	0

Students were less successful determining when to use semicolons, and their ability to accurately use colons remained the same. Again, this data conflicts with students' self-assessment of their ability to use internal punctuation. However, data from

the post-intervention writing samples supported students' beliefs that they were better able to use internal punctuation.

Sentence Practice

Although students' positive self-assessments in Constructs 2 and 3 of the post-intervention survey were not reflected in their test scores, many demonstrated that when they wrote their own sentences, they tended to successfully use internal punctuation. In week 6 of the intervention, students were asked to compose and correctly punctuate four sentences that contained combinations of independent and dependent clauses along with coordinating conjunctions. Of the 31 students who completed the exercise, 75% successfully wrote sentences that contained the required elements along with the correct punctuation. Representative samples included, "Sloths move slowly, and they are cute" (Student 5), and "Karen ordered pizza for a party and had to order more since it wasn't enough" (Student 18). These examples demonstrated that the writers were able to apply their understanding of the relationship between coordinating conjunctions, independent clauses, and phrases.

To gauge how well students could implement what they had been taught about semicolons one week earlier, students completed an in-class exercise in which they invented a sentence containing a semicolon connecting two independent clauses. Of the 28 students who participated in the activity, 93% completed the assignment correctly. Examples of correct semicolon usage included the following: "Bobby wasn't paying attention when he threw the ball; he broke his mother's vase" (Student 18), and "I like to eat peanut butter and jelly sandwiches sometimes; I like ham and cheese sandwiches

better" (Student 12). These sentences not only provided information regarding students' retention of the concepts taught using embodied and LEGO activities, but may have also helped prepare them to write their post-intervention writing samples.

Writing Samples

Many students demonstrated in their post-intervention writing samples that they used commas more accurately after having participated in the intervention. The pre-and-post-intervention writing samples will be discussed in this section to better illustrate the changes in the students' ability to accurately use internal punctuation. The quantitative and qualitative data will be presented together. Quantitative data included information regarding the percent change in comma errors and sentence length. Qualitative analysis was based on the clarity of syntax.

For both writing samples, students were not told which syntactical structures or punctuation to include in their paragraphs. Neither were they instructed to use a specific number of commas, semicolons, or colons. They were told, however, to use their best grammar and punctuation. Samples were analyzed from participants ($n = 30$) who completed both writing assignments. The samples were scored for correct comma, semicolon, and colon usage. However, too few semicolons or colons were used by the participants to merit inclusion in the data analysis.

Comma Errors

Fewer students included comma splices in their post-intervention samples than did in their earlier samples. The difference was found to be significant ($p < .05$, $t = 2.53$, $df = 32$). In the pre-intervention sample, eight students included comma splices in their

samples. In the post-intervention sample, just one student had a comma splice in the sample.

An examination of non-comma splice comma errors indicated that although students made fewer such errors on their Post-Intervention Writing Sample, a paired sample t-test showed that the difference in means was not was not statistically significant. Figure 15 presents the data on the difference in comma usage errors in the writing samples. Table 11 reports the percent difference in comma errors in the writing samples.

Figure 15

Pre-and-Post-Intervention Writing Samples: Frequency of Comma Errors

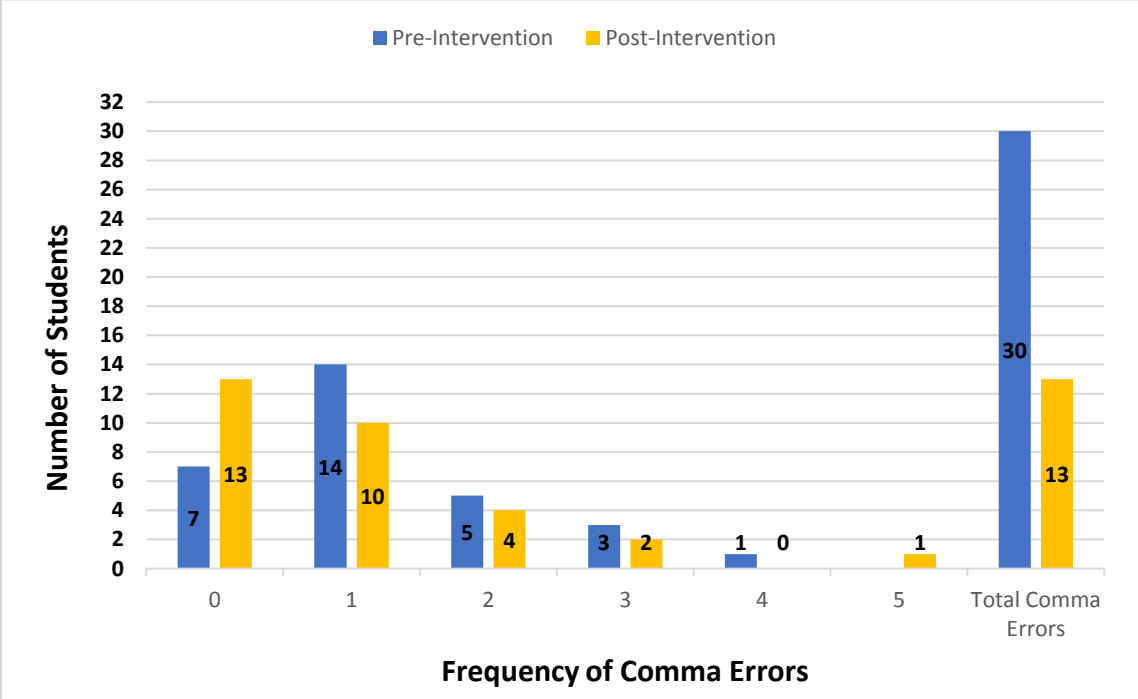


Table 11

Writing Sample Comma Errors

Frequency	Pre Intervention	Percent	Post Intervention	Percent	Percent Improvement
0	7	23.3	13	43.3	20.0
1	14	46.7	10	33.3	13.4
2	5	16.7	4	13.3	3.4
3	3	10.0	2	6.7	3.3
4	1	3.3	0	0	1
5			1	3.3	
Total	30		13		
Mean	1.23		0.97		
Standard Deviation	1.04		1.19		

Observed Sentence Types and Internal Comma Usage Patterns

Although there was no statistically significant difference between the means regarding internal comma errors, it was still possible to analyze students' sets of writing samples for differences in comma usage as well as other syntactic features of their writing. Comma usage was considered only for the following sentence types because they were taught in the intervention:

- compound sentences (contain a combination of independent clauses, phrases, and coordinating conjunctions)
- complex sentences (contain dependent and independent clauses)
- sentences that included an introductory prepositional phrase.

Correct and incorrect comma usage was tallied and inserted into a matrix based on the following variables:

- commas present where needed (correct)
- no comma present where writers often incorrectly place them (correct)
- comma present where not needed (incorrect)
- no comma present where needed (incorrect)

A comparison of the percentage of correct and incorrect comma usage for individual students' pre and post-intervention writing samples was calculated. Comparison of means was not possible because students were not instructed to use a specific number of commas or what types of sentences to write. After calculating the percentage of correct and incorrect comma usage for each pair of samples, the sample sets were sorted into three groups: improved outcome (n = 17), no change (n = 7), and worse outcome (n = 6).

The data showed that for all groups, longer sentences tended to contain more comma errors. Frequently, longer sentences also included extraneous or convoluted verbiage. Students who missed more than two class sessions also made more comma errors than those who missed no classes. Students whose absences were due to illness or accident tended to have fewer comma errors in their samples than students who had unexplained absences. As all sample sets were analyzed for comma errors and then grouped based on whether students' usage improved, worsened, or remained unchanged, any of the sets could have been chosen for inclusion in the presentation below. The four

sample sets included in the discussion were not chosen based on any particular aspect of the writing.

Improved Outcome Group. Pre-intervention sentences were often longer than those in the post-intervention samples. Additionally, the pre-intervention samples tended to contain convoluted sentence structure, while the post-intervention sentences were typically written using a more straight-forward style. Examples from two sample sets within the improved outcome group illustrate common traits of this group.

Sample Set 1 Qualities (Student 12): Average sentence length was shorter for the post-intervention sample (11 words) than for the pre-intervention sample (18 words). The syntax was more straightforward in the post-intervention sample than in the pre-intervention sample. The percentage of correct comma usage increased from the post-intervention (50%) to the post-intervention (100%).

- pre-intervention sentence: ***"I've played in multiple sports teams, as both players and leader positions so I can be a part of or lead any team with ease."***
  - This is a compound sentence containing unclear syntax. It contains 25 words and is missing a comma before the coordinating conjunction "so."
- post-intervention sentence: ***"Writing does not come easy to some people, but to others it does."***
  - This is a compound sentence containing clear syntax, 13 words and no comma errors.

- **Sample Set 2 Qualities (Student 9):** Average sentence length was shorter in the post-intervention sample (13 words) than in the pre-intervention sample (17 words). The syntax in the pre-intervention sample was less clear than in the post-intervention sample. The percentage of correct comma usage increased from the pre-intervention (25%) to the post-intervention (100%).
    - pre-intervention sentence***: "Disney has always been a part of my childhood and it also still is a big part of my life to this day"***
        - This is a complex sentence with unclear syntax containing 23 words.
    - post-intervention sentence: ***"Persistence matters, but the direction of persistence is even greater."***
        - This is a compound sentence with clearer syntax containing 15 words.

Worse Outcome Group. Sample sets in this group also tended to share similar traits with one another. Sentences in the pre-intervention samples were frequently long. However, unlike the Improved Outcome Group, the average sentence length of the post-intervention samples did not seem to impact comma usage. In other words, writing shorter sentences did not appear to lead to correct comma usage. To illustrate this point, average sentence length will be provided in the description of the sample set qualities. As the group name implies, all post-intervention samples in this group contained more comma errors than the pre-intervention samples.

- **Sample Set 3 Qualities (Student 2):** Average sentence length for the pre-intervention sample (28 words) was greater than for the post-intervention sample (14 words). Both samples contain convoluted syntax. The percentage of correct comma usage declined from the pre-intervention (40%) to the post-intervention (0%).
    - pre-intervention sentence: ***"It is a school/university that is notorious for being #1 in Innovation, with that being said, if you hire me for this position I will be able to bring a new form of innovation to your company."***
        - This is complex sentence containing a comma splice, convoluted syntax, and 38 words.
    - post-intervention sentence: ***"If it was not for a constant push and persistence I would have never done them."***
        - This complex sentence contains much clearer syntax; however, it is missing a comma after the dependent clause. The sentence is shorter (16 words) than the pre-intervention sentence.
- **Sample Set 4 Qualities (Student 30):** The average sentence length was shorter for the post-intervention sample (14 words) than for the pre-intervention sample (23 words). Regardless of whether the syntax is clear or convoluted, each sentence contained errors. The percentage of correct comma usage decreased from the pre-intervention (66%) to the post-intervention (0%).

- pre-intervention sentence: ***"In addition, my skills with electrical systems design, and conception have been honed by my interest in the subjects outside of a working environment."***
    - The introductory prepositional phrase in this simple sentence is correctly punctuated. The syntax is relatively clear. However, the comma before "and" should not be included. The sentence contains 24 words.
- post-intervention sentence: ***"Without persistence the quality of an essay is severely limited."***
    - This simple sentence contains clear syntax, but it is missing a comma after the introductory prepositional phrase. This sentence contains 10 words.

No Change Group. Of the eight paired sample sets in the "No Change" group, seven sets contained no comma errors in either sample. For each sample set, the sentences were similar to the Improvement Group post-intervention samples. The one sample set that contained comma errors had a 50% error rate in both samples. The sentences in this set were similar to those in the Worse Outcome Group. Sentences in both samples tended to be long and contained convoluted sentence structures.

Students' Reaction to the Intervention

At the conclusion of the study, student feedback about their experiences with the intervention was collected. Data sources included responses to Constructs 4 and 5 of the

Post-Intervention Survey, short answer responses to questions about the intervention, and student interviews.

Students' Experiences with the Intervention: Quantitative Data

As shown in Table 12 and Figure 16, students expressed generally positive attitudes about many of the embodied activities. They found most value in the comma and subject/object activities. They reported less enthusiasm about the Verbs of Being and Clauses embodied activities. The data showed that students tended to feel that the intervention helped them identify and understand the function of some parts of speech and dependent and independent clauses.

Table 12

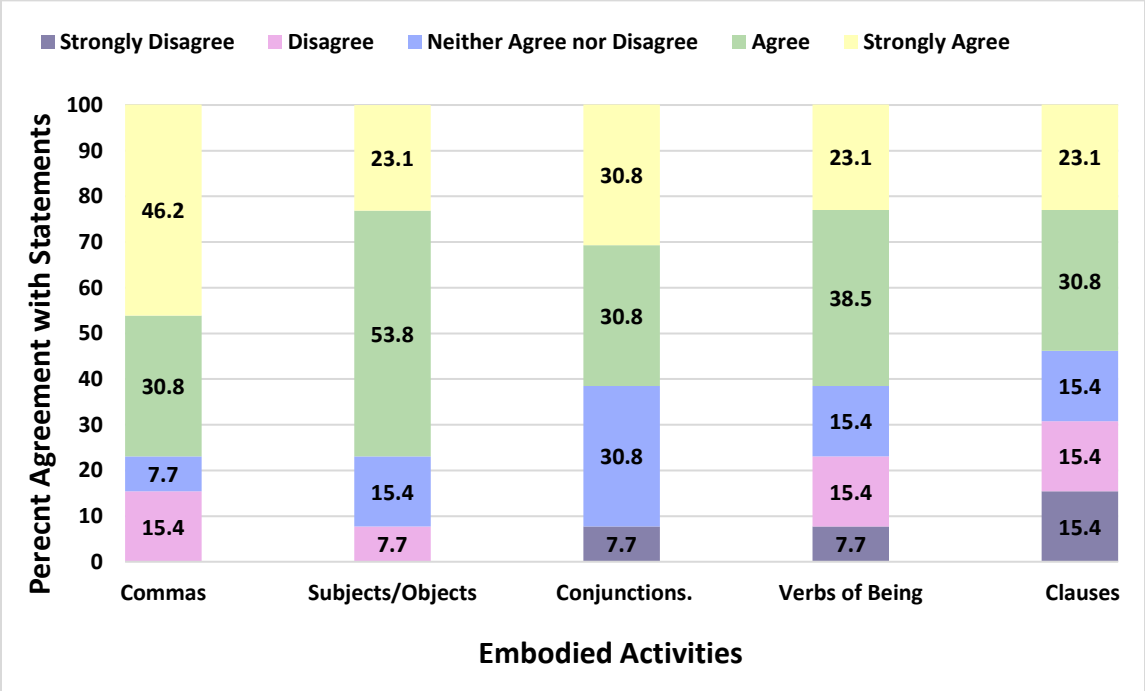
Post-Intervention Survey Construct 4 Responses: Embodied Activities Mean Scores

Statement	Mean	Standard Deviation
Separating bundled office supplies helped me understand what commas do.	4.08	1.12
The "nudging" embodied activity helped me understand the difference between subjects and objects	3.92	0.86
The activity where one student represented a coordinating conjunction and two other students represented clauses helped me understand what coordinating conjunctions do.	3.77	1.17
The "I am" index card that I looked at helped me understand that the eight verbs of being are verbs.	3.54	1.27
Drawing a picture of a time I lost my independence and became dependent on something helped me understand the relationship between independent and dependent clauses.	3.31	1.44

Note. N = 33

Figure 16

Post-Intervention Survey Construct 4 Responses: Embodied Activities



Data collected from Construct 5 of the Post-Intervention Survey showed that nearly all the students either agreed or strongly agreed that they enjoyed the LEGO activities and found them an effective tool to help them apply grammatical and syntactic concepts. Table 13 presents the data in order of highest to lowest mean score for each statement, and Figure 17 presents the data in the same order.

Table 13

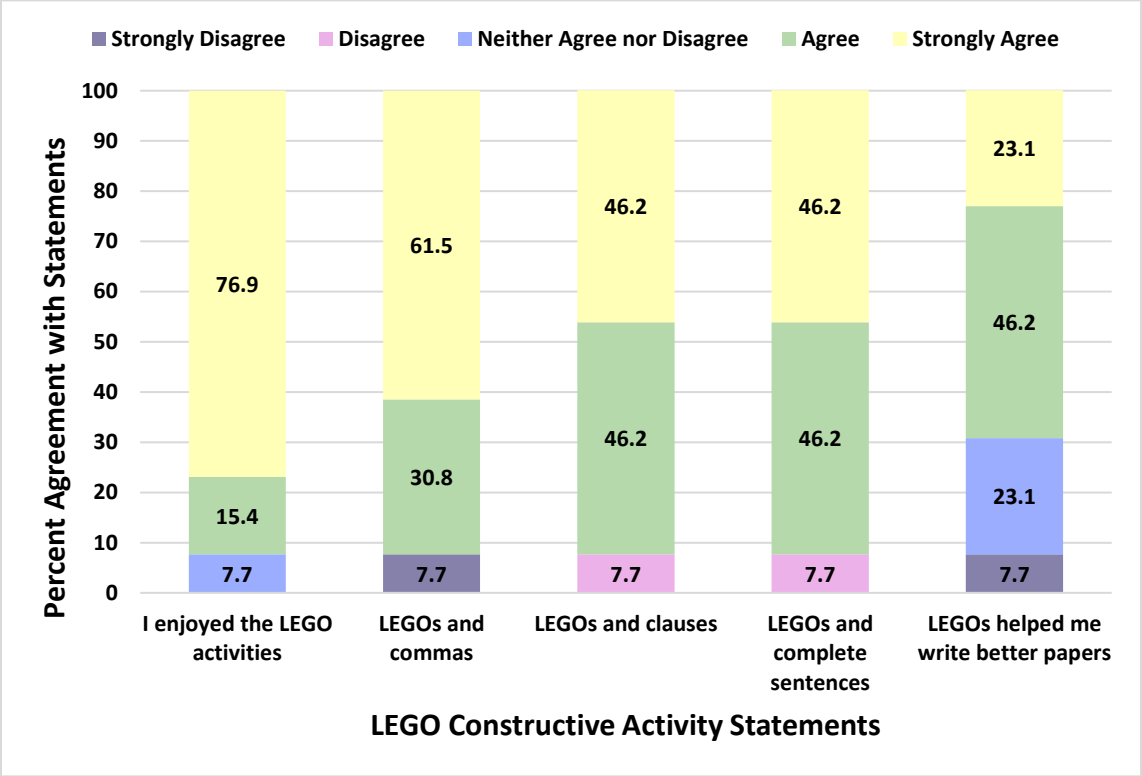
Post-Intervention Survey Construct 5: LEGO Constructive Learning Activity

Statement	Mean	Standard Deviation
I enjoyed the LEGO activities	4.69	0.63
The LEGO activities helped me learn how to use commas correctly.	4.38	1.12
The LEGO activities helped me learn how to correctly punctuate sentences that included dependent and independent clauses	4.31	0.85
The LEGO activities helped me identify complete sentences.	4.31	0.85
The LEGO activity helped me write better academic papers.	3.77	1.09

Note. N = 33

Figure 17

Post-Intervention Survey Construct : LEGO Constructive Activity



Many students reported that the LEGO activities helped them more accurately use internal punctuation, especially commas. The mean scores for the first four statements corresponded to “agree” on the Likert scale. The percentage scores demonstrated that few students strongly disagreed with any of the statements, and that no students strongly disagreed with three of the statements. Although students were most ambivalent about whether the activities helped them write more effectively, nearly 70% agreed and strongly agreed that the LEGO activities helped them write better.

Embodied Activities: Qualitative Data from the Post-Intervention Survey

As the short-answer portion of the Post-Interview Survey was analyzed and coded using open-coding processes, it appeared that the qualitative findings supported the conclusions of the quantitative data. The embodied activities were designed so that students could experience on a whole-body level the function of certain parts of speech, syntactic constructions, and punctuation marks. Students tended to view the embodied activities as a tool that helped them understand the function of specific grammatical concepts and syntactic structures. Like the quantitative data, the qualitative data also revealed that a few students found some embodied activities more helpful than others. However, because the more positive assessments provided richer insights into what students considered useful aspects of the embodied activities, prominent themes that emerged from those comments will be the focus of the following discussion

Physicality vs Passivity. Concepts related to the opposition of physicality and passivity were central to many responses to the question, "What did you most enjoy about the embodied activities?" Many students expressed appreciation for learning through instructional physical activities. One student wrote, "I enjoyed doing things, rather than being lectured at." The first portion of this statement highlighted the student's appreciation for being included bodily in the learning process. This sentiment contrasted with the student's description of being a passive recipient of a teacher's lesson. The seemingly derisive tone of the comment "being lectured at" hinted that the student appeared to find traditional educational approaches less effective than the embodied

activities. “Being lectured at” does not place the student in the center of teaching and learning.

Another student expressed the same attitude: “I most enjoyed the action. Often we are just sitting, but these activities got us involved.” The student linked the embodied activities’ inherent “action” and “involvement” to enjoyment. Although the student did not specify what “got us involved” meant, one could conclude that the student was referring to active, physical involvement in the lesson. Like the previous student, this student attributed positive outcomes to participation and physicality. The student described passive learning as “just sitting,” which lacks student inclusion and student physical engagement in the learning process. Both students’ comments allude to “novelty,” another prominent theme present in the qualitative portion of the Post-Intervention Survey.

Novelty. A few students described more overtly their perceptions of the embodied activities as a novel approach to classroom instruction. One student wrote, “We were able to get out of our seats and try a different way of learning.” This comment referred to the physical freedom to experience classroom learning in a “different,” novel way. The activity was inherently “different” than traditional classroom activities because learning occurred in the body, not just in the mind. Furthermore, the student’s reference to being “able to get out of our seats” seemed to indicate that they felt autonomous during the activities. Finally, the student included “try a different way of learning” in their response. Indeed, the embodied activities required that the student “try” something new. Trying or attempting something new provided the students with an active avenue to participate in

the study. As they engaged in the embodied activities, their experiences became data points; their feedback was integral to determining the study's direction. Therefore, the students had a stake in how the intervention evolved, another novel experience for many students.

Another student wrote, "I understood what we were doing from another angle." The "angle," or perspective," was internal (corporeal) and therefore personal. That student's body experienced the essence of the concept being explored, and that physical experience brought the concept into focus. The student "understood" the material because they inhabited it. Embodied activities physically brought the student into contact with a concept, that when viewed from an exterior point of view, appeared abstract. Once the body acted out the function of the concept, the concept became tangible and real. It made sense. When students were confused about how to perform the embodied activities or they wanted to compare experiences, they were able to consult with classmates. Sharing the experiences potentially deepened their understanding of the concepts taught through embodied activities.

Shared Experience. In their comments, many students expressed appreciation for peer interaction provided by the embodied activities. One student wrote, "The more interaction, the better." Although the student did not expound on the comment, it seemed that they enjoyed learning with others and found it beneficial socially and intellectually. This sentiment was shared by another student who wrote that they enjoyed "interacting with my peers as a group and as a whole class." As in the previous example, this student did not specify precisely what they enjoyed about peer interaction.

Constructive Activities: Qualitative Data from the Post-Intervention Survey

Once the students had internalized the function of the targeted grammatical concepts through participation in the embodied activities, the focus of the intervention shifted to a combined manual and visual experience. The intervention's constructive component, LEGO activities, was well-received by the students. Nearly all the students responded that they enjoyed the LEGO activities. Only one student reported that they did not find them useful or enjoyable. Of the numerous themes that emerged during the data analysis, themes pertaining to "fun," "hands-on," and "visualization" were the most prevalent.

Fun. At the beginning of the semester, no student described learning grammar as "fun." For many, however, their perception of what learning grammar and syntax could be like changed. In response to the question, "What did you most enjoy about the LEGO activities?" one student wrote, "I enjoy using LEGOs," and another responded, "LEGOs are fun." It appeared that these students equated LEGOs with play. Additionally, as the answers were written in the present tense, it seemed that that although they were no longer children, perhaps these students still played with LEGOs. Playing in a university classroom is not a typical experience, which may have made learning about grammatical features of language enticing.

Hands-On. During the semester, many students spoke about being "hands on" learners. The LEGO activity appealed to these students because they used their hands to learn about language. One student wrote, "I like doing things hands on, so I think I was better able to learn that way." This student linked enjoyment with "hands-on" activity.

Another student wrote, “The activity was hands on and easy to understand because the ability to pick up pieces and to move them around is easier to understand than rewriting a sentence.” Ease of understanding was an overriding concern that guided the development of the intervention. Students appreciated that the intervention was created to capitalize on their interests and preferences to learn with hands-on activities.

Visualization. As students manipulated LEGOs to match sentences provided for them, they could *see* how each block (word or punctuation mark) worked together to create meaning. Students had moved from large-scale, embodied experience to hands-on manipulation, to visualization. For example, one student wrote, “I saw how each word interacted.” Another commented, “Seeing in person how a sentence is structured and how each part is a different and important piece.” This student appeared to understand that each word, phrase, clause, and punctuation mark interacted in ways that impacted a sentence’s meaning. Students experienced, many for the first time, that they could make rhetorical decisions about their writing. They possessed the competence and agency to manipulate the sentence structures they initially chose to record their thoughts to more effectively communicate their ideas to a specific audience. “Visualization” in combination with “reflection” was a prominent theme in the student interviews as well as in the written comments on the Post-Intervention Survey.

Student Interviews

Eight students volunteered to participate in the semi-structured interviews. Questions were related to students’ previous experiences in English/writing classes and their experiences with the intervention. I also asked them to discuss what, if any, impact

they believed that their participation in the intervention impacted their writing (the interview protocol is located in Table 14 includes information about each of the eight interview participants.

Table 14

Student Interview Participants

Student	Gender	Missed Classes	Test Scores Pre/Post	Writing Samples Group	Engagement Level	Final Grade
1	Female	0	31/34	Improved	High	A+
2	Male	0	23/28	Improved	High	A-
3	Male	0	28/28	Improved	High	B
4	Male	1	31/34	Improved	High	A-
5	Male	0	23/27	Improved	High	A
6	Male	0	25/24	Improved	High	A-
7	Male	0	26/26	Improved	High	B+
8	Male	0	28/25	Worse	High	B+

Although each interviewee earned an above average final grade, not all of them enjoyed writing. Throughout the semester, Student 2 consistently remarked that he was unsure whether he would be able to write the minimum number of sentences required per paragraph for the essays and other written assignments. His comments were always good-natured, but he was clear about his distaste for writing. None of the other students ever complained about assignment guidelines.

"**Replaying" and the Embodied Activities.** When asked whether he perceived a connection between the embodied activities and their writing, Student 2 responded, "Definitely. So, when I'm writing, I'm thinking about the activity that we did, and that's

helping me better understand what I need to do for that particular sentence." This comment revealed that he mentally replayed the embodied activities while writing. The embodied activities impacted how he composed sentences. Additionally, he referred to "that particular sentence," an indication that as he wrote, he would consider how me might construct sentences to communicate a specific idea.

At the beginning of the semester, Student 2 regularly commented that he could not envision writing a six-to-nine paragraph essay. He reported feeling overwhelmed as he strived to write one paragraph. By the end of the semester, he had changed as a writer. At the beginning of the semester, the student admitted that he wrote as quickly as possible to get an assignment over with. At the time of the interview, he articulated how the embodied activities helped him write more deliberately and rhetorically.

Student 3's response to the question about the connection between the embodied activities showed that it took time for him to connect the experiences from the embodied activities to his writing. He stated that initially,

> ***Student 3***: I just thought of it as something entirely different. But then as we kept, um, going over the - the, um, the - the things that we did in the embodied activities and it kept coming up whenever we were doing assignments, then I - that's when I started making connections.
>
> ***Allison*****:** Okay. And so how did that impact your writing then?
>
> ***Student 3*****:** So, I was definitely more conscious about what I was writing instead of just putting stuff down on - paper or on my, uh, computer.
>
> ***Allison*****:** So, it made you think about what you were doing more?

***Student 3*:** Mm-hm.

Student 8 remarked that the embodied activities "allowed me to be a lot more introspective on the way my sentences are structured. I would say that the content remains largely the same, but how I put it together is different." This comment demonstrated that the student reflected on how the structure of his sentences impacted their meaning.

"(Re)seeing" and the Constructive Activities. A striking observation made by multiple interview participants provided insight into how the intervention impacted them. Those students described how as they wrote, they *saw* the LEGOs in their minds. These comments demonstrated the possibility that embodiment (seeing) and the constructive activity may have worked together in the bodies and minds of students as they wrote.

When Student 2 was asked whether he felt that the LEGO activities impacted his writing, the student responded, "I'd say--yeah. So, when I'm revising my drafts, I can definitely see in my mind the LEGOs." When answering the same question, Student 7 responded with a reference to the LEGOs that corresponded to subjects (blue) and verbs (red) ,"Um, after that, you know, you - you need a comma. Like, if I was looking at an actual sentence, I can, like, put in my head, like, blue and red."

For Student 8, the LEGO activities and the subsequent revisualizations were made abstract concepts real:

> The Lego activities have been fascinating in that it's been able to - it's been able to more accurately visualize how a sentence fits together because it - it brought into the real world a kind of an anchor point for me to - to really conceptualize a - a

> sentence. It put it there in front of me and I was able to - I - I guess I'm just restating at this point, but yeah, I was able to see it in motion--Grounded it to reality for me. Yes, I - I - it allowed me to think more - more precisely about how I was putting sentences together.

His remarks, like those of other students, demonstrated that he not only was considering how to construct sentences but also was thinking rhetorically. It appeared that he was thinking about how to arrange a sentence so that it conveyed what he intended. Comments such as these illustrated that students were engaging with their own thought processes. Such activities have the potential to positively impact the effectiveness of the writing.

"Improving" and the Intervention. Seven of the eight students attributed what they perceived as positive changes in their writing to their participation in the intervention. These students claimed that their writing was "improving." This sentiment expresses more than a positive view of their progress. It suggests that they viewed themselves as engaged in a process. They did not describe themselves as having arrived at a destination where they no longer needed to continue refining their writing. Student 1 commented on what she thought others might say about her writing. She indicated that she did not expect that anyone would say, "Oh my gosh, like, she's doing so good in this." But she added her self-assessment; "but it - it's improving. I think." Although she downplayed the advances she had made over the course of the semester, her self-

reflection indicated that she saw improvement even if others might not have concluded that her writing had become more effective.

Student 2's comments about whether he believed that the intervention had impacted his writing display a certain with similar hesitation: "It's definitely, probably gotten better, I hope." This self-assessment presented the possibility that as the student continued to qualify his response, he was recognizing that writers (including him) continually strive to improve their craft. Ending the comment with "I hope" seemed to indicate that he perceived that he had hope that his writing could improve.

Other students articulated the notion of "improving" through the word "better."

> "I feel -- now I know more about how the grammar works and I'm able to visualize it a bit better. I'm able to better structure my thoughts, unlike right now, I'm - I'm able to better structure my thoughts with, um, in conjunction with my word choice and with the overall plot. I can play around with the structure now that I have a better look at it. (Student 8)

The hopeful tone of "better" as it related to improvement was a prominent feature of the following comment made by Student 6:

> I haven't written in a long time because of - since really senior year, so, um, I feel like it's a big improvement already. Um, I feel like it's, uh - my first drafts are already better than what they would have been. I'm making a lot less mistakes. I think very minor - minor, uh, corrections I think I have to do – approaching now I feel like I just have an easier time. Uh, getting the words out on the page now.

> Rather than - I used to struggle a lot with writing. It was - just wasn't one of my strongest subjects but now I feel like I can get something down and then, uh, as like a first draft and then go back and add to it a little bit later.

Other students expressed more confidence about whether they perceived that their writing was "improving." One spoke about how the intervention provided him with increased confidence that resulted in him using more complex punctuation to communicate increasingly nuanced ideas:

> So, if I - whereas beforehand I wouldn't know whether to use a comma or a semicolon in some places or I wouldn't use it at all. And now I could put it in there knowing that we went over this in class and then we did the activities, and so I - I remember that. And then I'm able to put it down without much thought. And so, seeing it like that really enforced - reinforced, um, all the stuff we were learning. (Student 3)

Student 3's comment that he was able to confidently use internal punctuation because he relied on what he remembered from his experiences with the intervention is evidenced in the following portion of his response, "I'm able to put it down without much thought."

Summary of the Findings

The data showed that many students started the semester with a negative view of academic writing. Although some indicated that they believed they were good writers, many expressed that they believed that they had always been poor writers.

As students became involved with the intervention, they discovered that they could learn about grammatical concepts and retain and apply that knowledge in their own writing. In fact, they could become increasingly competent and effective writers who were able to communicate with a variety of audiences.

Although the mean scores for the pre- and post-tests were not significantly different, the majority of the students' scores did improve. Those students tended to use internal punctuation correctly more often in their post-intervention writing sample than those students whose scores remained the same or who performed worse on the post-test than they did on the pre-test.

Most students attributed increased ability to write effectively to their engagement with the intervention. Some students' comments in the post-intervention survey and the interviews suggested that the embodied and constructive activities worked together to help them respond rhetorically when revising and evaluating their work. These students also expressed that they thought about grammar and syntax as a result of the intervention. Having embodied the function of grammatical elements, followed by building and manipulating sentences through the constructive activities, students gained confidence to experiment with written language in ways they had not prior to participating in the study.

Chapter 5

DISCUSSION

This concluding chapter will revisit the purpose of the study and include a discussion of the development of the intervention as a product of action research as well as its development in light of the four concerns that informed my problem of practice. Additionally, this chapter contains a discussion of the intervention impact as well as implications of this study for those who also teach FYC courses in engineering/STEM contexts. The chapter will end with an examination of implications for further research and concluding thoughts.

Purpose of the Study

The purpose of this study was to examine how embodied and constructive learning activities within a rhetorical framework might help engineering students better understand and apply conventions of effective written communication. I believe that the study results have demonstrated that the intervention has great potential to help students achieve this critical learning outcome.

Development of the Intervention

As mentioned in Chapter 1, four concerns guided the development of the intervention: a) issues related to grammar instruction in FYC courses, b) engineering program accreditation criteria regarding student writing competencies, c) student preparation for, and attitudes toward, academic writing, and d) the adaptability of the intervention for educators and students in different contexts.

The intervention needed to respond to learning outcomes for both FYC courses and ABET accreditation criterion 3.3 without detracting from the educational imperatives of either. Additionally, the intervention needed to address my engineering students' educational needs and learning preferences. This involved creating activities that incorporated movement and hands-on instructional components. Finally, as an education action researcher, I sought to create an intervention for my instructional context that could be adapted and implemented by other educators working in other contexts.

FYC Learning Outcomes and ABET Criterion 3.3

The most recent iteration of the WPA Outcomes (2014) for FYC courses includes four learning goals. I believe that my intervention addresses the outcomes in a unique and helpful way. The WPA Outcomes include the following four components:

1. Rhetorical Knowledge
2. Critical Thinking, Reading, and Composing
3. Processes
4. Understanding Conventions.

"Understanding Conventions" includes diverse concerns, such as writing style, formatting, and citation style. Additionally, the outcomes statement reads in part, "By the end of first-year composition, students should develop knowledge of linguistic structures, including grammar, punctuation, and spelling, through practice in composing and revising" (2014). This goal aligns with the WPA position statement on grammar instruction, which, as discussed in Chapter 2, advises educators to teach grammar, when necessary, in conjunction with writing instruction.

For my study, I defined "effective conventions" as EWE grammar and syntax because those linguistic conventions help engineering students express themselves in a manner consistent with ABET's accreditation criterion 3.3. Many audiences with whom my students will interact when they enter the engineering field will expect that written communication will adhere to EWE conventions as evidenced by the articles and studies that were discussed in Chapter 2.

Although grammar instruction is not commonly included in FYC courses, I contend that teaching conventions rhetorically provided my students with ample opportunities to meet the remaining WPA Outcomes. As students strengthened their language awareness by thinking critically about which syntactic structures most effectively communicated their ideas and intentions, they were also working toward competency in "Critical Thinking, Reading and Composing" as well as "Rhetorical Knowledge." Likewise, when the students wrote informal journal assignments, they were provided opportunities to strengthen their rhetorical awareness and critical thinking, reading, and composing skills because they were required to differentiate between syntactic and grammatical conventions for their formal essays and informal journal assignments. Finally, my students worked toward competency in the "Processes" outcome as they engaged in multiple revisions of their formal essays to determine whether they had selected effective conventions in their drafts.

Engineering Students' Learning Needs and Preferences

I explained in Chapter 1 that my engineering students typically dislike writing, and they claim that writing instruction is of no value to them. They erroneously believe

that professional engineers are not expected to write. These attitudes manifest themselves in unmotivated students who are a challenge to teach. That challenge is compounded by the students' minimal exposure to grammar and language awareness during their K-12 education. Many of my students are ill-prepared to write at the college level; however, when they arrive at the university, many faculty expect they will know how to write clear, academic prose. As Leydens and Snyder (2009) explained, engineering students may have fewer opportunities to practice academic or formal writing than students in other majors because the engineering curriculum has little space for elective courses.

The nature of engineering curricula prompted me to incorporate robust rhetorical grammar instruction in my FYC courses, since my students likely will have insufficient opportunities to engage with academic language in purposeful ways. However, for that instruction to be successful, it had to appeal to my student population, many of whom described themselves as "hands-on" learners. Embodied and constructive learning activities seemed like promising pedagogical approaches to engage my students. The former would help my students internalize the function of the grammatical constructs and provide a foundation for the constructive activities. The constructive activities provided kinesthetic and visual experiences in which my students learned how EWE grammar and syntax works. Together, internalized understanding of function and constructive practice creating and manipulating sentences could lead to students using their grammatical and syntactic knowledge to make and accurately execute rhetorical decisions about how to construct sentences that communicated the students' intended ideas for specific audiences.

Adaptability of the Intervention

Although I created the intervention specifically for my engineering students, my non-engineering students have also enjoyed and benefitted from the intervention. Principles of embodiment apply to all people, so it follows that individuals, regardless of their learning preferences, may benefit from instruction that incorporates this expansive theory. Therefore, I expect that other educators may find the intervention a beneficial addition to their teaching practices. The intervention was not created as a static practice. I have continually refined it to work in my classroom with my students. It can easily be modified to meet the needs of students and educators so in other contexts.

As mentioned in Chapter 4, not all the embodied activities were equally successful. Students did not find the coordinating conjunctions and the clauses activities helpful. I recommend that if activities are not working well, students help refine the ineffective activities. Likewise, other educators may decide that the constructive activities I developed do not work in their context. The principle of moving syntactic elements in a sentence can be practiced with other objects. I chose LEGOs because I knew my students associate LEGOs with fun, and LEGOs are easily accessible. The relationships between the individual LEGOs and grammatical elements is not static either, but those relationships need to be carefully considered for the activities to be most beneficial.

Action Research and the Development of the Intervention

The systematic approach to action research as outlined by Mertler (2017) proved indispensable to my development as a scholarly practitioner. Through engagement in the recursive process of planning, acting, developing, and reflecting on the results of each

action research cycle that I completed in preparation for the final round of research, I refined my understanding of my problem of practice and the intervention that I developed as a response to that problem. Similarly, my research question underwent refinement as part of the action research process.

To illustrate how the action research process shaped my understanding of my problem of practice and impacted the development of my intervention, I have provided information about my Cycle 1 round of research.

Planning Stage

Based on the preparation I had undergone prior to beginning Cycle 1, I planned to carry out the following research activities:

- use the extant version of the intervention, which at that time included only the LEGO activities
- interview a Polytechnic School engineering faculty member to learn about their perceptions of engineering students' writing abilities and practices
- observe and document student attitudes and behaviors regarding the LEGO activities
- interview students at the end of the semester to learn about their experiences with the LEGO activities
- administer a pre- and post-test covering internal punctuation

Acting Stage

I carried out all that I had planned, and the data analysis proved very useful. For example, the faculty member's interview responses aligned with observations I had made

over many semesters teaching engineering students on the same campus: students' writing often lacked appropriate EWE conventions which negatively impacted their ability to communicate clearly. The interview increased my confidence that I had identified a problem that impacted not only my teaching practice, but had larger implications within my local context.

Analysis of the test scores showed mixed results. At the time, I did not have sufficient knowledge of quantitative analysis to interpret the results. I chose to continue using the test because it was designed to test specifically what I wanted to measure.

I learned more about coding processes and found that all the students who participated in the interviews enjoyed working with the LEGOs. They all reported that they believed that their participation in the activities positively impacted their ability to use EWE conventions.

I observed that some students did not follow my instructions regarding the use of the LEGO intervention.

Developing Stage

Students' positive response to the LEGO intervention informed my decision to continue its use for Cycle 2. However, I realized based on students' difficulty in following my instructions, I needed to clarify and simplify the procedures. This included creating individual legends for each student so that they could refer to it as they worked with the LEGOs.

Reflecting Stage

I reported my results to my professor and kept the write-up for my records.

I followed the same process for Cycle 2, however, this discussion will focus on the decisions I made regarding refining the intervention based on the results of Cycle 1 data. I will conclude this discussion with a discussion of how I plan to refine the intervention for further rounds of action research.

Cycle 2

My Cycle 2 round of research was equally as vital to the progression of my study and preparation for dissertation research. After planning and acting on those plans for Cycle 2, I discovered that I needed to make substantial revisions to my intervention. For example, as I mentioned in Chapter 3, I reduced the number of grammatical concepts included in the constructive portion of the intervention after observing that students struggled to work with too many LEGOs. More importantly, however, my discovery that the LEGO activities did not constitute embodied learning, I developed the embodied activities that are explained in Chapter 3. The analysis of the data I collected for this dissertation has already informed how I will revise this ongoing action research study.

Beginning in Fall 2020, I will teach a cohort of Polytechnic School engineering students for both their English 101 and 102 classes. All my cycles of research have led me to believe that students need additional time engaging with the intervention. During Summer 2020, I will begin planning how to improve my interview techniques so that I might help students provide more in-depth responses to survey questions.

Impact of the Intervention

My analysis showed that most students who participated in the intervention made strides toward communicating more effectively in an academic context through their

improved use of grammar and syntax. They demonstrated those abilities in part through their use of internal punctuation. However, the post-test, and post-intervention writing samples also showed that some students' writing did not improve as markedly as some of their peers. Here, I discuss some possible reasons for variations in the student outcomes and attitudes.

Changes in Students' Attitudes Toward Academic Writing

Interestingly, a small percentage of students reported on the post-intervention survey that they were less sure of their writing ability than they were prior to completing the intervention. These students may have realized over the course of the semester that effective writing involves much more thought and reflection than they were accustomed to. Their self-assessments may have been more realistic at the end of the semester. The greater gain, however, was in the percentage of students who felt that they could easily express themselves in writing. This change appeared to be corroborated by the unanimous agreement among interview participants that their writing had improved.

Engagement with Language

Of the many outcomes from the study, one seems particularly important. Students who began the semester reluctant to write and revise their essays engaged with written language in a new, non-threatening way, and fun way. Their responses to the intervention were overwhelmingly positive. Students who could not identify the subject of a sentence learned through a simple, embodied activity the difference between subjects and objects. Once they understood that foundational concept, most students were much better able to distinguish between independent and dependent clauses. Then they could apply what they

had learned about the function of commas to correctly punctuate compound and complex sentences. As they built sentences with LEGOs, they could determine, based on visual evidence, whether a sentence required a comma. They no longer relied on how a sentence "felt." Most importantly, many students made and accurately implemented rhetorical choices about how to structure their sentences to more effectively communicate their ideas as evidenced in their post-intervention writing samples.

The data revealed that "fun" played an important role in students' reaction to the intervention and their willingness to learn about language. Students looked forward to using the LEGO portion of the intervention in particular. Many days, students would ask at the beginning of class whether they would get "to play" with LEGOs. On days that we did not use the LEGO intervention, many students expressed disappointment. Including the LEGO activity in the intervention provided an effective way for me to engage students in language study. On many occasions, students told me during class that my FYC course was their favorite English class because they had fun while learning how to use EWE conventions. For many of my students, English/language arts classes were not fun for them.

Pre-and-Post-Test Outcomes

It is important to provide an explanation about the lack of improvement between the pre-and post-intervention test scores for a number of students. Many factors may have contributed to this outcome. Of the 33 students who took both tests, seven had lower scores on the post-test than on the pre-test. Two of those students experienced significant emotional stresses during the semester, and both students failed the class. One of the

students with a lower post-test score struggled all semester to understand the concepts taught using the intervention, as demonstrated through the mistakes he consistently made mapping sentences with the LEGOs. Additionally, many students were registered with the ASU's Disability Resource Center, many with ADHD. Those students demonstrated difficulty focusing on class activities, which could certainly impact performance on the pre- and post-intervention tests.

Implications of the Study for FYC Faculty Teaching in Engineering/STEM Contexts

My study adds to the small body of literature in support of grammar instruction in writing courses. For those faculty who teach in contexts similar to mine who are interesting in exploring the viability of incorporating explicit grammar instruction in their curricula, they may find that adapting the intervention for use in their classroom improves their students' abilities to use internal punctuation in their writing as it did for many of my students. They may also discover through use of the intervention that their students may even have fun engaging with language.

Implications for Further Research

Transfer of Knowledge and Writing Practices

For some students, it appears that what they learn in one context does not transfer to another. For example, a student whose writing improved over the semester may not have seen an improved post-test score. Students with higher post-test scores may not have shown improvement in their writing. Improvement does not necessarily occur at the same rate across activities. Other areas of concern include the transfer of writing practices to writing in other contexts. Longitudinal studies would also help identify issues pertaining

to transfer of learning and writing practices over time in various contexts. Studies of engineering students' writing over the course of their undergraduate careers would also be highly beneficial.

Students' Experience with the Intervention

Future study regarding refinements to the intervention so it aligns more closely with engineering students' interests is needed to strengthen its applicability to this student population. I believe that when the intervention includes additional elements that link it specifically to engineering topics and processes, engineering students may respond even more positively to the intervention.

Application of Embodied Activities in Writing Instruction

While my study adds to the literature on embodied pedagogies in language arts education, I have only found one resource, Giovanelli's (2015) book on embodied grammar instruction, that explores how embodied activities can be applied to written language instruction. Much more research is needed in this area.

Concluding Thoughts

Teaching composition to engineering students provides me with exciting and rewarding opportunities to grow and improve as an educator as I learn from and about my students. Over the years, I have collaborated with my engineering students to discover pedagogical approaches that work well for them. As they have shared with me how they approach problems from an engineering mindset, I have worked to incorporate their insights into my teaching practice. Students provide me with important clues about how I might continue to improve my teaching methods to meet their needs.

I continually ask students to engage with language and writing in ways that they may not initially understand and that challenge them to think about grammar in ways that are new to them. As they participate in the intervention, many students have demonstrated that their ability to use EWE conventions has improved as has their attitude toward academic writing. Their generosity at helping me refine and improve my teaching so that I can be a more effective instructor inspires me to continue striving to better serve this amazing population of students. It is with great gratitude that I acknowledge their indispensable role in the successful completion of this dissertation.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

EXEMPTION GRANTED

Gustavo Fischman

Division of Educational Leadership and Innovation – Tempe

480/965-5225

fischman@asu.edu

Dear Gustavo Fischman:

On 5/1/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Teaching Professional Engineering Discourse in the First-Year Composition Classroom: A Rhetorical, Embodied Approach
Investigator:	Gustavo Fischman
IRB ID:	STUDY00010045
Funding:	None
Grant Title:	None
Grant ID:	None

Documents Reviewed:	• Comprehensive Recruit Consent Form Student Revised_Dissertation.pdf, Category: Consent Form; • Form-Social-Behavioral-Protocol_Ellsworth _IRB Final.docx, Category: IRB Protocol; • Grammar and Punctuation Pre-and Post-test Draft Instructions_IRB.pdf, Category: Participant materials (specific directions for them); • Pilot Survey Consent Form _ IRB.pdf, Category: Consent Form; • Journal Assignments Draft IRB_Ellsworth.pdf, Category: Participant materials (specific directions for them); • Student Interview Protocol_Dissertation.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Interview Questions for Faculty_Dissertation IRB.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Faculty Interview Consent Letter_Dissertation IRB Final.pdf, Category: Consent Form;

	• Pilot Survey Summer 19_IRB.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (1) Educational settings, (2) Tests, surveys, interviews, or observation on 5/1/2019.

In conducting this protocol, you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Allison Ellsworth

APPENDIX B

SCHEDULE OF STUDY PROCEDURES

Week	Instructional Content	Procedures
1	• Student Information Sheet • discussed study preparatory activities	• distributed and collected Student Information Sheets • distributed and collected student recruitment letters • watched and discussed Dweck's *The Power of Yet*
2-3	• continued preparatory activities	• assigned and liberal education readings • distributed accreditation documents
4	• pre-intervention writing sample • pre-intervention test • pre-intervention survey	• distribute and collect consent forms • provide instructions for all activities • all activities take place in class
5	• introduce embodied cognition activities (ECA) • subject/object	• movement through an angle • nudge your neighbor subject/object ECA
6	• subject vs object review • complete sentences discussion • verbs of being	• pick up pencil ECA • complete sentences ECA • verbs of being "I am" index card ECA
7	• coordinating conjunctions • subordinating conjunctions • independent and dependent clauses • commas	• paired items coordinating conjunctions ECA • independence/dependence picture drawing ECA • comma separating ECA
8	• begin constructive activities	• introduce LEGOs • subject/verb

Week	Instructional Content	Procedures
9	• complete sentences review	• AC LEGO sentences
10	• sentences containing coordinating conjunctions • initial independent clause • initial dependent clauses	• introduction of additional LEGOs • practice sentences
11	• review sentences	• continue practicing
12	• period/comma • comma splices • sentence fragments • semicolons	• period and comma ECA • yarn comma splice ECA • semicolon ECA
13	• colons • introductory prepositional phrases • student interviews	• proposed colon ECA • completed 4 student interviews
14	• student interviews	• completed 4 student interviews
15	• post-intervention	• post writing sample/test/survey

APPENDIX C

COMPREHENSIVE STUDENT RECRUIT CONSENT LETTER

Dear Student:

My name is Allison Ellsworth, and I am a doctoral candidate in the Mary Lou Fulton Teachers College (MLFTC) at Arizona State University. I am working under the direction of Dr. Gustavo Fischman, a faculty member in MLFTC. We are conducting a research study on students' perceptions of and experiences with writing. The purpose of this study is to better understand issues pertaining to students' writing challenges.

We are asking for your help, which will involve your participation in the following in-class activities:

- 5-minute survey regarding your experiences in high school English classes. This survey will be administered at the beginning of the semester. Students must be 18 or older to complete the survey.
- 5-minute survey regarding your experiences with learning activities conducted in this English 101 class. This survey will be administered at the end of the semester. Students must be 18 or older to complete the survey.
- Ungraded pre and post-test punctuation quiz administered at the beginning and end of the semester. The quiz takes approximately 15 minutes to complete. This test is a part of the course, but data will be collected only for students 18 and older.
- Ungraded 5-minute journal entries regarding your experiences with class learning activities. The journal entries are a part of the course syllabus, but data from journal entries will be collected only from students 18 and older.

Approximately 10 students will be recruited to participate in an interview at the end of the semester. If you participate in the interviews, we will ask your permission to record the interview. Only the research team will have access to the recordings. The recordings will be deleted immediately after being transcribed and any published quotes will be anonymous. To protect your identity, please refrain from using names or other identifying information during the interview. Let me know if, at any time, you do not want to be recorded and I will stop. At any point during the interview, you may decide to discontinue your participation. Interviews will be transcribed using an online transcription service and then coded. After completion of the coding, all recordings will be erased.

Your participation in this study is voluntary. If you choose not to participate or withdraw from the study at any time, there will be no penalty whatsoever. You must be 18 years of age or older to participate.

The benefit to participation is the opportunity to provide us with important insights that may help us improve writing instruction for engineering students enrolled in First-Year Composition courses. Your responses to the surveys, quizzes, journal entries and interview will also inform future iterations of the study. There are no foreseeable risks or discomforts to your participation.

Your responses will be confidential. To maintain your anonymity, a master list of student participants will be created, and an ID will be assigned to each student. The master list will be kept in a locked cabinet that only the researchers will have access to. Pre and post tests will be kept in a different locked cabinet apart from the master list.

Electronic data will be kept on a password protected computer to which only the researchers will have access. Results from this study may be used in my dissertation, reports, presentations, or publications, but your name will not be used. The master list will be destroyed one year after the completion of the study.

If you have any questions concerning the research study, please contact the research team – Gustavo Fischman at fischman.asu.edu or Allison Ellsworth at allison.ellsworth@asu.edu or 480-727-4529.

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact Gustavo Fischman at fischman.asu.edu or the Chair of Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance at 480-965-6788.

Thank you,

Allison Ellsworth, Doctoral Candidate

Gustavo Fischman, Professor

By signing below, you are agreeing to be part of the study.

Name

Signature

Date

APPENDIX D

STUDENT INTERVIEW PROTOCOL

1. Can you describe your experiences in high school English and writing classes?

2. Prior to this English 101 class, did you take any other writing classes at ASU or any other college or university?

3. If yes, could you describe your experiences in that/those class(es)?

4. Did you receive any type of grammar instruction in high school?

5. Did you receive any grammar instruction in other university or college writing classes? (only if the participant took post-secondary writing classes including WAC 101).

6. In what ways do you feel your writing has changed over the course of the semester?

7. How would you describe your experiences with all the embodied activities?

8. What sorts of connections, if any, do you see between your participation in the embodied activities and your writing ability?

9. How would you describe your experiences with the LEGO activities?

10. What sorts of connections, if any, do you see between your participation in the LEGO activities and your writing ability?

11. Is there anything unrelated to the embodied activities that pertains to this class that you'd like to share with me?

APPENDIX E

PERMISSION TO USE STUDENT INFORMATION SHEET LETTER

Dear Student,

Thank you for your participation in my doctoral dissertation research study last semester. Your participation has been extremely helpful.

I am asking your permission to use select comments that you provided on the information sheet "Getting to Know You: English 101" that you filled out the first day of the semester. Your comments regarding your experiences in high school English classes and concerns that you had about writing classes would help me better explain students' feelings about academic writing.

No identifying information about you will be included in my dissertation.

For me to use your comments, you must be 18 or older.

You participation is voluntary and will not impact your grades.

If you are willing to let me use your comments, please respond to this email and indicate your consent.

Thank you,

Allison Ellsworth, Doctoral Candidate

Gustavo Fischman, Professor

If you have questions about this request, please email me at allison.ellsworth@asu.edu or Dr. Gustavo Fischman at fischman@asu.edu.

This study has been reviewed and approved by the Arizona State University Institutional Review Board. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can

contact the Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

APPENDIX F

STUDENT INFORMATION SHEET

Getting to Know You: English 101

Please take a few minutes and respond to the following questions. This will help me know more about you and your experiences in English/writing classes. Thank you!

1 What is your name?

2 What do you prefer to be called?

3 Where are you from?

4 Have you chosen a major? If yes, what is it?

5 Is English your native language?

6 Do you speak and/or read any languages other than English? If yes, which one(s)?

7 Have you taken any freshman writing classes (including ENG 101) at ASU or any other university/college before taking this class? If yes, what have you taken, where did you take it, and who was the instructor?

8 Describe your experiences in high school English/writing classes?

9 Describe any concerns you have about writing classes?

10 In what ways do you hope this class will benefit you?

11 What helps you learn and succeed academically?

12 What are some of your educational, career and personal aspirations?

13 Is there additional information that would be helpful for me to know about you?

APPENDIX G

PRE-AND-POST INTERVENTION WRITING SAMPLE INSTRUCTIONS

Pre-Intervention Writing Sample Instructions

Imagine that you are applying for a job that matches your career aspirations. Write the first paragraph of a cover letter that would accompany your application. This is a formal letter, so use your best grammar, punctuation and write in complete sentences.

Post-Intervention Writing Sample Instructions

Write a paragraph containing a minimum of 6 sentences in which you explain the importance of "persistence" when writing an academic paper. Use your best grammar and punctuation and write in complete sentences.

APPENDIX H

CONSENT TO USE COPYRIGHTED PRE-AND-POST-TEST

EMAIL EXCHANGE

Allison,

Oh my gosh, that was the best conversation I've had since writing that dissertation. Thank you for hunting me down for two years.

I certainly grant you permission to use my instrument in your dissertation studies. I look forward to having more conversations with you about your research.

Thank you, Jennifer, for helping us in this matter.

Pam

Pamela Van Horn Howard, PhD

719-685-4858

On Fri, Sep 6, 2019 at 9:41 AM Allison Ellsworth <Allison.Ellsworth@asu.edu> wrote:

Hello Pam,

It was such a pleasure to speak with you yesterday! Thank you so much for the time you spent with me discussing your dissertation, my research, and the joys of commas and syntax. Above all, thank you for your generosity in granting me permission to use your assessment tool for my dissertation.

I don't know what the next steps are for formalizing your consent, but perhaps Jennifer can lend assistance.

All the best,

Allison

Hello Jennifer,

Yesterday afternoon I found a phone number online for Pamela. We had an amazing conversation, and she was thrilled to hear that I have learned so much from reading her dissertation. She granted me permission to use her test instrument for my dissertation!

I am copying you on an email I'm sending to Pam thanking her for her generosity.

Best,

Allison

APPENDIX I

PRE-INTERVENTION SURVEY

Pre-Intervention Survey

Fall 2019

Directions

Q1. Circle the answer that best matches your feelings about your own academic writing, where

1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I enjoy writing papers.	1	2	3	4	5
I look forward to beginning writing assignments.	1	2	3	4	5
I feel that I am good at writing papers.	1	2	3	4	5
It is easy for me to express my ideas in writing.	1	2	3	4	5
I enjoy revising my writing assignments.	1	2	3	4	5

Q2. Select the answer that best matches your feelings about your ability to use English grammar in your academic writing assignments, where

1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I understand English grammar.	1	2	3	4	5
I use correct English grammar in papers.	1	2	3	4	5
I can identify prepositional phrases in my papers.	1	2	3	4	5
I can identify independent clauses in my papers.	1	2	3	4	5
I can identify dependent clauses in my papers.	1	2	3	4	5

Q3. Select the answer that best matches your ability to use punctuation in your academic writing assignments where

1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I understand how to use commas.	1	2	3	4	5
I understand how to use semicolons.	1	2	3	4	5
I understand how to use colons.	1	2	3	4	5
I can correctly punctuate a sentence that starts with a dependent clause.	1	2	3	4	5
I can correctly punctuate a sentence that starts with an independent clause.	1	2	3	4	5

Knowing some personal information about you will help me learn more about student attitudes toward academic writing. Please circle the answer that best applies to you.

Gender Identification	Male	Female	Other	Prefer not to Respond
Age	18	19	20	21 or Older
Class Standing	Freshman	Sophomore	Junior	Senior

What is your major? _____

Thank you for your time and help with this research. If you have questions about this pilot study, please contact Allison Ellsworth at 480-727-4529 or at allison.ellsworth@asu.edu.

Sincerely,

Allison Ellsworth

Doctoral Candidate

Arizona State University

APPENDIX J

POST-INTERVENTION SURVEY

Directions

Q1. Circle the answer that best matches your feelings about your own academic writing, where
1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I enjoy writing papers.	1	2	3	4	5
I look forward to beginning writing assignments.	1	2	3	4	5
I feel that I am good at writing papers.	1	2	3	4	5
It is easy for me to express my ideas in writing.	1	2	3	4	5
I enjoy revising my writing assignments.	1	2	3	4	5

Q2. Select the answer that best matches your feelings about your ability to use English grammar in your academic writing assignments, where

1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I understand English grammar.	1	2	3	4	5
I use correct English grammar in papers.	1	2	3	4	5
I can identify prepositional phrases in my papers.	1	2	3	4	5
I can identify independent clauses in my papers.	1	2	3	4	5
I can identify dependent clauses in my papers.	1	2	3	4	5

Q3. Select the answer that best matches your ability to use punctuation in your academic writing assignments where

1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I understand how to use commas.	1	2	3	4	5
I understand how to use semicolons.	1	2	3	4	5
I understand how to use colons.	1	2	3	4	5
I can correctly punctuate a sentence that starts with a dependent clause.	1	2	3	4	5
I can correctly punctuate a sentence that starts with an independent clause.	1	2	3	4	5

Knowing some personal information about you will help me learn more about student attitudes toward academic writing. Please circle the answer that best applies to you.

Gender Identification	Male	Female	Other	Prefer not to Respond
Age	18	19	20	21 or Older
Class Standing	Freshman	Sophomore	Junior	Senior

What is your major? _____

Thank you for your time and help with this research. If you have questions about this pilot study, please contact Allison Ellsworth at 480-727-4529 or at allison.ellsworth@asu.edu.

Sincerely,

Allison Ellsworth

Doctoral Candidate

Arizona State University

APPENDIX K

POST-INTERVENTION SURVEY SHORT-ANSWER QUESTIONS

1. What did you most enjoy about the embodied activities?

2. What did you least enjoy about the embodied activities?

3. How do you think the embodied activities could be improved?

4. What did you most enjoy about the LEGO activity?

5. What did you least enjoy about the LEGO activity?

6. How do you think the LEGO activity could be improved?

APPENDIX L

PRE-AND-POST TEST

This test will be administered

- During class
- On paper
- Will not count toward students' course grade

Section 1: In this first section, you are asked to decide whether a comma, semicolon, or colon is missing from the sentence. For each of the following sentences, choose one answer that best clarifies the sentence's meaning from the choices given.

Example: This test may seem difficult but you will do well.

A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-1
We had been planning our ski trip for three months events didn't turn out as expected however'
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-2
Before we even made it onto the slopes we experienced our share of mini-disasters.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-3
First, the car wouldn't start and then the "check engine" light came on.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-4
To our amazement, however we found a small-town garage open for business at 6:00 a.m.
A Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-5
Charging us $400 the mechanic fixed our car.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-6
We arrived at the resort three hours behind schedule and found the parking lot completely full.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed

1-7
We were redirected to an overflow lot where we found a spot in the very last row.
A Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-8
We maneuvered into the spot just as the shuttle was pulling away.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-9
We had to wait in three long lines one for the shuttle, one for the tickets, and one for the ski lift.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-10
We managed two runs down the slopes which were very icy, and then I injured my ankle.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-11
We gave up and left for home.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

1-12
We learned this lesson from our experience leave for the slopes the day before you want to actually ski.
A. Missing a comma
B. Missing a semicolon
C. Missing a colon
D. No additional punctuation is needed.

Section 2: In this section, you are asked to decide whether you should Add some punctuation.

Locate the caret (^) in the following sentences and choose the answer that best clarifies the sentence's meaning from the choices given.
Example:
This test may seem difficult ^ but you will do well.
A. Insert a comma
B. Insert a semicolon
C. Insert a colon
D. No additional punctuation is needed.

2-1
Because we had been warned of the impending snowstorm ^ we bought extra food and set the snow shovel by the front door.
A.Insert a comma
B. Insert a semicolon
C. Insert a colon
D. No additional punctuation is needed.

2-2
The windows were drafty ^ so we applied some weather-stripping.
A Insert a comma
B Insert a semicolon
C. Insert a colon
E. No additional punctuation is needed.

2-3
Before the temperature dropped ^ we cut some firewood for the wood-burning stove.
A. Insert a comma
B. Insert a semicolon
C. Insert a colon
D. No additional punctuation is needed.

2-4
We lit a fire ^ as the snow began to fall.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-5
We drank hot cocoa by the fire ^ which was casting an amber glow throughout the room.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-6
We were delighted to see the snow piling up ^ maybe school would be cancelled.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-7
We burned all of the wood ^ that we had chopped earlier.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-8
We awoke to a foot of snow ^ and news that the city was closed for business.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-9
My favorite activities on snow days ^ are sleeping in, reading a good book, and taking a walk outside.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-10
Instead of those activities however ^ I usually have to shovel the walk, unbury the car, and make sure the pipes don't freeze.
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

2-11
A Insert a comma
B Insert a semicolon
C Insert a colon
D No additional punctuation is needed.

Section 3: In this section, you are asked to decide whether you should retain, remove, or Replace commas.
For each of the following sentences, choose one answer that best clarifies the sentence's meaning from the choices given.
Example:
This test may seem difficult, but you will do well.
A Retain all commas.
B Remove all commas.
C Replace comma(s) with semicolon(s).

3-1
Anyone, who has an interest in photography, is encouraged to sign up for Journalism 101 this semester.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-2
A journalistic photographer will work with the student news writers, and will be required to photograph events on campus as needed.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-3
The duties of a journalistic photographer are challenging, the hours are flexible though.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-4
The journalism department partners with the film department to teach photographers how to process film, which presents added benefits to staff photographers.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-5
Each class admits only two student photographers, because space is limited.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-6
The journalism class photographers work under the guidance of paid staff photographers of the student newspaper, paid photographers have already completed the journalism class.
A Retain all commas.
B Remove all commas.
C Replace comma(s) with semicolons

3-7
In general, the journalism course offers young journalists both an education in journalistic techniques and practical writing experience.
A Retain all commas.
B Remove all commas.
C Replace comma(s) with semicolon(s).

3-8
Because the class is so popular, applicants for the course must submit a writing sample that conforms to AP Publication Style.
A Retain all commas.
B Remove all commas.
C Replace comma(s) with semicolon(s).

3-9
Style manuals for AP, the preferred publication style for most newspapers, may be purchased at the bookstore.
A Retain all commas.
B Remove all commas.
C Replace comma(s) with semicolon(s).

3-10
The AP manual is reasonably priced, and it is one book that journalists are sure to use often.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

3-11
The class is demanding, it takes hard work and long hours to produce a quality student newspaper.
A. Retain all commas.
B. Remove all commas.
C. Replace comma(s) with semicolon(s).

Howard, P. (2012) Development of a measure assessing knowledge and use of internal punctuation to signal syntactic relationships (Unpublished doctoral dissertation). University of Denver, Denver, CO. Available from ERIC. (1651832065; ED549763) . Retrieved from https://digitalcommons.du.edu/cgi/viewcontent.cgi?article=1294&context=etd

APPENDIX M

STUDENT JOURNAL PROMPTS

September 19, 2019 Journal Prompt

1. Do you remember whether you were taught grammar and punctuation in K-12?

2. If yes, what was your experience like?

3. Do you believe understanding how to use grammar and punctuation is important?

September 26, 2019 Journal Prompt

1. What is a subject in a sentence?

2. How can you identify a subject?

3. What does a subject do?

October 29, 2019 Journal Prompt

Write the following:

2 sentences with two independent clauses connected with a coordinating conjunction

2 sentences that contain a coordinating conjunction and no comma.

APPENDIX N

CULTURALLY SUSTAINING PEDAGOGY

Paris (2012) argued that culturally sustaining pedagogies do not seek to elevate Dominant American English (DAE) as the preferred spoken or written language. Rather, as part of their duty to help maintain cultural and ethnic diversity in the United States, educators must work to "perpetuate and foster—to sustain—linguistic, literate, and cultural pluralism as part of the democratic project of schooling" (p. 95). In a later work, Paris and Alim (2017) called for teachers to acknowledge that students of color must be allowed to gain the skills of self-determination, which can only happen when they are able to subvert the power structures that subjugate them. Paris and Alim invoked Delpit's (1988) work in making this argument.

Delpit (1988) argued that Black children need explicit instruction about the rules of the dominant culture so that they could subvert the unjust power structures that kept these children from succeeding. In a later article, Delpit (1992) argued against Gee's (1989) contention that teaching the Dominant discourse to students for whom such discourse was not part of their culture, damaged them. Delpit called again for teachers to provide explicit instruction in the Dominant discourse for minority children.

I contend that there are ethical ways in which to teach what Gee called the Dominant Discourse. I believe that I accomplish this by combining socially sustaining pedagogical tenants with contextualized, purposeful, and transparent instruction in Standard English. I tell students that I neither believe nor teach that Standard English is the "best" form of English. There is no "best" version of English. I show students that sometimes, so-called "correct" English, is inappropriate in certain contexts. I also explain

that in professional contexts, industry expects practitioners to be adept at using SE and EWE. I believe that it is in all my students' best interest to gain fluency in SE and EWE.

I consider the rich linguistic differences among my students a benefit to the entire class. I frequently ask students who speak, read, or understand languages other than English to share insights into their languages and then we discuss how the languages are similar or different than English. When appropriate, I also share with students my knowledge of foreign languages. I want them to know that I prize my foreign language abilities. I frequently discuss the tremendous advantages of possessing skills in multiple languages and dialects of English. I want to share with students my firm belief that regardless of which language or dialect a person speaks, knowing or learning other languages or registers of English provides pathways to better understanding the work we do in my English 101 class with Edited Written English. This perspective is supported by the NCTE, which states that, ". . . instructors should identify the strengths second-language writers bring to the classroom and seek opportunities to use these writers' literacy and linguistic practices as a foundation" (NCTE, Understanding and Teaching Writing: Guiding Principles).