An Investigation on the Effectiveness of Iconic Gestures as a Vocabulary Teaching Strategy for Novel Concepts in the L2 Classroom

By

Collin S. Olson

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Dissertation Committee:

Dr. Eric Oslund, Chair

Dr. Amy Elleman

Dr. Aleka Blackwell

Dedication

for Lita and Lito

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Abstract

Gestures and other bodily movements are frequently used as instructional strategies in second language classrooms. Research has demonstrated that gestures are an effective strategy to improve L2 vocabulary recall. However, previous studies have only used vocabulary items that are known to participants in their native languages. Additionally, previous research has only investigated if gestures improve L2 recall, but whether such recall results in improved passage comprehension has not been studied. In this study, adolescent Spanish-speaking participants learned vocabulary items in English. Half of the words were concepts known to the participants in L1, but the other half were concepts that they had not yet learned in their native language. Half of the participants learned the vocabulary items while making representative gestures, while the other half learned the words by copying them down. After four days of instruction, participants took vocabulary and comprehension assessments over the words they learned. Results suggested that gestures were no more effective for learning L2 vocabulary as conventional second language teaching strategies, and that participants who copied the words learned abstract concepts better than those who made gestures. All participants demonstrated improved comprehension of sentences containing target vocabulary, but there was not a statistically significant difference between conditions. The results of this study suggest that gestures are not a useful strategy for students learning a second language in content-embedded classrooms. Limitations and directions for future research are discussed.

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CHAPTER 1: INTRODUCTION

Background and Statement of Problem

In 2000, English language learners (ELLs) made up 8.1% of the total school population in the United States. By 2017, this number had increased to 10.1% nationally (National Center for Education Statistics, 2019, Table 204.20). An analysis by August et al. (2014) found that between 2004 and 2014, the ELL school population in the United States increased 32% while total school enrollment only increased 4.9%. Thus, the number of children who speak a first language other than English has been growing faster than the population of children who are native English speakers in the United States (Gandara & Rumberger, 2009). Between 1990 and 2005, 10.8 million school-aged children immigrated into the United Sates (Padolsky, 2005), but many children who enter ELL classrooms were born in the United States to households that speak a language other than English (Bunch, 2013). Frey (2011) estimates that roughly one in three children in the United States grows up in an immigrant household if one includes second and third generation immigrants. These numbers are expected to continue to increase as global migration is estimated to reach over 400 million individuals by 2050 (Suarez-Orozco et al., 2011).

While immigration has been a constant in the history of the United States, what it means to be an English speaker has changed because schools have more recently focused on mastery of academic language as an indicator of fluency (Suarez-Orozco et al., 2011). Similarly, increased attention on standardized testing and measuring English ability has created the expectation that students can comprehend grade-level English content, not

just be fluent conversational speakers. However, ELLs are not a homogeneous group, and these students are disparately prepared to succeed in US classrooms. Often, the only characteristic ELLs share is that their first language is not English. Their educational outcomes are predicted by a variety of variables, including their first language, the quality of their education in their native country, their families' socioeconomic status, and their parents' level of education. Unfortunately, it is difficult to parse how these interrelated factors affect their success in US schools because pre-migration demographic data is not collected at the federal level nor frequently even at the local level (Lukes, 2015).

Educational Outcomes for ELs

Unfortunately, educational outcomes for ELLs are generally poor in the United States. In particular, Hispanic and Latino children from Central America have relatively poor outcomes (Crosnoe & López Turley, 2011). This is a cause for concern because around a third of immigrants who have moved to the United States in recent years have been from Central American countries (Budiman et al., 2020). In a longitudinal study, Kanno and Cromley (2003) found that ELLs lag far behind their native-English speaking peers in attending and completing college. Fry (2007) observed that 47% of ELLs were behind on reading ability as compared to their non-ELL peers in the fourth grade and that this disparity continued to grow to 50% in eighth grade. Due in part to the requirement that students master academic language, Parrish et al. (2006) observed that ELL students in California had only a 40% chance of exiting the ELL program within 10 years. Even

after acquiring English, second generation immigrants continue to underperform on standardized assessments compared to their more established peers (Barth et al., 2008).

There are several variables that contribute to how successful ELLs are in US schools. A student's English language ability is an obvious factor (Stiefel et al., 2010), but English proficiency may also be a confounding variable indicative of a high socioeconomic status and an advanced education in the student's native country. Pre-migration factors play a more important role in student success than post-migration factors, such as the family's socioeconomic status in the United States, especially because a family's SES tends to diminish post-migration (Pong & Landale, 2012). Parents' pre-migration educational level is also a strong predictor of student success in US schools because a higher education level tends to result in a higher SES both pre- and post-migration as well as a greater focus on academics within the household (Bunch, 2013; Pong & Landale, 2012). Students who have interrupted formal educations in their native countries are more likely to have parents that did not complete high school compared to their educated peers (Potochnick, 2018). It is well established that proficiency in one's native language has a direct effect on the ease with which one acquires a new language (Browder, 2014; Cummins, 2000; Lukes, 2015; Thomas & Collier, 2002). For this reason, the length and quality of a student's education in his or her native country is a strong predictor of that student's success in US schools after immigrating (Potochnick, 2018).

Children of immigrants are more likely to live in a poor household in which neither parent has a degree compared to native-born children (Crosnoe & López Turley, 2011). In 2010, the poverty gap between immigrant and native-born children in the United States

was 12% (Hernandez et al, 2010). Because many immigrant families are undocumented, they frequently do not have access to social services that could lessen the effects of poverty (Yoshikawa, 2011). Furthermore, because these families have lower incomes, they are more likely to attend underfunded schools with fewer resources to help them overcome educational deficits (Ruiz-de-Velasco & Fix, 2000). Orfield and Lee (2005) argue that many immigrant families, and Latino children in particular, face a unique "triple segregation" of race, language, and poverty.

Students with Interrupted or Limited Formal Education

Within the field of second language acquisition, significant attention has recently been focused on students with interrupted or limited formal education (SIFE or SLIFE). SIFE refers to students who have immigrated to a new country but who have missed several years of quality education in their native countries. Many students from a SIFE background come from countries at war, were raised in refugee camps, or are from countries where females are prohibited from going to school (Potochnick, 2018). Even when schooling is available, it may be limited to only elementary grades, students may not have access to technology and textbooks, there may be too few teachers, attendance may not be compulsory, or outdated pedagogy such as rote-memorization may be used (Lukes, 2015). In Potochnick's (2018) study of 15,240 ELL students enrolled in schools in the United States between 2004 and 2006, 11% were foreign-born students with limited education in their native country, 65% of those students from a SIFE background immigrated at the high school level, and they were two years behind their peers on reading and math assessments on average.

In their 2016 study on American and Mexican immigrants, Glick and Yabiku found that children whose families immigrated to the other country were less likely to enroll in school, especially if the children were older. One reason for this is that immigrant families are more likely to live in poverty, and thus children have to work to support their families (Ruiz-de-Velasco & Fix, 2000). However, many children from a SIFE background from Central America are unaccompanied minors. Gindling and Poggio (2010) observed that 96% of children immigrating to the US from Central America are separated from at least one parent while 80% of children are separated from both parents. In many instances, children are sent to live with family members in the United States in order to escape poverty or violence in their home countries (Rosenblum & Ball, 2016). Children who immigrate to the United States without their parents are more likely to drop out and have poorer educational outcomes in general (Gindling & Poggio, 2010).

However, the age at which a child immigrates without a parent is important. Children who immigrate without at least one parent while they are young tend to have more favorable outcomes than those who immigrate unaccompanied as teenagers (Gindling & Poggio, 2010). While some evidence suggests that even elementary aged children who have experienced interrupted formal education in their native countries continue to do poorly into high school (Browder, 2012), in general students who enter US schools at younger ages have more favorable outcomes than older students. This could be due to the fact that younger children tend to learn a second language more easily, because of the increased focus on literacy instruction at the elementary level, or because older students are more likely to have interrupted educations in their native countries as compared to

younger children (Gindling & Poggio, 2010). The proportion of foreign-born students in US schools is greater at the high school level than the elementary level (Capps et al., 2005), but this may reflect that foreign-born students are no longer counted as ELLs once they pass an English proficiency exam or that many elementary-aged ELLs are born in the US to households that speak a language other than English (Gandara & Rumberger, 2009).

The Importance of L1 Literacy

Estimated L1 literacy rates are low for ELLs in the US. Gandara and Rumberger (2009) cite that 39% of ELLs have only limited literacy skills in their native language but caution that this estimate may be too high due to the same problems with demographic data discussed above. While it is true that many children from a SIFE background are still successful because of their determination to succeed and because of their belief in the power of education (Lukes, 2015), on average these students see poorer educational outcomes as compared to their educated peers (Browder, 2014). Students from a SIFE background have lower GPAs and perform worse on standardized assessments compared to other ELLs without interrupted educations (Callahan, 2005; Thomas & Collier, 2002). Thomas and Collier (2002) observed that for each year of missed schooling in one's native country, math and English scores saw a reduction of 10% to 15% compared to peers without interrupted educations, even after the students had been in US schools for several years. This discrepancy is observed even if those students from a SIFE background are taught in their first language, indicating that their poorer performance is not due to a lack of English proficiency alone (Ruiz-de-Velasco & Fix, 2000).

However, students from a SIFE background develop English proficiency more slowly than their educated peers (Browder, 2018), and as a result can take more than a year longer to test of ELL programs (Potochnick, 2018). The negative impact of an interrupted education becomes more pronounced the older the student is because it means that more years of L1 education have been potentially missed (Potochnick, 2018), and students from a SIFE background continue to struggle in school even after developing English proficiency because of their gaps in content knowledge (Browder, 2018; Lukes, 2015). These students face a unique challenge in US schools because English is primarily taught via grade-level content instruction, which the students do not have the educational foundations to understand (Bunch, 2013; Potochnick, 2018; Richardson Bruna, 2008). Unfortunately, students from a SIFE background in the US are not afforded extra time to catch up on educational deficits while simultaneously learning a new language (Bunch, 2013), adapting to a new country, and learning the culture of US schools (Chavajay & Rogoff, 2002).

The Challenge of Vocabulary Acquisition

In several surveys, L2 learners indicate that learning vocabulary is one of their biggest concerns (Gu & Johnson, 1996; Hulstijn, 2001; Lawson & Hogden, 1996; Lu & Liu, 2011; Porte, 1988). It is estimated that L2 learners need to know a minimum of 5,000 words to comprehend a text that does not contain subject-specific vocabulary (Laufer, 1992; Nation, 1990), while others suggest 10,000 words is a more appropriate number (Hazenberg & Hulstijn, 1996) or that knowledge of at least 95% of the words in that text must be known (Hirsh & Nation, 1992). Memorized word lists have long been

the primary method by which students are taught vocabulary (Oxford & Crookhall, 1990) if students are explicitly taught vocabulary at all. Students at the middle and high school level are less likely to receive targeted language instruction as compared to elementary students (Ruiz-de-Velasco & Fix, 2000), in part because many secondary teachers in the US receive no training or preparation for working with ELLs or teaching literacy development (Lucas, 2011).

For older ELLs with limited formal education in their native countries, vocabulary acquisition becomes more challenging because the students need to not only know basic, conversational terms but also academic vocabulary concerning concepts that they may not have learned yet. Cummins (1999) differentiates between basic interpersonal communication skills (BICS) and cognitive academic language proficiency (CALP). In a school setting, BICS refers to language that students would use when conversing with teachers, ordering food in the cafeteria, and most importantly, when they talk with their peers. CALP would refer to vocabulary, syntax, and the more formal type of discourse associated with content area classes and specific academic subjects. Students naturally first progress in BICS because it involves language skills that are more basic, more commonly used, and are learned through interpersonal, 'context-embedded' scenarios (Cummins, 2000). A challenge that ELLs face in US schools is that while BICS is acquired prior to CALP, assessments of English language ability focus primarily on CALP skills.

There is a gap of several years between when students achieve conversational fluency and when they develop the type of language used in academic contexts

(Cummins, 1981). Some scholars argue that it takes students between 4 and 7 years to develop academic fluency (Suarez-Orozco et al., 2011; Thomas & Collier, 2002). Janzen (2008) argues that one reason academic fluency takes longer to acquire than basic conversational skills is that there is only limited exposure to academic language and that some specific academic vocabulary is only used in specific content classes.

For example, the academic language used in a math class is different than that used in a history class. This difficulty is compounded for students from a SIFE background, who may not have learned the content in their first language and who may be inexperienced with the more formal structure of academic contexts (Fry, 2007; Janzen, 2008). The type of vocabulary used in content classes is more likely to consist of longer, multisyllabic words that many ELLs may struggle to acquire given English's stress patterns (Murphy & Kandil, 2004). Academic vocabulary is also more likely to refer to abstract terms that are not easily represented (Janzen, 2008), and it is likely to be domain-specific so that students are exposed to specific terms in only subject and must have requisite background knowledge to understand them (Torgensen et al., 2007). Cummins (2000) argues that a major distinction between BICS and CALP is how the language itself is taught and acquired. BICS is learned through informal communication and involves the speakers making gestures, providing feedback, and interacting. In contrast, CALP is traditionally learned by listening to a teacher lecture or by reading a book. Students are required to rely on linguistic ability alone, and there is an absence of other communicative cues present in informal discourse (Cummins, 2000).

Incidental Learning and Direct Instruction

Much of the academic vocabulary that high school students are exposed to occurs while they are reading or listening in class, and that vocabulary is acquired through incidental learning rather than direct instruction. A meta-analysis by Swanborn and de Glopper (1999) found that students, reading in their native language, can infer the meaning of about 15% of unknown words they encounter in a text through context alone. The authors further observed that students were more likely to infer the meaning of unknown words if the students had higher reading ability and if they were older.

Swanborn and de Glopper's (1999) findings that native speaking students have about a 15% chance of deciphering the meaning of an unknown word through context alone indicates that incidental learning is of limited efficacy for improving vocabulary acquisition. Given that ELLs who have low English proficiency are likely less skilled in the use of syntactic and morphological clues than native speakers and that the number of unknown words in a text will be larger, incidental or implicit learning is an even more inappropriate instructional methodology for ELLs (Peters et al., 2009). It is true that ELLs can acquire vocabulary incidentally through exposure (August et al., 2014); however, whereas children acquire vocabulary in their native language over a prolonged period (Nagy & Herman, 1987), ELLs in high school are expected to acquire thousands of words quickly (Hulstijn, 2001). Incidental learning alone is thus insufficient to quickly build vocabulary knowledge in a second language, and ELLs instead require direct, explicit vocabulary instruction (Peters et al., 2009; Torgensen et al., 2007).

Successful L2 vocabulary instruction involves three characteristics (Peters et al., 2009). First, students must be told or be able to infer the meaning of new words. Second, the target vocabulary must be frequently repeated. Finally, the vocabulary terms must be used in a subsequent task-based processing activity. Students should be aware that they are completing a vocabulary task so that their attention is focused on understanding the new words (Carter & McCarthy, 1988; Laufer & Hulstijn, 2001; Peters, 2007). When students are exposed to new vocabulary, they benefit from rich instruction that includes multi-modal features of the word, linguistic characteristics beyond just the phonological, and semantic components (Torgensen et al., 2007). The rate at which new words are learned increases as the learner gains more knowledge of the L2 linguistic system, such as its phonological and morphological structures (Hulstijn, 2001). By repeating context-embedded target vocabulary, learners are also improving their generalized knowledge of the language (Ellis & Sinclair, 1996; Papagno et al., 1991).

While the more immediate goal of vocabulary instruction is for the learner to understand a text or spoken discourse, the overall goal of the second language classroom is to enable learners to speak and write in L2 as well. When students complete activities with the target vocabulary, they are building their productive knowledge enabling them to use the terms in situations beyond the classroom (Barcroft, 2009; Yamamoto, 2014). Instruction that involves active processing as opposed to memorizing definitions results in greater acquisition of the target vocabulary (Wright & Cervetti, 2016).

Those students who immigrate at the high school level not only face the challenge of having to rapidly develop fluency in English, but they have to do so through content-

embedded instruction that they may not have been educationally prepared for in their native countries because they did not attend school up until the age that they immigrated. In many states, students cannot attend high school past the age of 18 (National Center for Education Statistics, 2017, Table 1.2), and thus unfortunately, students may not be granted extra time to catch up on their educational deficits and are thus enrolled in their age-appropriate grade level with native-English speakers (Bunch, 2013). These students are required to quickly acquire thousands of new vocabulary items in English, but not all students will have the required background knowledge to understand grade-level academic content, in which content vocabulary is frequently learned through implicit exposure.

CHAPTER II: LITERATURE REVIEW

Research on the role that gestures play in communication and learning is extensive and has been approached from a variety of disciplines (Morgenstern & Goldin-Meadow, 2021). Scholars in the field of communication have examined the way in which gestures complement and enrich spoken discourse (McNeill et al., 1994). Those in education and psychology have explored if using gestures during instruction can improve recall and comprehension (Cook et al., 2010; Ianì & Bucciarelli, 2017). In particular, using gestures while learning has been a longstanding interest in the field of second language acquisition (Allen, 1995). The role that the body plays in cognition is a perennial topic in psychology and neuroscience and holds important implications for how language has evolved and how humans learn (Rizzolatti & Arbib, 1998; Rizzolatti et al., 1996).

The Role of Gestures in Communication

The use of gestures among humans is instinctive, and gestures are an intrinsic component of human communication rather than something simply tacked on to speech (McNeill, 2015). Individuals blind from birth use gestures naturally without being taught to do so (Iverson & Goldin-Meadow, 1998), and even young children use gestures when telling stories (Colletta et al., 2010). People who are blind use different gestures based on what language they speak, almost like a gestural accent, but they make similar gestures, regardless of what language they speak, when they gesture silently to an internal monologue (Özçalışkan et al., 2016). The fact that individuals gesture without speaking or when they are alone indicates that gesture serves a purpose not just for communication (McNeill et al, 1994), but also in the “mediation of thought” (McCafferty, 1998).

However, gestures are primarily used for the benefit of the listener rather than the speaker, and the number of gestures speakers use increases with how attentive their listeners are (Jacobs & Garnham, 2007).

Two important studies demonstrate that listeners benefit from the additional information provided by gestures, but only when the spoken information is insufficient on its own. In an innovative experiment, the sound quality of a speaker was purposefully degraded in a series of stages (Drijvers & Özyürek, 2017). It was observed that as the sound quality worsened, listeners relied on the speaker's gestures to a greater extent. In a related study, experimenters described a hidden picture in English to native-Norwegian and native-English speaking children (Dahl & Ludvigsen, 2014). The experimenters used gestures while verbally describing the picture to half of the participants in each language group, while the other half only received verbal descriptions. Based on the children's ability to draw the pictures afterwards themselves, the researchers found that gestures provided no benefit to the native-English speakers, but that the native-Norwegian speaking students were more accurate if they also observed gestures.

McNeill (1992) developed a method of categorizing types of gestures that is now widely used in the literature on gesturing. He distinguishes between four types of gestures: iconic, metaphoric, deictic, and beats. Iconic gestures refer to gestures that resemble the concepts they represent, such as one hand making a bowl shape while the other hand moves as if to spoon soup to the mouth. Metaphoric gestures refer to those gestures which cannot easily represent abstract or complex concepts. An example of a metaphoric gesture would be rotating a finger near one's head to describe someone as

crazy. Deictic gestures are pointing gestures that are used to draw one's attention to something in the environment. Finally, beat gestures are used to punctuate or emphasize something in speech, and in some interventions, draw attention to prosodic features of speech. For example, in Gluhareva and Prieto's (2017) study, native-Catalan speaking participants learning English demonstrated improved prosody when speaking English after they observed an instructor making a drumming motion for each word stressed in a sentence as compared to when the instructor made no motions.

This system of categorizing types of gestures was expanded upon by Kendon (2004) to consider the function that gestures play in relation to spoken discourse. Gestures can be redundant with speech and provide no additional semantic information. For example, if a person says "I have a headache" while tapping his or her head, the gesture provides no additional information beyond what was conveyed in speech. However, if a person says "I've injured my arm" while massaging his or her elbow, the gesture specifies which part of the arm has been injured. Gestures are also used by speakers to provide descriptive information about topics being discussed. For example, speakers make gestures while speaking to indicate the relative sizes and spatial relationship of objects being talked about without providing that information in speech. Gestures can also be used to serve as a representative placeholder for an object being discussed. For example, in a narrative about a person finding a wedding ring, the speaker may hold up his or her fingers as if inspecting the ring. This movement directs the listener's attention to the ring being discussed and it conveys the speaker's surprise and curiosity upon finding it.

Listeners unconsciously incorporate the information provided through gestures when they hear someone speak. While most gestures in everyday conversations are redundant with the spoken information, gestures typically do provide some additional information (Beattie & Shovelton, 1999). For example, one experiment illustrates how listeners use gestures to comprehend ambiguous speech (Holle & Gunter, 2007). Participants heard a sentence containing the word *ball*, but *ball* could be interrupted as a dance or a toy in the context of the sentence. When participants also observed a dancing motion or a throwing motion, they were able to more quickly resolve the ambiguity of the sentence. However, how beneficial the gesture was depended on how related it was to the correct version of the homonym, its *iconicity*, and the benefit was similarly decreased with the addition of distractor movements, such as grooming motions in which speakers scratched themselves or fixed their hair. Similarly, it has been observed that when participants listen to a narrative with mismatched gestures, they incorporate these inaccuracies into their retellings of the story (Cassell et al., 1998). For example, in Cassell et al.'s (1998) study participants listened to a story about a cat chasing after a bird. The speaker was using each hand to represent either the cat or the bird. The text that was being read described how the cat lunged after the bird. In the matched gesture condition, the speaker made a motion in which the hand representing the cat moved quickly towards the hand representing the bird. However, in the mismatched condition, the hand representing the cat moved quickly away from the bird. Some of the children listening to the story incorporated the information from the mismatched gesture when they recounted the story.

These studies indicate that gestures provide additional information to speech that listeners unconsciously incorporate.

Gesturing as an Instructional Strategy

Teachers are unconsciously aware of children's ability to convey information through gestures rather than spoken language and routinely interpret children's gestures as implicit knowledge (Alibali et al., 1997). Likewise, unconscious and spontaneous gesturing by teachers has been shown to aid instruction. Language learners reported during interviews that the gestures that teacher unconsciously make during instruction aides their comprehension of the lesson (Roth, 2011; Sime, 2008). Gestures are used not only as a communication strategy, but also as a problem-solving strategy, and preventing students from gesturing during specific tasks can hinder their ability. For example, one study required preschool-aged participants to count objects (Alibali & DiRusso, 1999). In some trials, the participants were allowed to count the objects by touching them as they counted, whereas in other trials, they were not allowed to use their hands to count. When the participants were not allowed to use their hands to count, they made more errors during the task. Another study suggests that using gestures is a way to lighten the cognitive load of a task (Goldin-Meadow et al., 2011). Adult participants were required to solve a factoring equation. After they were given a list of words to memorize, and then they were asked to explain how they had solved the earlier math problem. It was observed that when participants were allowed to gesture during their explanation, they could recall more of the memorized words afterwards than compared to when they were not allowed to gesture. The authors argue that these results show that gesturing reduces

the cognitive demand of explaining how to solve the math problem, allowing participants to remember more of the words (Goldin-Meadow et al., 2001). Similarly, Bucciarelli et al. (2016) found that participants' performance decreased by 13% in a puzzle solving task when they were prohibited from gesturing. In two similar studies, Hatano et al. (1977) and Brooks et al. (2018) both found that expert abacus users could solve math problems faster using gestures than with actual abaci, but when they were prohibited from gesturing, not only did their speed decrease but they made more errors in their calculations.

There has been an interest in using gestures as a teaching strategy for some time, with Popelka and Berger conducting the first such study in 1971. A number of studies have used gestures to improve performance on a variety of different learning tasks, including mental rotation tasks (Chu & Kita, 2011; Goldin-Meadow et al., 2012; Risko et al., 2014), diagramming molecular structures (Stieff et al., 2016; Stull et al., 2012), understanding mechanical operations (Kang & Tversky, 2016; Pouw et al., 2016), charting human anatomy (Cherdieu et al., 2017; Macken & Ginns, 2014), understanding symmetry in preschool classrooms (Valenzeno et al., 2003), statistics (Rueckert et al., 2017), and syntax (Post et al., 2013). However, the majority of the research on using gesturing as a learning strategy has focused on general recall and second language instruction.

Using Gestures to Improve Recall

A number of studies have demonstrated that when participants watch experimenters making gestures during instruction, participants' recall of the sentences is improved as

compared to when no gestures are observed (Aussems & Kita, 2019; Ianì & Bucciarelli, 2017; Popelka & Berger, 1971; Straube et al., 2008; Vilà-Giménez et al., 2019). Likewise, it has been observed that recall of story events is improved when participants make the same gestures as the instructors (Cook et al., 2010; Igualada et al., 2017; Zimmer et al., 2000), act out story events with playsets (Berenhaus et al., 2015; Glenberg et al., 2007), reenact the story using computers (Glenberg et al., 2011), or even imagine using playsets (Glenberg et al., 2004).

It has also been demonstrated that using gestures during instruction improves narrative comprehension (Dargue & Sweller, 2018; Macoun & Sweller, 2016), and that gestures benefit comprehension regardless of the age of the learner or the difficulty of the task (Dargue & Sweller, 2020). The distinction between studies examining recall tasks and those testing whether gestures improve narrative comprehension can be murky. In many of the recall tasks, participants' recall was measured either through free recall, where participants were asked to name everything that they could remember from the intervention, or guided recall, in which they indicated whether a sentence or word had been used during the intervention. Some studies examining comprehension use post measures clearly distinct from recall. For example, Macoun and Sweller's (2016) outcome measure includes this question: "Why did Daisy and her family leave the park" (p. 78)? In contrast, Dargue and Sweller's (2018) study includes this question during posttesting: "Tell me everything that happened in the video you just saw" (p. 341), which would seem to measure recall more than comprehension. Such interchangeable language

makes it difficult to know what exact benefit gestures may serve to improve comprehension.

In two different meta-analyses, it was observed that gestures improved narrative comprehension with an overall effect size of $d = 0.61$ (Dargue et al., 2019; Hostetter, 2011). Hostetter's (2011) meta-analysis included thirty-eight studies, and studies were coded as involving abstract gestures or gestures relating to spatial or motor information. For example, a study in which gestures were used to describe the taste of tea was coded as abstract (Krauss et al., 1995), whereas a study in which gestures were used to present mathematical concepts, such as using gestures to explain how to add two numbers together, were coded as spatial or motor information (Goldin-Meadow & Singer, 2003). The authors observed that that in order for a gesture to benefit comprehension, the gesture had to be related to spatial or motor information as compared to abstract topics. Studies were also coded as whether the gestures used either provided additional context to the narrative or were redundant with the narrative. An example that the authors provided for nonredundant gestures is the scenario in which the experimenter was speaking of a ball but used gestures to indicate the ball's size, whereas that information was never present in the spoken narrative. The authors found that for gestures to benefit narrative comprehension, the gesture used also had to add additional, relevant information to speech rather than being redundant. Finally, studies that included young participants found a greater benefit for using gestures as compared to adolescents or adults.

Dargue et al.'s (2019) meta-analysis included sixty-four studies, and the majority of those studies required participants to observe gestures rather than make the gestures themselves; however, the authors found that the studies that required participants to gesture had larger effect sizes than those studies that did not. Contrary to Hostetter's (2011) findings, Dargue et al.'s (2019) meta-analysis found that gestures that added additional information to speech were no more beneficial to comprehension than redundant gestures. The authors speculate that these results may differ because the extra information provided by gestures must be needed to understand the spoken information to be beneficial. Finally, the authors found no benefit of using gestures to improve comprehension for adolescents, but they acknowledge that their meta-analysis only included two studies with adolescent participants.

Using Gestures to Learn a Second Language

Gestures are widely used in second language classrooms (Gullberg et al., 2010; Morgenstern & Goldin-Meadow, 2021), and their use is encouraged in SLA methodologies as 'extralinguistic cues' that aid L2 acquisition (Krashen, 1981; Long, 1989). Since the 1960's, there has been an effort in second language pedagogy to make L2 instruction more similar to the ways in which one learns one's native language (Krashen & Terrell, 1983). Traditionally, SLA classrooms frequently focus on immediate production of L2 (Macedonia & von Kriegstein, 2012), rely primarily on audio-visual content (Lee et al., 2012; Graham et al., 2014), and rarely include the rich sensorimotor components that are involved in learning L1 (Macedonia, 2013). Asher's (1969) Total Physical Response (TPR) methodology can be seen as one of the earliest approaches to

use gestures as an instructional methodology in L2 classrooms. In TPR, students learn L2 vocabulary by mimicking the actions and commands of the instructor. For example, in a French L2 classroom, the students would all stand up when the teacher said “levez-vous” and then jump when the teacher commanded “sautez.”

Using gestures to improve L2 vocabulary acquisition

Young children as participants. Gestures have been shown to improve L2 vocabulary recall among young children. Three studies demonstrate that gestures can be used in a typical classroom setting to teaching L2 vocabulary. In the first, gestures were used to teach eight vocabulary words in English to native-French speaking children (Tellier 2008). In the second, native-Greek speaking children learned 14 words in Italian (Mavilidi et al., 2015), and in the third study, native-Greek speaking children learned 20 words in English (Toumpaniara et al., 2015). Participants understood the concepts denoted in L2 in their native languages. These experiments all included a between-subject design, in which some participants watched and copied gestures during instruction, while the other participants only listened to the terms (Mavilidi et al., 2015; Toumpaniara et al., 2015) or saw pictures of the terms (Tellier, 2008). All three interventions lasted for four weeks, and outcome measures required participants to produce the L2 term when given the L1 word. In Tellier (2008), participants who learned words through gestures scored higher on both immediate (d = 0.94) and delayed (d = 1.09) posttests. Participants who learned words through gestures outperformed those who learned without gestures (d = 0.24) in Toumpaniara et al. (2015). Likewise, Mavilidi et al. (2015) observed effect sizes

of $d = 0.60$ for words learned with gestures. These studies indicate that gestures are an effective learning strategy for young children learning a second language.

This line of research was expanded upon to investigate if gestures could be used to improve L2 vocabulary acquisition without a teacher but with participants viewing videotaped instruction by a teacher (Andrä et al., 2020) or an artificial avatar (Macedonia et al., 2014). Experimenters observed high rates of attrition when fifth-grade participants learned L2 vocabulary with an avatar, with more than half the participants having to be removed from the intervention due to misbehavior or attrition (Macedonia et al., 2014). The same problem was not observed with second-grade participants watching a recording of an actual teacher (Andrä et al., 2020). Despite problems with attrition, words were better learned with gestures than without in Macedonia et al. (2014). Importantly, some words were learned with participants watching gestures while other words were learned with participants copying the gestures themselves. Improved acquisition of terms was only observed when participants made the gestures during instruction (Macedonia et al., 2014).

Among the studies investigating L2 vocabulary acquisition among children, only Andrä et al. (2020) examined word-level features. Native-German speaking participants learned 24 words in English that were divided evenly between abstract and concrete terms. Participants learned half of the vocabulary terms with gestures, while the other half were learned through hearing the terms without additional enrichment. Participants were able to recall the L2 terms learned with gestures better than those learned without gestures in general. In a L1 to L2 translation task, participants who made gestures learned

abstract verbs better than those who did not (g = 0.80), while in a L2 to L1 translation task, participants who made gestures learned abstract nouns better than those did not make gestures (g = 0.86). In a follow-up experiment, the gesture condition was compared to a condition that viewed pictures of the target vocabulary as additional enrichment. Results indicate that seeing pictures was as effective for learning all terms as was making gestures.

Adults as participants. Studies have shown that gestures are also effective for adults learning a second language. While gestures have been shown to improve L2 listening comprehension among adults (Sueyoshi & Hardison, 2005), the majority of research with adult participants has been focused on vocabulary acquisition. Several studies have demonstrated that gestures improve L2 acquisition among adults in general (Macedonia & Klimesch, 2014; Macedonia & Knösche, 2011) in diverse target languages, including Mandarin (Huang et al., 2019), Italian (Repetto et al., 2017) Japanese (Kelly et al., 2009), and artificial languages (Macedonia & Repetto, 2016), and have observed that benefit of gestures is long-lasting (Macedonia & Klimesch, 2014).

Word-level features have been examined in two studies with adult participants. In the first, Macedonia and Knösche (2016) investigated whether gestures have a different effect on word acquisition based on part of speech of concreteness. Vocabulary items were coded as concrete nouns, abstract nouns, verbs, and adverbs. It was observed that while gestures improved performance of all types of words, the greatest benefit was seen in concrete nouns, followed by verbs, abstract nouns, and finally adverbs. There were statistically significant differences between categories for the paired terms learned

without gestures. Whether gestures can be used to improve acquisition of abstract terms alone has also been studied (Repetto et al., 2017). Adults learned 30 abstract terms by either making an associated gesture, by reading the term, or by seeing a picture of the term. It was observed that making gestures improves recall of abstract vocabulary in L2 as compared to reading or viewing a picture of the term. Unfortunately, Repetto et al. (2017) did not include concrete vocabulary terms as a comparison, and thus no study has examined whether gestures are equally effective for teaching abstract and concrete terms for adults in L2.

In all of the studies reviewed, researchers chose the gestures used during the intervention, but participants were only surveyed in one study on whether they agreed the gestures were iconic representations (Macedonia & Klimesch, 2014). This is problematic because it is impossible to infer anything about the effectiveness of using gestures if the gestures are not seen as representative by the participants (Macedonia et al., 2011). Furthermore, there has been a lack of consistency about the scope of the gestures made. For example, some of the gestures made in Repetto et al.'s (2017) study including full body motions including the experimenter's feet. However, it is unknown if full body gestures and facial gestures might have a different effect on learning than hand gestures, and this adds further evidence to the need for a standardized system of gestures in this field of research.

All of the studies discussed demonstrate that using gestures improves recall of vocabulary (Macedonia et al., 2011) and that improved recall of L2 terms was observed even 444 days post-intervention (Macedonia and Klimesch, 2014). Whether gestures are

equally effective for learning abstract and concrete terms has been examined in children (Andrä et al., 2020), but the comparison has not been explored for adults (Repetto et al., 2017). Similarly, research in L1 has demonstrated that using gestures during instruction improves comprehension (Dargue et al., 2019; Hostetter, 2011), but no previous research has examined whether gestures can provide a similar benefit in L2. The vocabulary items that have been used in the L2 research have consisted of relatively basic terms, and all the L2 vocabulary items used denoted concepts that the participants understood in their native language. Thus, it has not been examined whether gestures can be used to teach novel vocabulary in L2 which denotes novel concepts to participants. Furthermore, none of the studies reviewed have focused on what would be considered academic vocabulary, which is the type of vocabulary that ELL students typically find the most challenging, especially at the middle and high school levels. Therefore, an examination of whether gestures can similarly improve L2 acquisition of vocabulary that is complex, abstract, and academic in nature is a logical progression for this field of research.

Explanations for the Benefits of Gesturing

The use of gestures by humans has drawn interest from a variety of disciplines, and as such there have been several theoretical explanations to account for the purpose of gesturing in human discourse and how it enriches communication and learning. Within the field of neuroscience, scholars have examined gestures with an eye towards the role that the sensorimotor system plays in cognition (Pulvermüller, 1999). Research on mirror neurons offers a theoretical explanation for the innate use of gestures in language and the role of gestures in the evolution of human language (Airbib, 2005). Behavioral studies in

psychology have further developed this area of research into the theory of embodied cognition (Barsalou, 2008). Finally, there are several theoretical explanations for why gestures improve recall and vocabulary learning specifically.

The Enactment Effect

That movement improves recall was first observed in Engelkamp and Krumnacker (1980), in which the authors found that participants could remember phrases better if they had acted them out previously. The authors called this the 'enactment effect,' and the phrase is still used widely in research on gesturing. Shortly after, Cohen (1981) noticed the same effect, which he called the SPT effect, for 'subject-performed task.' As the previous discussion has shown, the research on gesturing has demonstrated that actions and gestures improve participants' ability to remember words, phrases, and events as compared to when no movement is made. There are various theories to explain this effect.

Some authors have theorized that simply moving during instruction improves memory (Cutica et al., 2014; Nathan, 2012; Toumpaniara et al., 2015). However, this view is at odds with other studies that have demonstrated that meaningless gestures have either no effect or a negative effect on learning (Cole & Schneider, 2007; Dargue & Sweller, 2018; Kelly et al., 2009). Others have argued that gesturing during instruction encourages participants to pay more attention to what is being taught, so the enactment effect is really just the effect of increased attention (Knudsen, 2007; McNeill et al., 1994). One study suggests that the benefit of gesturing is not increased attention though (Wakefield et al., 2018). Using eye tracking software, it was observed that gestures did

not increase the participants' attention but rather directed it instead. Different eye movement patterns were observed whether participants were gestured to or not, but the overall amount of eye movement between groups did not differ. These findings suggest that using gestures does not make participants more attentive.

In cognitive science, the symbol grounding problem was proposed by Harnad (1990) to ask how abstract symbols in the brain become tied to their real-world referents. Some researchers have argued that gestures can be used to more quickly make this connection. For example, Kang and Tversky (2016) argue that while spoken words are almost always arbitrary, gestures can resemble the thought or action they represent. As a consequence, they argue, learners can more quickly understand the meaning of new words when they are learned with accompanying gestures. Gestures can help learners more quickly develop a complete understanding of a new concept compared to when words are used alone.

Another theory argues that the enactment effect occurs because movement causes a 'motor trace' in the memory associated with the word that has been learned (Engelkamp & Zimmer, 1984). According to this view, the area in the brain where a concept is stored is thus connected to motor areas in the brain. When a gesture is then made, it 'primes' the semantic area, allowing faster recall of the semantic concept (Fischer & Zwaan, 2008). This theory can explain why incongruent gestures have a negative effect. As unrelated motor and semantic areas are connected, and it takes more time for the brain to correct the error (Körner et al., 2015). A similar theory that to explain the benefit of gestures is called "Gesture as Simulated Action," which argues that gestures emerge as the 'link

between perception and action" (Hostetter & Alibali, 2008, p. 502). According to this view, gestures are simulated action because of the connection between semantic and motor areas. As semantic areas are activated, corresponding motor areas may become activated as well, resulting in gesturing. The authors argue that whether or not gesturing occurs is dependent, in part, on the strength of the activation.

Deep Knowledge: Improved L2 Acquisition

Concepts acquire meaning through the ways in which one interacts with the world (Gallagher & Lindgren, 2015). As a result, individuals have different conceptions of the external world, and learning a word or concept means developing a full and rich semantic network (Vogt & Thomaschke, 2007). It has been observed that actions and sensations directly affect information processing (Körner at al., 2015), and differential activity in the brain can be observed during both encoding and retrieval for words that were learned through movement as compared to those that were learned with only verbal information (Nyberg et al., 2001). According to this view, because concepts always have a bodily component, whether through our external senses, such as the smell of a flower or the sound of a hammer hitting a nail, or whether they relate to our internal states, such as the stomach pangs of anxiety or the rapid heartbeat of elation, involving the body when words and concepts are learned more quickly develops a rich mental representation (Kang & Tversky, 2016; Ianì & Buccarelli, 2017; Straube et al., 2008). By extension, using gestures during encoding more quickly develops 'deep knowledge' or a concept, which results in faster acquisition (Macedonia & von Kriegstein, 2012; Macedonia & Klimesch, 2014).

According to this view, concepts are built through our experiences and interactions with the external world. When one is learning a second language, words in L2 get mapped onto the already developed semantic network in L1 (Macedonia, 2014). Because those concepts in L1 have associated sensorimotor features, it is thought that including bodily movements during encoding aids in this mapping.

This argument is supported by both behavioral and imaging studies. In one study, a Stroop design was used to investigate whether L2 spatial terms are overlaid on L1 systems or whether they are developed separately (Ahlberg et al., 2018). Participants were shown prepositions written in different font colors and were instructed to raise or lower their hands based on the color shown. Reaction times were significantly higher when the color and the preposition were mismatched. This result was observed not only for native German speakers, but also for L2 German learners, and there were differential delays depending on whether the L1 had similar or different spatial systems to German. The authors argue that these results indicate that not only are L1 linguistic systems activated during L2 processing, but L1 experiential knowledge is as well.

Another theory states that bilingual speakers have separate lexical systems for each language but that the two systems share semantic representations (Kroll & Stewart, 1994). According to this view, embodiment in L2 is first mediated through L1 as proficiency is built, which suggests that sensorimotor activation is low when first learning L1 (Monaco et al., 2019). However, once L2 proficiency is developed, embodiment should be observed in both languages (Ahlberg et al., 2018). This activation was observed in an fMRI study conducted by De Grauwe et al. (2014). In this study, the

researchers observed both motor and somatosensory activation among both native Dutch speakers and native German speakers learning Dutch as a second language while the participants read motor verbs, such as *throw*, compared to non-motor verbs, like *earn*. This effect was observed for both cognate and non-cognates, indicating that concepts become semantically integrated with motor and sensory areas of the brain in a second language.

Research Questions

A substantial body of research has explored the use of gestures and other body movements during instruction. This line of research has already resulted in promising applications in the field of L2 acquisition, particularly with regard to vocabulary acquisition. Thus far, previous studies have only examined the effect of gestures on the acquisition of L2 vocabulary items which are direct translations of already acquired L1 vocabulary. As a result, it remains unknown whether the findings would generalize to a population of EL students in an instructional context that requires acquiring L2 vocabulary that also reflects new concepts, as is the typical case with ELLs in US high schools where they must simultaneously acquire a new language and new conceptual knowledge. Specifically, this study addresses the following four research questions:

1. Does the use of iconic gestures during instruction improve English vocabulary acquisition among high-school aged Spanish speakers?
2. Are iconic gestures an effective teaching strategy for teaching novel concepts in L2?
3. Are iconic gestures equally effective for learning concrete terms and abstract terms?

4. Does the use of iconic gestures during vocabulary instruction translate to improved comprehension of sentences containing target items?

CHAPTER III: METHODOLOGY

Participants

Participants (N = 68) were selected from a high school with a large EL population in the Southeastern United States. Participants' ages ranged from 13 to 18 (M = 16.12, SD = 1.22) and 52.9% were female. To qualify for participation in the study, participants had to be enrolled in the state's EL program according to their English proficiency scores on the WIDA ACCESS test (TN DOE, 2016). Only participants who scored below a 3.0 on their previous ACCESS test were included in this study. In Tennessee, a composite score of 4.4 indicates that the student is a fluent English speaker. A score of 3 is considered 'developing.' Students who score a 3 on ACCESS should be able to understand spoken and written language about some common topics in school, and they can communicate ideas in spoken and written English using several connected sentences (WIDA, 2022). Students who score a 3 still need language support classes in school. The average participant score on the most recently administered ACCESS test was 1.65 (SD = 0.49). Only participants who had been in the United States for fewer than two years were included in the study. This ensured that all participants had limited English proficiency and were unlikely to have been exposed to the academic language used in content area classes. On average, participants had been in the United States for 8.25 months (SD = 5.81). The school where the study was conducted has a large 'newcomer' program, in which students focus on building English language skills for a time before taking regular academic subjects with their native-English speaking peers.

All participants included in the study were native Spanish speakers. The inclusion of only Spanish speakers removed any confounding factors such as L1 linguistic and orthographic features that could be present if the participants spoke a variety of native languages. Three participants were removed from the study due to absences.

Intervention and Procedures

This experiment was a randomized-control trial that included a between-subject design in which all participants were taught novel English vocabulary denoting novel concepts. Participants were seated alone at a table while an experimenter supervised. Vocabulary items were delivered by computer in a controlled setting to ensure fidelity and because previous research has found that gesture studies conducted in classroom settings with adolescents resulted in greater inattention and misbehavior given the nature of the intervention (Macedonia et al., 2014).

The experimental procedure was similar to the majority of the studies conducted by Macedonia's research group (Andrä et al., 2020; Macedonia & Klimesch, 2014; Macedonia & Repetto, 2016; Macedonia et al., 2014; Repetto et al., 2017). On the screen, a native-Spanish speaking instructor pronounce each word in English, the written English word was presented, a picture illustrating each word was displayed, the instructor provided a definition in English, and the instructor used the word in a sample sentence. The total elapsed time for this portion was ten seconds. This was followed by the instructor reading the term in Spanish, displaying the written word in Spanish, and then providing a definition of the term in Spanish. This portion was also presented for ten seconds to ensure equal exposure time in both languages. All words were learned with the

audio of the terms in both languages, the written form in both languages, and a picture illustrating the word. A local artist was commissioned for the pictures used in the intervention.

The participants were randomly assigned to one of two conditions. In the first condition, the written condition, the participants wrote down the word in English on a sheet of paper each time it was taught. Previous research has shown that copying down words improves recall of those words (Altalhab, 2018; Hummel, 2010). In the second condition, the gesture condition, the instructor demonstrated a gesture, and participants copied this gesture. Participant characteristics compared across conditions are displayed in Table 1.

Table 1

Means (and standard deviations) of participant characteristics between the gesturing and writing groups

Measure	Gesturing (n = 34)	Writing (n = 34)	t	p
WIDA ACCESS	1.71 (0.49)	1.58 (0.48)	0.99	.322
Months in US	8.27 (4.91)	8.23 (6.69)	0.34	.973
Age	16.10 (1.34)	16.14 (1.10)	0.15	.885
Productive Vocabulary	0.53 (.83)	0.56 (1.46)	0.10	.919
Receptive Vocabulary	7.65 (2.57)	7.06 (2.17)	1.02	.588
Comprehension	6.62 (2.94)	6.41 (3.29)	0.27	.206

Dargue et al.'s (2019) meta-analysis found that larger effect sizes were observed in studies where participants made gestures themselves as opposed to only watching the instructor make gestures. Participants had fifteen seconds to copy each word, and a looping image of each gesture to be copied was displayed for fifteen seconds as well. This design ensured that participants in both groups were exposed to a learning stimulus for an equal amount of time and both were involved in active, rather than passive, learning strategies. This addresses the limitation of unequal stimuli (Macedonia & Repetto, 2016) addressed in greater detail in Chapter 2. The instructor also explained how the gesture is representative of the word that it is associated it. The experimenter supervising the participants made sure that they carried out the tasks correctly. The procedures for both conditions are summarized in Table 2.

Table 2

Procedures for each condition per vocabulary item

Writing Condition	Gesture Condition
Word shown on screen in English	Word shown on screen in English
Picture shown for word	Picture shown for word
Definition provided in English	Definition provided in English
Sample sentence provided in English	Sample sentence provided in English
Word shown on screen in Spanish	Word shown on screen in Spanish
Definition provided in Spanish	Definition provided in Spanish
Participants copy the word in English	Instructor demonstrates gesture
	Participants copy gesture

The intervention was delivered via computer for several reasons. Because instruction was videotaped, fidelity of instruction could be ensured as compared to instruction being delivered in a whole class setting. Computerized delivery more easily allowed participants to be alone during the intervention because native Spanish-speaking instructors are limited. A 2021 meta-analysis found that technology-assisted vocabulary instruction has been shown to be more effective for L2 learners than traditional instruction (Hao et al., 2021). It was also hypothesized that participants would be more likely to make gestures if they were alone compared to a whole class setting because some participants may be embarrassed (Macedonia et al., 2014). Participants were explicitly told that they were being taught strategies to improve vocabulary learning.

Twenty vocabulary items were included in this study. This number of vocabulary items is in line with previous literature (Andrä et al., 2020; Huang et al., 2019; Kelly et al., 2009; Macedonia & Repetto, 2016; Repetto et al., 2017; Tellier, 2008), and is within the range of vocabulary items for L2 vocabulary studies suggested by Hjetland et al. (2021). During an intervention session, participants were exposed to the vocabulary items three times. Therefore, participants in the written condition wrote each vocabulary item a total of three times, and those in the gesturing condition made the gesture a total of three times per intervention session. This was a similar number of exposures as used in several of Macedonia's studies (Andrä et al., 2020; Macedonia et al., 2011; Macedonia & Repetto, 2016). Previous research has shown that learners must be exposed to novel vocabulary repeatedly and in quick succession for best acquisition (Baddeley, 1997; Nation, 2001). Therefore, the intervention was delivered over four consecutive days, as

was similarly done in most of the studies conducted by Macedonia's research group (Andrä et al., 2020; Macedonia et al., 2011; Macedonia & Klimesch, 2014; Macedonia & Knösche, 2911). Posttesting occurred the day after the final intervention session. Participants also took a delayed posttest four weeks after the end of the intervention.

Word Selection

The vocabulary items in this study were chosen in accordance with guidance suggested by Hjetland et al.'s (2021) comprehensive review of L2 vocabulary intervention designs. The central features of this study's word selection included those words that were not cognates in Spanish, that were concepts previously unknown to the participants, and that were low frequency (Chen, 2006; Hjetland et al., 2021). Numbers in parentheses next to some items indicate the word's rank in the top 5,000 most frequently used words according to the billion-word *Corpus of Contemporary American English* (Davies, 2008). None of the novel terms were included in the top 5,000 most frequently used words in English. Of the twenty vocabulary items included in this study, half were concepts that the researchers hypothesized the participants would know in Spanish while the other half were concepts that they would not have learned yet in school in their native countries. As in previous studies, the participants' teachers consulted on which words the participants would or would not be familiar with (Andrä et al., 2020; Hjetland et al., 2021).

Cognates also had to be avoided to remove a possible confounding variable (Chen, 2006; Hjetland et al., 2021), and so many of the unknown terms used in the study are related to vocations in English, because English and Spanish share a substantial amount

of vocabulary and are classified as Tier 3 words under Hjetland et al.'s (2021) paradigm. Words for the known category were selected from Bushong's (2010) analysis of Coxhead's (2000) academic word list of non-cognate terms for Spanish speakers. Half of the words were concrete concepts, and the other half were abstract terms. The concreteness of the terms was determined by five English teachers at the school where the experiment was conducted. The teachers were given a selection of words and asked to rank each word as either concrete, abstract, or a mix of both. Potential vocabulary terms that were not ranked as clearly abstract or concrete were removed from the study. None of the words were cognates in Spanish. Words for the novel category were chosen by first compiling a list of uncommon words, as measured by word frequency, selected from an online dictionary of sign language (European Sign Language Center) that were not Spanish cognates. This list was then given to the teachers who worked with the participants, and the teachers indicated which concepts were least likely to be known by their students.

Fifteen of the words were nouns, and the other five words were verbs. Some of the novel terms are unique to trades and as such, there are not true equivalent terms in Spanish. For example, *kerf* refers to the width of a blade. There is not an equivalent term in Spanish, so *el corte,* the cut, is provided as an approximation. During the intervention, a definition of *ancho de un cuchillo* was provided in Spanish (see Appendix C).

Figure 1

Words used in the intervention and their Spanish equivalents

Known + Concrete		**Novel + Concrete**	
core (n.) (1754)	el núcleo	kerf (n.)	el corte
layer (n.) (2385)	la capa	screed (n.)	el renglón
wardrobe (n.)	el armario	bellows (n.)	los fuelles
survey (n.) (4591)	la encuesta	caliper (n.)	la pinza
diver (n.)	el buceadora	vellum (n.)	la vitela
Known + Abstract		**Novel + Abstract**	
acknowledge (v.) (1854)	reconocer	foreground (n.)	los primer plano
bias (n.) (3496)	la parcialidad	blurb (n.)	el texto publicitario
enhance (v.) (2630)	mejorar	jingle (n.)	una canción
release (v.) (948)	liberar	leaven (v.)	leudar
task (n.) (1164)	la tarea	embezzle (v.)	malversar

Gesture Selection

Previous literature has shown that dynamic gestures are more effective for instruction than static gestures (Hodges et al., 2018; Kang & Tversky, 2016). All gestures used in this study were dynamic and involved movement as opposed to static gestures. All gestures were adopted from various sign languages and taken from an international online sign dictionary at spreadthesign.com (European Sign Language Center). This dictionary is operated by the non-profit European Sign Language Center and compiles signs for

different words with the help of affiliate partners in different countries. The dictionary includes signs from 43 sign languages and over 580,000 videos of signs (European Sign Language Center). Some words, such as *vellum*, did not have an entry in the dictionary. In this instance, the gesture for a similar concept, *leather-bound book*, was used instead. When a word was included in the dictionary, there were signs from several different languages provided. For example, *enhance* includes signs from 24 different languages. The sign that seemed most representative of the concept was chosen by the researcher to be used in this study. Examples of each gesture and each picture used per vocabulary item are provided in Appendix A.

Measures

Pre-test Measures

The following measures were taken prior to the intervention in order to ensure that theparticipants in both conditions were equivalent at baseline with regards to L1 and L2 literacy abilities. The two vocabulary and the sentence-level comprehension measures were also administered to conduct a pre- and posttest analysis. Table 3 lists the pretest and posttest measures used in this study. There were no statistically significant differences between any of the conditions on any of the literacy measures (Table 1). All researcher-created measures are found in Appendix B.

WIDA ACCESS 2.0. The students' English proficiency was measured using the Assessing Comprehension and Communication in English State to State for English Language Learners (Center of Applied Linguistics, 2017). The ACCESS is a large-scale measure of English proficiency used in public schools in 41 states. ACCESS is composed

of four measures: Listening, Reading, Writing, and Speaking, and is administered based on grade cluster: K-2, 3-5, 6-8, and 9-12. Participants can receive scores ranging from 1 to 6 for each domain. The Listening and Reading sections are multiple-choice, and the Writing and Speaking sections require students to type their responses or record them via a microphone. The Writing and Speaking sections are reviewed and scored by the testing company. Raw scores for each domain are not released to schools, but schools receive a scale score for each domain along with a proficiency score. Participants completed the ACCESS by computer in February of 2022. The range for the scores was between 1.0 and 2.9. Across all grades and tiers, ACCESS has a reliability of .93 for the listening portion, .95 for reading, .95 for writing, and .89 for speaking. Overall comprehension has a .96 reliability.

Researcher-Created Spanish Proficiency Exam. Participants took a researcher-created assessment that measures listening comprehension as a measure of Spanish proficiency. The assessment was adapted, with permission, from practice test materials created by the National Spanish Examinations (www.nationalspanishexam.org). The assessment consists of 10 multiple-choice questions that are read-aloud in Spanish. The range for the scores was between 0 and 10. While the distribution of scores appeared normal ($M = 4.81$, $SD = 2.06$) and Shapiro-Wilk was not significant ($p = .069$), reliability was low for this measure ($\alpha = .487$). The results of this measure were not included in the analysis as a result of its low reliability.

Posttest Measures

Receptive Knowledge of L2 Vocabulary. Participants took a researcher-created assessment of their receptive knowledge of the target vocabulary. In the receptive knowledge task, the participant's ability to identify the correct L1 meaning when presented with the vocabulary item in L2 was assessed. Nation and Webb (2011) argue that when the participants have low L2 proficiency but speak the same first language, including answers in L1 can improve participant performance by up to 10%. The authors argue that this improvement occurs because participants are not restricted by their limited proficiency in L2. Thus, the receptive measure may allow participants to demonstrate recall of target vocabulary even if they are unable to define the term in English (Repetto et al., 2017). Following Nation and Webb's (2011) design of a productive knowledge measure for L2 learners, the participants were given a vocabulary item used in a sample sentence in English. There were four multiple choice answers in Spanish from which they had to select the correct definition of the term. Each vocabulary word was tested once for a total of twenty questions. The range on this measure was between 10 and 20. Reliability for the posttest delivery of the receptive vocabulary task was acceptable ($\alpha = .764$). This measure is a departure from the cued and free recall tasks used by Macedonia's research group. It was hypothesized that this measure would give a more accurate indication of L2 acquisition versus simple recall.

Productive Knowledge of L2 Vocabulary. Participants took a researcher-created assessment of their productive vocabulary knowledge. Participants were shown the vocabulary items in English and were required to write the equivalent word or a phrase in

Spanish. Answers were scored on whether they demonstrate semantic understanding of the term, and grammatical and spelling errors will not be considered. Partial credit was not given. Each vocabulary item was measured once for a total of 20 questions. The range of scores was between 0 and 20. The experimenter scored the answers, and the native-Spanish teacher who recorded the videos scored the measure for reliability. The teacher was a licensed EL teacher with a Master's degree in EL instruction. He was familiar with the vocabulary items used in the study and their definitions. The experimenter trained the teacher by providing examples of which types of answers would be acceptable and which would not. Interrater reliability was 99.29%. Reliability was high for this measure ($\alpha = .941$).

Sentence-Level Comprehension Questions. Participants took a researcher-created comprehension assessment that evaluated their ability to use the appropriate term in a sentence. Previous research on using gestures to improve L2 vocabulary acquisition has not included a comprehension measure. This measure included 20 cloze questions, in which the participant chose the appropriate term from four options. The foils were the vocabulary items used in the study and were the same part of speech as the correct answer, but their use in the sentence would be illogical. For example, *layer* was not used a foil for the sentence "The (core) of the planet is made of rock" because layer could be seen as a logical choice. In this instance, the other foils, *wardrobe, kerf*, and *task* could not logically complete the sentence. This measure evaluated if the participants comprehended the meaning of the target vocabulary, not just their ability to recall or

translate the terms. The range for this measure was between 3 and 20. Internal consistency was high (α = .870).

Delayed Posttesting. Participants took a delayed posttest four weeks after the completion of the intervention. Participants took the receptive knowledge posttest, the productive knowledge posttest, and the comprehension posttest. All measures during the delayed posttest were the same as used in immediate posttesting.

Table 3

Pre- and Posttest Measures

Pretest Measures	Posttest Measures
English Language Proficiency	Receptive Knowledge of L2 Vocabulary
Listening	Productive Knowledge of L2 Vocabulary
Reading	Sentence-Level Comprehension
Writing	
Speaking	
Composite	
Spanish Language Listening Proficiency	
Receptive Knowledge of L2 Vocabulary	
Productive Knowledge of L2 Vocabulary	
Sentence-Level Comprehension	

CHAPTER IV: RESULTS

Immediate Posttesting Controlled for Pretest Scores

The average performance on each of the three researcher-created measures taken immediately after the completion of the intervention was analyzed while controlling for performance on the receptive vocabulary, productive vocabulary, and comprehension measures taken at pretest using ANCOVA. These results and descriptive statistics are summarized in Table 4. Once the pretest scores on the productive vocabulary measure were controlled for, those in the writing condition (M = 18.10) outperformed those in the gesturing condition (M = 16.66) by 1.91 points (g = -0.70), but the difference was not statistically significantly ($F_{(1, 65)}$ = 1.73, p = .193). Similarly, when the comprehension scores taken at pretest were controlled for, those in the writing condition (M = 12.85) outperformed those in the gesturing condition (M = 12.00) by 0.85 points (g = -0.16), and the difference was not statistically significant ($F_{(1, 64)}$ = 0.83, p = .365).

When the receptive vocabulary pretest scores were controlled for, there was a statistically significant difference between the conditions for the receptive vocabulary measure taken at posttest. Using the adjusted means, those in the writing condition (M = 18.10) outperformed those in the gesturing condition (M = 16.66) by 1.44 points ($F_{(1, 64)}$ = 5.52, p = .022, g = -0.22). Because participants in the writing condition had lower pretest scores but higher posttest scores, these results indicate that participants in the writing condition demonstrated greater growth than those in the gesturing condition.

Table 4

Performance on immediate posttesting while controlling for pre-test scores

Measure	Gesturing (n = 34)	Writing (n = 34)	F	p	g
Receptive Vocabulary	10.95	12.85	5.52*	.022	-0.22
Productive Vocabulary	16.66	18.10	1.73	.193	-0.70
Comprehension	12.00	12.85	0.83	.365	-0.16

* $p < .05$

Delayed Posttesting

The average performance on the three researcher-created measures taken four weeks after the completion of the intervention was analyzed while controlling for pre-test scores using ANCOVA. These results are summarized in Table 5. When the pre-test scores on the receptive vocabulary measure were controlled for, those in the writing condition (M = 17.41, SD = 2.78) learned 1.53 (g = -0.43) more words as measured by the delayed receptive vocabulary measure (p = .059) than those in the gesturing condition (M = 15.88, SD = 4.16). When scores on the productive vocabulary measure taken at pre-test were controlled for, those in the writing condition (M = 12.44, SD = 6.50) learned 1.79 (g = -0.27) more words than those in the gesturing condition (M = 10.65, SD = 6.62) on the delayed productive vocabulary measure (p = .225). When the pre-test scores on the comprehension measure were controlled for, those in the writing condition (M = 12.51, SD = 5.01) learned 1.20 (g = -0.23) more words than those in the gesturing condition (M = 11.30, SD = 5.28), and the difference was not statistically significant (p = .238).

Table 5

Performance on delayed posttesting while controlling for pre-test scores

Measure	Gesturing (n = 34)	Writing (n = 34)	F	p	g
Receptive Vocabulary	15.88 (4.16)	17.41 (2.78)	3.70	.059	-0.43
Productive Vocabulary	10.65 (6.62)	12.44 (6.50)	1.50	.225	-0.27
Comprehension	11.31 (5.28)	12.51 (5.01)	1.42	.238	-0.23

Repeated measure *t*-tests were used to investigate if participants experienced learning loss between immediate and delayed posttesting. Results indicated that minor learning loss was observed for all measures in both conditions, and the only statistically significant difference occurred on the receptive vocabulary measure for the writing condition. These data are summarized in Table 6.

On the receptive vocabulary measure, the average score for participants in the writing conditions decreased from 17.97 (SD = 2.25) at immediate posttesting to 17.25 (SD = 2.78), for a statistically significant difference of 0.73 (g = -0.29) words ($t_{(33)}$ = 2.71, p = .011). The average score for the gesturing condition decreased by 0.73 (g = -0.20) words from 16.79 (SD = 3.08) at immediate posttesting to 16.06 (SD = 4.16) at delayed posttesting (p = .147).

On the productive vocabulary measure, the average score for those in the writing condition decreased from 12.88 (SD = 6.32) at immediate posttesting to 12.47 (SD = 6.50) at delayed testing, for a decrease of 0.41 (g = -0.06) words (p = .474). The average

score for the gesturing condition decreased by 0.29 (g = -0.04) words, from 10.91 (SD = 6.66) at immediate posttesting to 10.62 (SD = 6.62) words at delayed posttesting (p = .602).

On the comprehension measure, the average score for the writing condition decreased by 0.33 (g = -0.06) words. On average, they answered 12.74 (SD = 5.78) questions correctly during immediate posttesting but 12.41 (SD = 5.01) at delayed posttesting (p = .432). Those in the gesturing condition scored 12.12 (SD = 4.82) at immediate posttesting but 11.41 (SD = 5.28) during delayed posttesting, a decrease of 0.71 (g = -0.14) words that was non-significant (p = .111).

Table 6

Performance on immediate and delayed researcher created measures

Measure	Posttest	Delayed	*t*	*p*	*g*
Receptive Vocabulary					
Writing	17.97 (2.25)	17.24 (2.78)	2.71*	.011	-0.29
Gesturing	16.79 (3.08)	16.06 (4.16)	1.49	.147	-0.20
Productive Vocabulary					
Writing	12.88 (6.32)	12.47 (6.50)	0.73	.474	-0.06
Gesturing	10.91 (6.66)	10.62 (6.62)	0.53	.602	-0.04
Comprehension					
Writing	12.74 (5.78)	12.41 (5.01)	0.80	.432	-0.06
Gesturing	12.12 (4.82)	11.41 (5.28)	1.64	.111	-0.14

Note. Negative Hedge's *g* values indicate delayed posttesting was lower than immediate posttesting.

* $p < .05$

Item Analysis

Twenty words were included in this study. Of those twenty, ten words were those thought to be novel concepts to the participants, while the other ten were those that were thought to be familiar to the participants in their first language. Likewise, ten of the words were abstract concepts, while the other ten were concrete concepts. These vocabulary items and their categories are listed in Figure 1 on page 40.

Independent samples *t*-tests were used to compare the average performance between conditions for each category of word. Results are displayed in Table 7. Bonferroni corrections were applied to correct for multiple comparisons. After correcting for type 1 error, a statistically significant difference between groups was only observed for abstract words as measured by the receptive vocabulary measure. Participants in the writing condition learned 0.82 more abstract terms than those in the gesturing condition ($t_{(66)}$ = 2.85, p = .024, g = -0.68). There were no statistically significant differences observed on any other comparison on the productive vocabulary or comprehension measures.

Table 7

Means (and standard deviations) for each category of word for the writing and gesturing conditions

Measure	Gesturing (n = 34)	Writing (n = 34)	t	p	g
Receptive Vocabulary					
Known	8.76 (1.37)	9.41 (1.05)	2.19	.132	-0.52
Novel	8.03 (1.93)	8.56 (1.46)	1.28	.828	-0.31
Concrete	8.12 (1.90)	8.47 (1.60)	0.83	.999	-0.20
Abstract	8.68 (1.47)	9.50 (0.83)	2.85*	.024	-0.68
Productive Vocabulary					
Known	6.35 (3.26)	6.82 (3.12)	0.61	.999	-0.15
Novel	4.88 (3.60)	6.14 (3.52)	1.47	.592	-0.35
Concrete	5.65 (3.54)	6.09 (3.52)	0.52	.999	-0.12
Abstract	5.59 (3.45)	6.88 (3.17)	1.61	.448	-0.39
Comprehension					
Known	5.88 (2.29)	6.26 (2.82)	0.61	.999	-0.15
Novel	6.35 (2.65)	6.35 (3.00)	0.00	.999	0.00
Concrete	6.53 (2.51)	6.26 (3.05)	0.39	.999	0.10
Abstract	5.71 (2.44)	6.35 (2.85)	1.00	.999	-0.24

* $p < .05$

When the data were analyzed at the word level, there were no statistically significant differences on performance between the writing and gesturing conditions as measured on the receptive vocabulary, the productive vocabulary, or the comprehension measures. Thus, there were no specific words that benefited from being learned with either gestures or by being copied down.

Survey of Iconicity

During immediate posttesting, participants in the gesturing condition took a survey indicating on a 5-point Likert scale whether they thought each gesture was a good representation of the word that they learned. A score of 1 indicated a 'bad representation,' a 3 indicated a 'fair' representation, and 5 indicated an excellent representation. Of the twenty words, *kerf* received the lowest rating ($M = 3.21$, $SD = 1.37$) while *acknowledge* received the highest rating ($M = 4.44$, $SD = 0.89$).

Participant ratings were analyzed for the four word features (i.e., concrete, abstract, known, and novel). There was not a statistically significant difference between the average rating for concrete words ($M = 39.65$, $SD = 8.02$) and abstract words ($M = 40.38$, $SD = 7.22$) ($t_{(33)} = 1.02$, $p = .316$). There was a statistically significant difference between the average participant score for known and novel terms ($t_{(33)} = 4.44$, $p < .001$). Participants ranked the gestures for known terms ($M = 41.15$, $SD = 6.96$) higher than the gestures for novel terms ($M = 38.88$, $SD = 7.97$) by a difference of 2.26 points.

CHAPTER V: DISCUSSION

Vocabulary Acquisition

The first research question examined whether making iconic gestures during instruction can improve L2 vocabulary acquisition among high-school aged students. The results from this study suggest that making iconic gestures during instruction is not more effective than copying the vocabulary terms down, which is how ELs typically learn vocabulary. On the receptive and productive vocabulary measures, participants in the writing condition learned a larger percentage of words that than those in the gesture condition, but the difference was not statistically significant. When pretest scores were controlled for, participants in the writing condition learned 1.44 more words on average than those in the gesturing condition on the receptive vocabulary measure although the difference was not statistically significant. This result indicates that participants in the writing condition knew fewer words at the pretest but understood more words during posttesting.

In almost all the previous research on using gestures to learn L2 vocabulary, participants in the intervention condition outperformed those in the control condition. As discussed in the literature review, many of the previous studies on this topic did not include a balanced condition. In Tellier (2008), participants in the control condition were shown pictures of the vocabulary items. In both Mavilidi et al. (2015) and Toumpaniara et al. (2015), participants in the control condition saw the vocabulary words written down and heard them spoken aloud. Participants in the control condition in Sueyoshi and Hardison (2005) were played an audio recording of the vocabulary item. Similarly,

participants in the control in Macedonia et al.'s (2014) study heard the vocabulary word pronounced aloud. Those in the control in Kelley et al. (2009) and Huang et al. (2019) were not shown the gesture those in the intervention saw, and no supplemental enrichment was provided. Likewise, Cohen (1981) observed that words learned through gestures were better recalled as than those learned by silently memorizing words lists. None of these studies included a counter factual that was given an active and equivalent enrichment to compare the effect of gestures. While these studies demonstrate that gestures can be used to learn L2 vocabulary, they cannot make the claim that gestures are more effective than alternate learning strategies, and the findings in the current study suggest that making iconic gestures during instruction is not an effective learning strategy when compared to how students are typically learning a second language in schools.

All known previous studies on L2 acquisition found that gestures improve recall of vocabulary items (Andrä et al., 2020; Macedonia et al., 2011). The previous literature has measured vocabulary acquisition through two tasks: free recall and cued recall. In a free recall task, participants list as many L1 or L2 words they can remember in a given amount of time. In a cued recall task, participants are given the L1 or L2 term and asked to provide the word in the other language. The two vocabulary tasks used in this study differ from both free and cued recall tasks. On the receptive vocabulary measure, participants were given a sentence in English with the target vocabulary bolded. They were asked to choose the equivalent of the bolded term in Spanish. On the productive vocabulary measure, participants were given the vocabulary item in English and were asked to write the equivalent word or definition in Spanish. Both of these tasks were

developed based on best practices for second language vocabulary interventions (Nation & Webb, 2011).

The receptive vocabulary measure was used in this study rather than the L1 to L2 cued recall task as in previous studies because the English proficiency of the participants was low, and it was the expectation that participants would be able to choose the appropriate L1 equivalent of the target L2 word when it was presented in a sentence, but they would be less likely to be able to write out the target item in English if a cued recall task was used. This was the case as the scores for both conditions on receptive vocabulary measure were consistently higher than the productive vocabulary measure. The productive vocabulary measure was similar to an L2 to L1 cued recall task like that used in previous studies. One important difference is that participants were allowed to write an explanation of the L2 word rather than only its L1 equivalent. This was required since some of the target vocabulary did not have equivalent terms in Spanish. Free recall tasks were not used in this study because they are a measure of general recall rather than vocabulary acquisition. The different results observed here compared to previous research may be explained by the different outcome measures used. Because free recall tasks were not used, the participants' ability to remember which words they were exposed to, in both L1 and L2, was not measured. Furthermore, the receptive and productive vocabulary measures afforded the participants, who had very limited L2 ability, greater ability to demonstrate acquisition of the target items as compared to the cued recall tasks used in the previous literature.

Delayed posttesting was conducted in the current study four weeks after the completion of the intervention. There were no statistically significant differences between the average score on the receptive or productive vocabulary measures between the writing and gesturing conditions for delayed posttesting. On the receptive vocabulary measure, the writing condition was observed to have statistically significant learning loss between immediate and delayed posttesting. There were no statistically significant differences between the immediate and delayed posttests on the productive vocabulary measure for either condition. These results suggest that while gestures were less effective for learning vocabulary compared to copying the terms, the benefit that iconic gestures did provide extended beyond the intervention period. A similar finding was observed by Macedonia and Klimesch (2014), in which words learned with gestures were recalled better than those learned without gestures for up to 444 days after the completion of the intervention.

Novel Concepts

Previous research on using gestures to teach L2 vocabulary has focused on relatively simple vocabulary that participants are likely to already know in their first language. No study has examined the use of gestures to teach novel concepts in a second language. This is an important avenue of research because in many EL programs in the United States, students are learning novel concepts in content area classes like math or science while they are simultaneously building English proficiency. Furthermore, some theoretical explanations for the benefits of gesturing imply that gestures would be more beneficial for established concepts compared to novel ones (Macedonia, 2014). This

study explored this research question by including ten vocabulary items which were thought to be known to the participants and ten vocabulary items that were thought to be new concepts.

On the receptive vocabulary measure, participants in the writing condition learned 0.65 more known words than those in the gesturing condition, but the difference was not statistically significant. However, participants in the gesturing condition learned 0.53 more novel words than those in the gesturing condition, and again the difference was not statistically significant. There were likewise no statistically significant differences in the amount of known or novel terms learned between conditions as measured by the productive vocabulary task. These results suggest that using gestures is not any more effective for learning novel concepts compared to conventional teaching methods.

As measured by both the receptive and productive vocabulary tasks, words for known concepts were learned better than words for novel concepts by participants in both the writing and gesturing conditions. These results were expected as it was hypothesized that terms known in L1 would be more easily learned in L2 than words for completely new concepts would be. This was the case regardless the method by which the terms were learned.

Abstract Terms

Half of the target vocabulary items were abstract terms and half were concrete. Contrary to expectations, abstract terms were learned better than concrete terms in both conditions as measured by the receptive vocabulary measure. Participants in the writing condition learned 0.82 more abstract words than those in the gesturing condition on the

receptive vocabulary measure, and the difference was statistically significant. While participants in the gesturing condition learned 0.35 more concrete words on the receptive vocabulary measure than those in the gesturing condition, the difference was not statistically significant. There was not a statistically significant difference for abstract or concrete terms between conditions on the productive vocabulary measure.

The scores on the receptive vocabulary measure suggest that gestures are less effective for learning abstract terms than copying down vocabulary terms. Andrä et al. (2020) observed that while gestures improved recall of both concrete and abstract terms, pictures were equally effective. Because participants in both conditions saw pictures in this study, comparisons to Andrä et al. (2020) cannot be made, but it was observed in the current study that copying words down was more effective for learning abstract terms.

Among previous studies examining the benefit of gestures on L2 acquisition, only Repetto et al.'s (2017) study explicitly examined abstract vocabulary. In their study, they found that gestures improved acquisition of abstract terms, and so the results here are in line with prior literature. However, Repetto et al. (2017) did not also include concrete terms as a comparison. This means that this is the first study to compare the effectiveness of using gestures to learn concrete versus abstract terms. One theory explaining the benefit of gestures for learning argues that gestures provide extralinguistic information that learners can use to build a more complete understanding of a term. Since abstract terms are by nature more difficult to represent through a gesture, it was hypothesized that abstract terms would be learned less well than concrete terms. While this was the case on the receptive vocabulary measure when conditions were compared, abstract terms were

learned better than concrete terms overall. Furthermore, the opposite finding was observed on the comprehension measure. Future research is needed to examine this topic more fully.

Comprehension

The participants completed a comprehension assessment in a cloze format, in which they selected the correct target item to complete a sentence. Participants in the writing condition answered 1.20 more questions correctly than those in the gesturing condition, and the difference was not statistically significant. There were no differences observed for the comprehension measure between conditions for any of the item-level features, such as a concreteness or known status. These results suggest that using gestures to learn L2 vocabulary did not result in improved comprehension of sentences containing the target vocabulary.

This assessment should be viewed as exploratory because no comprehension measures have been used in the previous research on using gestures to improve L2 vocabulary acquisition. Two meta-analyses have been conducted to investigate whether gestures improve comprehension in the participants' native language. Both Dargue and Sweller (2019) and Hostetter (2011) observed that gestures improve comprehension on average by $d = 0.61$. It is difficult to relate the results of these meta-analyses and the findings in this study for three reasons. First, studies included in the meta-analyses only consisted of those in which participants were studying content in their native language. Secondly, Dargue and Sweller (2019) did not differentiate between studies in which participants observed an instructor making gestures and those in which they copied the

gestures themselves. Finally, as was discussed in more detail previously, these meta-analyses did not make a clear distinction between comprehension and simple narrative recall. Hostetter (2011) found that gestures only benefitted young learners on comprehension tasks compared to adolescents or adults. More research is needed to assess if gestures can result in improved L2 comprehension.

L1 or L2 Proficiency

L1 Proficiency

Participants took a researcher-created measure of Spanish listening comprehension, and the data were examined to assess whether the effectiveness of learning vocabulary with gestures is moderated by L1 proficiency. Most previous L2 research has included either young children (Mavilidi et al., 2005; Tellier, 2008; Toumpaniara et al., 2015) or students at the university level (Macedonia et al., 2011; Macedonia & Klimesch, 2014; Macedonia & Knösche, 2011; Macedonia & Repetto, 2016; Repetto et al., 2017). The participants enrolled in the current study were all adolescent students, but they were from diverse educational backgrounds. Some had attended private schools in their home countries while others had only completed up to the second grade. No previous L2 study has measured L1 proficiency, and so this analysis was exploratory in nature. Unfortunately, the researcher-created measure had low reliability, and the data gathered was not informative. More research is needed to understand what if any role L1 proficiency plays on the benefits of gesture for acquiring L2.

L2 Proficiency

English proficiency was measured with the WIDA ACCESS assessment. The participants' ACCESS scores were used to investigate whether the effectiveness of learning vocabulary with gestures in a second language is moderated by the participants' proficiency in L2. Unfortunately, the English proficiency of the participants in the current study were too low to be informative. Sueyoshi and Hardison (2005) found that participants with lower L2 proficiency benefited more from gestures than those with greater L2 proficiency. Other studies have shown the opposite, however, that lower L2 proficiency results in a reduction of benefits of gesturing for acquiring L2 (Macedonia & Repetto, 2016; Post et al., 2013; Yeo et al., 2017). More research is needed to understand the role that L2 proficiency plays when using gestures to learn vocabulary in L2.

Limitations & Future Research

The results of this study suggest that gestures may not be an effective strategy for learning academic vocabulary in a second language at least under similar conditions to the ones in this study. These findings are at odds with most of the prior literature on gesturing interventions in a second language. There are many characteristics of this study that differ from the previous research, including the difficulty of the task, the setting of the experiment, and characteristics of the participants.

Previous literature on gesturing has shown that gestures must provide additional information to the discourse in order to be useful (Macoun & Sweller, 2016). When gestures are redundant to the spoken discourse, listeners do not rely on them for information (Holle & Gunter, 2007). It is unknown if the task of learning these 20 words

was difficult enough to require additional enrichment. However, this is not likely given how much more difficult the words were in this study as compared to previous ones. Given that the gesture condition performed worse than the writing condition, making the gestures may have had a negative effect by distracting or confusing the participants since the vocabulary was so challenging. It was not feasible to reliably screen for prior conceptual knowledge associated with the chosen terms, and arguably relying on teacher estimation of such knowledge presents an additional limitation in the current study. The participants' teachers decided which terms would be unlikely to be known to them, so any inferences that can be drawn on the benefits of using gestures to teach new concepts must be viewed with caution.

Previous research has observed a benefit from making gestures when learning simple vocabulary in L2. This benefit was not observed here, and it may be that making a single quick gesture for a more complex concept was insufficient. One of the challenges in this study was choosing words that were both non-Spanish cognates and that could be defined in a single sentence. A classroom setting would allow for instruction of difficult concepts, like *mitochondria* or *filibuster*, and including more difficult words may result in more observable differences between conditions on vocabulary and comprehension measures. Future studies examining the effect of making gestures to learn academic vocabulary may benefit from being conducted in a classroom setting with extended instruction rather than in a controlled setting.

Another limitation of this study is that the majority of previous research on this topic was conducted in the artificial language Vimmi by Macedonia and her research group.

This makes it difficult to compare the results in this study, conducted in English, with those of Macedonia's research group. Using an artificial language would have clear benefits in this study because there are many cognates between Spanish and English, and the majority of academic vocabulary in English is derived from Latin. An artificial language was not employed in this study for two reasons. First, previous research has shown repeatedly that gestures benefit L2 vocabulary acquisition when learning an artificial language. The participants in this study were enrolled in an EL program and were already learning English. Thus, by choosing to conduct this study in English, an effort was being made to examine the benefits of using gestures in L2 acquisition for a more practical application. While this study was still conducted in a controlled setting, it was hypothesized that English would be a more effective target language to use because the participants were already familiarizing themselves with English phonemes and prosody. One limitation of the current study is that participants were not surveyed at the conclusion of the intervention regarding whether they enjoyed using gestures to learn vocabulary or if they felt that gestures were helpful. Given that the participants were adolescents, they may have been embarrassed or confused while making the gestures. Most of the studies that have investigated if gestures can be used to improve L2 vocabulary acquisition have been conducted with either college-aged adults or elementary-aged students, and more research is needed to examine whether gestures can improve L2 vocabulary acquisition with adolescent participants.

Conclusion

Numerous studies have shown that using gestures during instruction can improve general recall and L2 vocabulary acquisition. The study presented here sought to expand on prior research by including vocabulary for novel concepts that participants had not yet been exposed to in their native language. The benefit of using gestures for abstract versus concrete terms was also examined. Results indicated that gestures were not a more effective learning strategy compared to copying the word down as measured by vocabulary or comprehension tasks regardless of word level features.

An important feature of this study is that participants in the control condition received balanced instructional content equal to gesturing whereas prior studies have compared a gesturing condition to a condition that simply did not use gestures and thus received less instructional stimulus than the intervention condition. Participants in the control condition in this study copied down the target items that they were learning, which is the methodology for learning L2 terms typically employed in second language classrooms. Previous studies compared the acquisition of words learned with accompanying gestures to those learned by hearing the target word pronounced or by reading it. The results from this study suggest that using gestures is not more effective than how ELs are already learning L2 vocabulary. A limitation of this study is that the positive results demonstrated by participants in both conditions may have been due to exposure alone rather than copying the terms or making the gestures.

It is difficult to compare previous studies examining the instructional benefit of gesture because there is not a standardized system to describe the gestures being used in

each study. Previous research has established that how beneficial a gesture is depends on how representative it is to the learners using them. However, very few studies have surveyed participants on the gestures that are used in interventions. The gestures used in this study were taken from various sign languages, and all the gestures that were used can be viewed online at www.spreadthesign.com. Participants also completed a survey where they ranked the saliency of each gesture used. None of the gestures were rated as being poor representations, and this is likely because the gestures were taken from existing sign languages. Future students should work towards a standardized system of gestures so that the results of studies can be compared more accurately.

The majority of studies conducted on using gestures to improve L2 acquisition have been conducted in laboratory settings. While the current study was also conducted in a controlled setting, an effort was made to move this field of research towards a more practical application by teaching the type of complex vocabulary that students would be learning in school. Future research should continue to explore how gestures might be used in the second language classroom to improve L2 vocabulary acquisition and comprehension.

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APPENDIX A: INTERVENTION MATERIALS AND GESTURES

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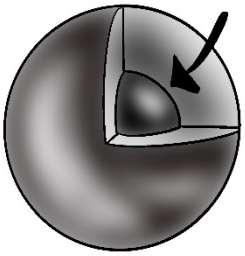
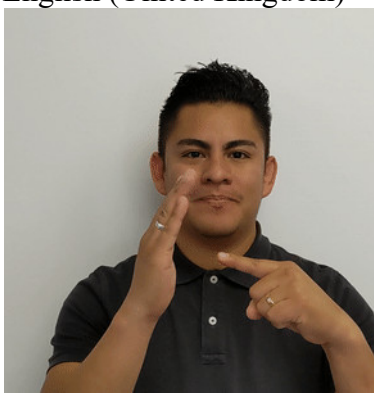
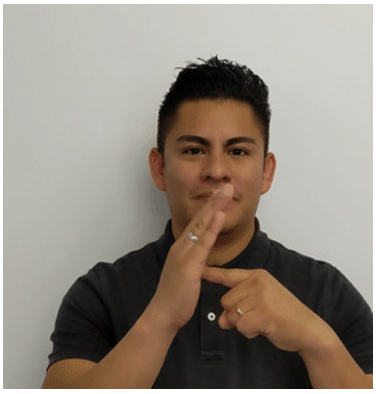
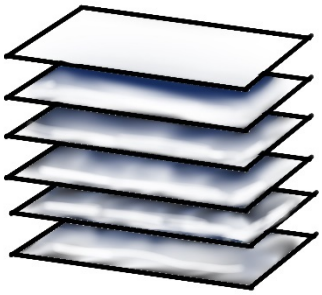
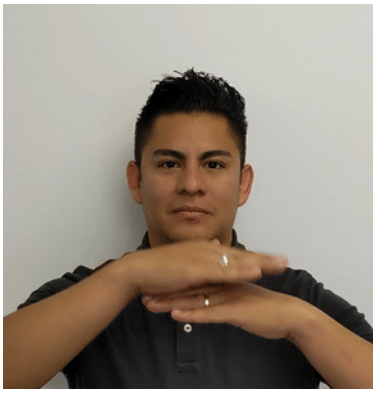
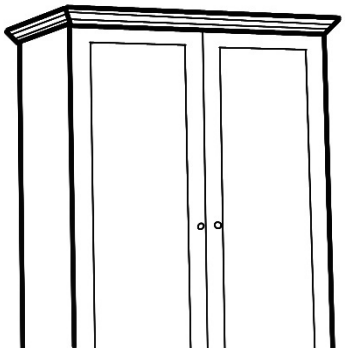
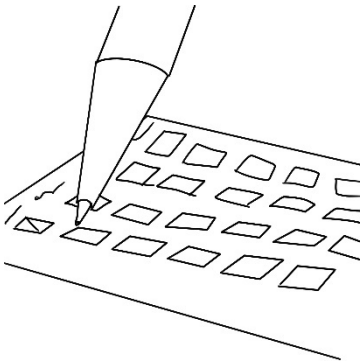
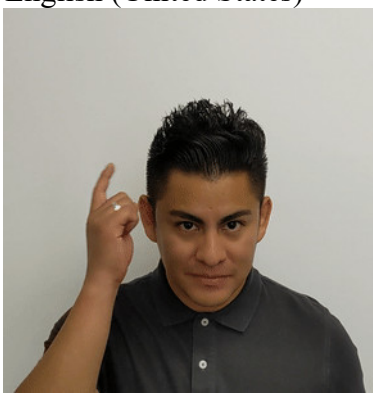
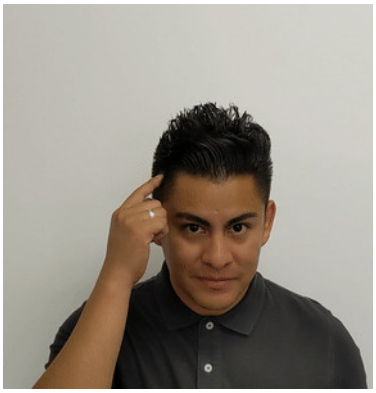
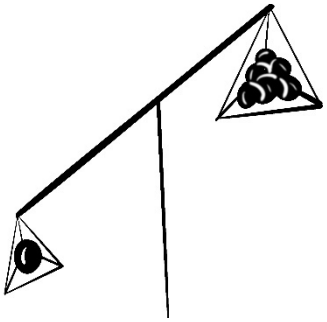
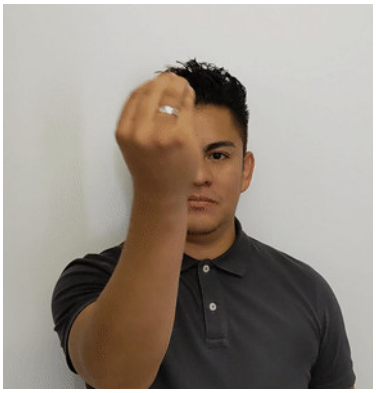
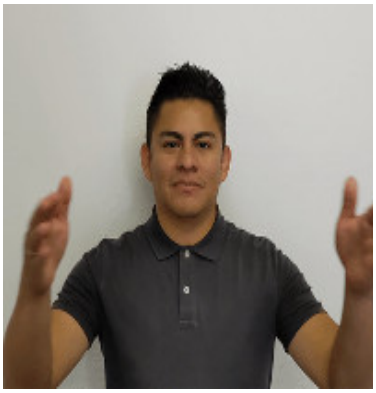
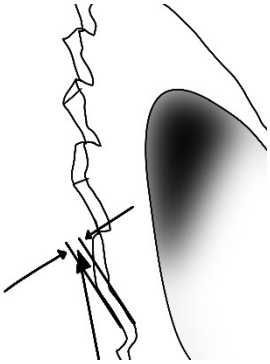
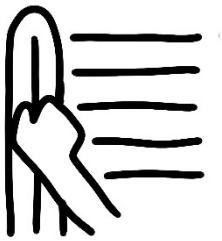
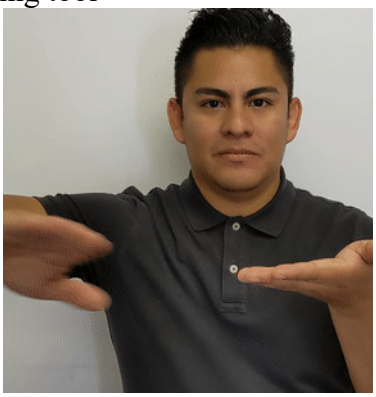
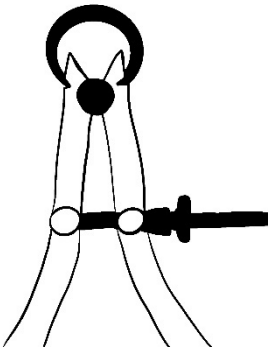
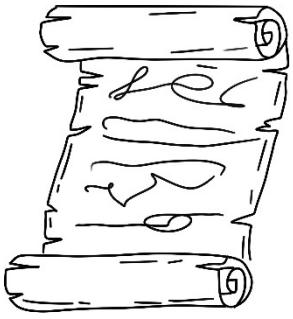
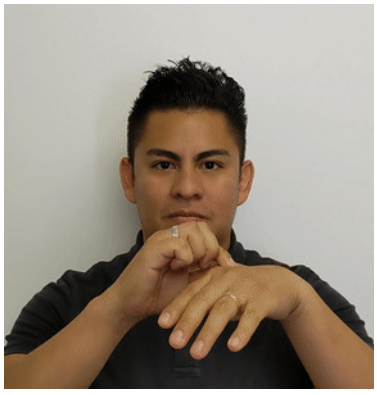
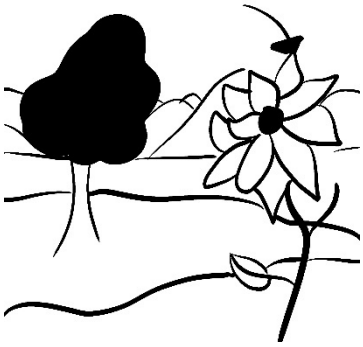
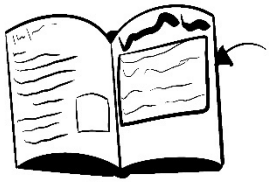
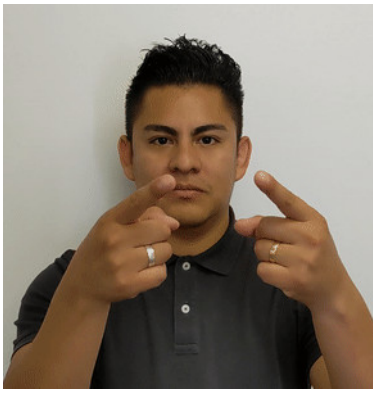
	 
Layer	English (United States)
	 
Wardrobe	English (United Kingdom)
	 

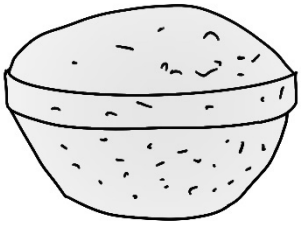
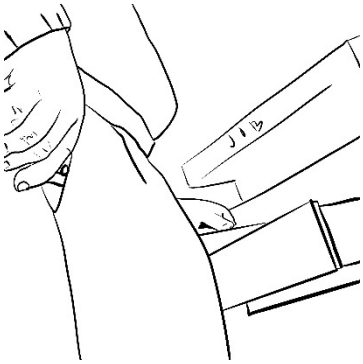
Survey 	English (United Kingdom)  
Diver 	Polish  
Acknowledge 	English (United States)  

Bias	Spanish (Argentina)
	 
Enhance	Spanish (Spain)
	 
Release	German
	 

Task	Spanish (Spain)
	 
Kerf	Spanish (Spain) for “width”
	 
Screed	German (Austria) for “smoothing tool”
	 

Bellows	Estonian
	 
Caliper	Lithuanian
	 
Vellum	Lithuanian for “leather-bound book”
	 

Foreground 	French (France)  
Blurb 	German (Germany)  
Jingle 	Lithuanian for “song”  

Leaven 	Icelandic  
Embezzle 	Russian (Russia)  

APPENDIX B: RESEARCHER-CREATED MEASURES

Receptive Vocabulary Knowledge
Instructions: Choose the word in Spanish that best represents each bolded English word.

1. core: The **core** of the planet is made of rock.
(a) el exterior
(b) los anillos
(c) el centro
(d) la luna

2. layer: The cake has three **layers** of chocolate.
(a) piezas
(b) trozos
(c) cucharas
(d) capas

3. wardrobe: I put my clean clothes in the wardrobe.
(a) el armario
(b) la cama
(c) la secadora
(d) el baño

4. survey: The students did a **survey** to pick classes.
(a) un programa
(b) un baile
(c) una rifa
(d) una encuesta

5. diver: The **diver** looks at the fish in the ocean.
(a) el buceador
(b) el cocinera
(c) el detective
(d) el agricultora

6. acknowledge: The teacher **acknowledges** the good work of the students.
(a) critica
(b) castiga
(c) alaba
(d) reconoce

7. bias: The newspaper showed **bias** towards the president.
(a) la moderación
(b) la parcialidad
(c) el favoritismo
(d) el odio

8. enhance: She **enhanced** the room with a new color.
(a) mejoró
(b) dañó
(c) rediseñó
(d) cambió

9. release: I **released** the animal into the forest.
(a) puse
(b) tiré
(c) liberé
(d) atrapé

10. task: I have to finish a **task** before I leave.
(a) una ducha
(b) una comida
(c) una tarea
(d) una película

11. kerf: The **kerf** of a knife is important.
(a) el color de la hoja
(b) la longitud de la hoja
(c) el ancho de la hoja
(d) el peso de la hoja

12. screed: The workers use a **screed** to build a wall.
(a) alisan el concreto
(b) miden la distancia
(c) apilan ladrillos
(d) cortan trozos de madera

13. bellows: She uses the **bellows** to start the fire.
(a) enciende la estufa
(b) apila madera
(c) enciende fósforos
(d) empuja el fuelle

14. caliper: I measure the ball using a **caliper**.
(a) con una regla
(b) con pinzas
(c) con una escala
(d) con una cucharada

15. vellum: Old books were written on **vellum**.
(a) en piedra
(b) en madera
(c) en papel
(d) en vitela

16. foreground: The artist painted a house in the **foreground** of the picture.
(a) en primer plano
(b) en el cielo
(c) en el fondo
(d) en la casa

17. blurb: The **blurb** on the book was written by a famous writer.
(a) el resumen
(b) el apéndice
(c) la introducción
(d) el texto publicitario

18. jingle: The commercial had a funny **jingle**.
(a) una canción
(b) una broma
(c) un producto
(d) un baile

19. leaven: We **leaven** the bread before cooking.
(a) sumergimos en aceite
(b) permitimos leudar
(c) cortamos en rodajas
(d) sacamos del congelador

20. embezzle: The owner **embezzled** from the company.
(a) recibió un cheque
(b) tomó prestados suministros
(c) robó dinero
(d) se tomó vacaciones

Sentence-Level Comprehension Questions

Instructions: Choose the word that completes the sentence best.

1. To be fair, a referee can have no _____ during a soccer game.
a. core b. task c. bias d. screed

2. After I wash my clothes, I put them in a _____.
a. wardrobe b. layer c. task d. caliper

3. The _____ of the planet is made of rock.
a. wardrobe b. core c. kerf d. task

4. It is cold outside so wear many _____ of clothing today.
a. biases b. layers c. calipers d. bellows

5. Painting your house can _____ its appearance.
a. release b. embezzle c. enhance d. leaven

6. The _____ found a boat on the bottom of the ocean.
a. kerf b. diver c. screed d. blurb

7. The students took a _____ to discover what classes they should take.
a. survey b. core c. wardrobe d. bias

8. The principal will _____ the best students with a party.
a. enhance b. release c. acknowledge d. embezzle

9. The police will _____ the criminal from jail after two years.
a. acknowledge b. release c. enhance d. leaven

10. You need a knife with a small _____ to get thin cuts of meat.
a. kerf b. survey c. bias d. diver

11. Workers use a _____ to get the concrete smooth.
a. survey b. vellum c. screed d. core

12. The worker has one more _____ to complete before she can go home.
a. vellum b. task c. foreground d. kerf

13. Old books were written on _____ before paper.
a. vellum b. diver c. jingle d. wardrobe

14. You can make a fire bigger by using the _____ to give it air.
a. layer b. bellows c. diver d. jingle

15. You have to _____ the bread before you cook it.
a. embezzle b. leaven c. acknowledge d. enhance

16. The engineer measures a ball using a _____.
a. caliper b. jingle c. blurb d. vellum

17. The artist painted a tree in the _____ so it looked close to you.
a. screed b. foreground c. blurb d. survey

18. The _____ on the book said it was the best story she had read.
a. bellows b. foreground c. blurb d. layer

19. I love the sound of the _____ in the commercial on TV.
a. jingle b. caliper c. bellows d. foreground

20. The workers _____ money from the business when the boss is not there.
a. acknowledge b. leaven c. enhance d. embezzle

Spanish Listening Comprehension Measure

Instructions: Listen to the following prompts and answer the questions:

1. Juan Luis está haciendo una investigación genealógica cuando se encuentra con esta publicación en un sitio de historia familiar que origina en Argentina

La palabra genealogía proviene del griego, "genos" (raza) y "logos" (ciencia), y consiste en la enumeración de los antepasados de una persona. Es una de las ciencias auxiliares de la historia (1) que trata del origen y descendencia de las familias (o de un linaje) a través de una realidad documental y (2) que por medio del estudio de documentos fidedignos se ocupa en establecer el parentesco entre personas y familias y el origen, descendencia y alianzas de las mismas. La genealogía se nutre de diversas fuentes de información escritas, pero siempre se debe comenzar por la tradición.

Cual afirmación resume mejor esta publicación:

A. Clasifica los pasos en la investigación del linaje de uno
B. Explica la importancia de la tradición oral y los documentos legales en la investigación genealógica
C. Describe porque la genealogía es de importancia histórica a la sociedad
D. Define la genealogía como una subcategoría de la historia en la cual la persona traza su linaje

2. Rodrigo esta buscando en un sitio de tecnología y se encuentra con el pasaje siguiente

Aunque las redes inalámbricas para conectarse a Internet son comunes en la mayoría de las ciudades del planeta, existen lugares extraños en los que se puede encontrar conexiones WiFi. Por ejemplo, un cementerio en Kentucky puede ser el único en el mundo en ofrecer conexión WiFi. El servicio fue establecido para ayudar a los visitantes con sus investigaciones genealógicas. Como otro ejemplo, una empresa de telefonía sueca instaló puntos de acceso a Internet WiFi a lo largo de la montaña más alta de la Tierra: el monte Everest. También, los primeros turistas espaciales que viajen con la compañía Virgin Galactic pueden sumar a la experiencia de la gravedad cero, la de navegar por Internet desde sus naves espaciales.

¿Cuál es el punto principal del articulo?

A. Los puntos de acceso a internet Wifi están disponibles en lugares muy inusuales e inesperados.
B. El monte Everest es la única montaña en el mundo con internet Wifi.
C. El Virgin Galactic planea proveer excursiones al espacio.
D. Es posible el uso del internet inalámbrico en todo el mundo.

3. Mientras busca libros a través de un sitio web en línea, se encuentra con esta reseña.

Busque otra opción para conocer la historia de España. Compré *La Historia de España* guiado por el título, una historia de España para personas con conocimientos superficiales de esta a fin de profundizarlos un poco más. ¡Totalmente decepcionado! Es una historia escrita para personas que conocen muy bien la historia de España. Aquí no se hace una descripción de los hechos. Todo se da por sabido y lo que se hacen son comentarios e historia social de España. Si usted no conoce a profundidad la historia de España no se le ocurra leer este libro porque lo único que logrará es confundirse. Los nombres de los personajes van surgiendo como si ya uno los conociera. No digo que el libro sea malo. Lo que digo es que no es un libro para conocer la historia de España que es lo que induce a creer el título de la obra. Si su interés es conocer esta historia le recomiendo, del mismo autor la Historia de España para Dummies o leer artículos de revistas como Aventura de la Historia.

¿Cuál declaración caracteriza mejor la opinión que se presenta en este repaso?

A. Este libro es una colección de artículos de aventuras históricas.
B. El titulo del libro no refleja precisamente el contenido
C. Este libro es un manual excelente para aquellos que no conocen nada de la historia de España.
D. Varias partes del libro están mal escritas.

4. Mientras lees un periódico en línea de Columbia, te encuentras con este articulo tratando con las condiciones en varias prisiones.

A la frialdad de las cifras que revelan el estado lamentable en que se encuentra la mayoría de las cárceles del país, le hacía falta la crudeza testimonial de sus protagonistas: los miles de sindicados y condenados que, por diversas circunstancias, hoy pagan sus culpas en centros penitenciarios que degradan la condición humana. Las imágenes de los reclusos que deben compartir un reducido espacio, durmiendo incluso bajo los camastros de una celda; el estado deplorable de los sanitarios; la demora en el suministro de medicamentos para quienes padecen enfermedades graves; la falta de agua y de mínimas condiciones higiénicas distan mucho de lo que debería ser la prestación de un servicio carcelario digno y eficiente.

¿Cuál condición de las prisiones colombianas se mencionan en este articulo?

A. El retraso en la dispensación de medicamentos a los enfermos gravemente.
B. La corrupción entre los administradores de la prisión
C. La falta de capellán de prisión para ayudar a los reclusos
D. El creciente problema de las drogas agravado por las condiciones pobres.

5. Mientras Miguel lee un pasaje de El País, se encuentra con este pasaje de un artículo.

Recientemente hemos tratado de atender a las empresas pequeñas. Lo hacíamos cuando no lo hacía nadie. Siempre hemos estado con los pequeños y medianos negocios, y seguiremos focalizados en aquellos. Pese a lo que opinen los analistas y agencias de las calificaciones y la fuga de clientes que no quisieron implementar nuestro modelo para que lleguen a ser una empresa exitosa, seguiremos apostando por nuestro modelo de negocio. Hemos percibido un aumento de inversiones en el balance para el margen de explotación. Estos tipos de negocios son nuestra fuente principal. Y pese a que todos los bancos sanos ahora han entrado en este segmento de retraso de cuota, nosotros seguimos ganando nuestra cuota de mercado.

¿Cuál es el propósito de este pasaje?

A. Presentar los datos de un analista calificado sobre las tendencias del mercado.
B. Para advertir a los consumidores de la posible explotación de empresas de inversión fraudulentas
C. Anunciar la tasa de intereses bajas en hipotecas ofrecidas por un banco estable.
D. Promover un modelo de negocio rentable para las empresas pequeñas y grandes

6. Estás leyendo el comienzo de un cuento del autor uruguayo Horacio Quiroga

El hombre pisó algo blanduzco, y en seguida sintió la mordedura en el pie. Saltó adelante, y al volverse, con un juramento vio un yararacusú que, arrollada sobre sí misma, esperaba otro ataque. El hombre echó una veloz ojeada a su pie, donde dos gotitas de sangre engrosaban dificultosamente, y sacó el machete de la cintura. La víbora vio la amenaza y hundió la cabeza en el centro mismo de su espiral; pero el machete cayó en el lomo, dislocándole las vértebras.El hombre se bajó hasta la mordedura, quitó las gotitas de sangre, y durante un instante contempló. Un dolor agudo nacía de los dos puntitos violetas y comenzaba a invadir todo el pie. Apresuradamente se ligó el tobillo con su pañuelo y siguió por la picada hacia su rancho.

¿Dadas las primeras líneas, donde comienza la historia?

A. En la tierra salvaje
B. En un hospital o clínica
C. En un campo de batalla durante una guerra.
D. En un campo de futbol

7. Romina lee el siguiente fragmento de un artículo de una web dedicada a la historia del arte en España.

Los trabajos de restauración que se están llevando a cabo en la Alhambra de Granada han deparado una importante sorpresa. Cuando los restauradores retiraron la madera y la yesería que revisten la estancia, descubrieron una colección de más de ochenta dibujos realizados por los artesanos que trabajaron en la decoración de esta joya del arte nazarí (granadino). Estos dibujos descubiertos conservan sus pigmentos originales, sin retocar, y son de diversos tipos: motivos vegetales, animales fantásticos, versículos del Corán, e instrucciones de montaje para los artesanos. Se dice que el más interesante de todos es el de una figura con cabeza humana, con barba blanca y turbante y cuerpo de animal. Esta imagen es de gran importancia, puesto que en el ámbito musulmán se rechazaban las representaciones de personas y animales; tal vez por eso las figuras fueron tapadas tras su realización. Otro aspecto interesante es que algunos de los dibujos están firmados, algo que tampoco es frecuente, ya que los artesanos nazaríes trabajaban de forma anónima.

¿Que menciona el autor como la razón probable por la cual se escondieron los dibujos?

A. Para esconder la identidad de los artistas para que pudieran permanecer anónimos.
B. Para protegerlos durante el trabajo de restauración en la Alhambra.
C. Porque no fueron considerados suficientemente significativos para la Alhambra.
D. Porque son dibujos de imágenes prohibidas.

8. Mientras lee el diario, ve el siguiente artículo publicado en la página ambiental.

La fractura hidráulica (también conocida por el término en inglés fracking) es una técnica para posibilitar o aumentar la extracción de gas y petróleo del subsuelo. Frente a la preocupación manifestada por algunas asociaciones ecologistas respecto a los posibles riesgos medioambientales derivados de esta técnica, en el sentido de que, además del demostrado incremento de sismos, los compuestos químicos podrían contaminar tanto el terreno como los acuíferos subterráneos. Las quejas de los residentes cercanos a un campo de pozos en una localidad provocaron una investigación llevada a cabo por la EPA y en la cual informó de la detección de metano y otros componentes químicos extraídos de dos fuentes potables, algunas de ellas con niveles peligrosos. El informe también advirtió que la contaminación encontrada es típicamente imposible o muy costosa de mitigar o corregir.

De acuerdo con este texto, ¿qué efecto controversial de la fractura hidráulica fue investigada?

A. Los niveles altos de contaminación en el agua subterránea.
B. Un peligro aumentado de terremotos en zonas sísmicas.
C. El posible daño sensorial y neurológico a los trabajadores
D. La alta cantidad de agua requerida para completar el proceso.

9. Francisco lee este reportaje online sobre medicina en un periódico británico.

Agregar plata a los antibióticos puede potenciar su efecto entre 10 y 1.000 veces, según un nuevo estudio. La plata ha sido empleada como antimicrobiano durante siglos. Los egipcios y fenicios utilizaban cisternas de plata para conservar el agua, y con el mismo objetivo los emperadores chinos comenzaron a utilizar cubiertos de plata. Sin embargo, no se comprende aún completamente el mecanismo de acción que provoca la muerte de las bacterias. Los científicos infectaron el tracto urinario de ratones, a los que trataron con plata, antibióticos, y el cóctel plata-antibióticos. El tratamiento con el cóctel resultó ser mucho más eficaz. El hallazgo es clave, porque muchos antibióticos están perdiendo su efectividad.

¿Cuál de los siguientes describe precisamente los puntos principales del articulo?

A. Los antibióticos se están convirtiendo menos efectivos contra las infecciones todos los días.
B. Los egipcios, fenicios, y chinos usaban la plata como el método principal para tratar infecciones.
C. Agregando plata a los antibióticos es más eficaz que solo el uso de antibióticos.
D. El papel mas importante de la plata es el tratamiento de infecciones de el tracto urinario.

10. You are visiting the Prado Museum in Madrid and have downloaded an app to your phone which explains the different works of art.

El quitasol (1777) es un cuadro de Francisco de Goya que forma parte de la serie de cartones para la Real Fábrica de Tapices. Aparecen dos figuras, una jovencita vestida a la moda francesa, y un criado. Las líneas de fuerza dibujan casi un triángulo equilátero, figura geométrica que expresa una gran serenidad, en el que se enmarca la muchacha. Por otro lado, todas las miradas convergen en el rostro de la joven, matizado por una sombra filtrada de suaves tonos verdes creados por el color de la sombrilla. El óvalo de la joven es una elipse regular y en ella se cruzan dos diagonales determinadas por la dirección de la mirada del mozo y la línea del muro de la izquierda, cuya perspectiva se ha forzado para que esta diagonal incida en el buscado centro de atención del cuadro.

¿De acuerdo con el texto, cual declaración es el mejor resume del análisis del dibujo?

A. Líneas geométricas dirigen al espectador a la cara de la mujer.

B. Las áreas ocurras y claras separan la composición naturalmente.

C. Los tonos suaves crean un sentimiento de serenidad pacífica.

D. Las proporciones matemáticas permitieron la conversión fácil a un tapiz.

APPENDIX C: COPYRIGHT PERMISSION

Collin Olson
1904 Cross Creek Dr
Murfreesboro, TN 37127

April 21, 2022

Dear Lisa Greenman,

I am a graduate student at Middle Tennessee State University. I would like your permission to adapt ten questions from The National Spanish Exam practice links from your website www.nationalspanishexam.org. These questions will be adapted into a listening comprehension measure for my research. These materials will not be shared with anyone else, and the data gathered from the questions will be used for educational research purposes only.

Please indicate your approval of this permission by signing the letter where indicated below.

Thank you very much.

Sincerely,

C. Olson

Collin Olson

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:

Lisa Greenman
NSE Director
National Spanish Examinations
160 Rail Road, Suite 3
Chesterton, IN 46304
nse@aatsp.org

APPENDIX D: SCRIPT USED DURING INTERVENTION

1. **Core** 2. The **core** is the middle of something, like an apple or a planet. 3. For example, we can say “Do not eat the **core** of the fruit.” 1. In Spanish, **core** is *el núcleo*. 2. El núcleo es el medio de algo, como una manzana o un planeta. 1. Ahora, escribe la palabra **core** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **core**. Parece que estoy señalando el centro de algo. Quiero que hagas este gesto para **core**.
1. **Layer** 2. A **layer** is when a substance is put on top of another substance. 3. For example, we can say “There are many **layers** of blankets on my bed.”
1. In Spanish, **layer** is *la capa.* 2. Una capa es cuando una sustancia se coloca encima de otra sustancia.
1. Ahora, escribe la palabra **layer** en tu papel.
1. Ahora, les voy a mostrar un gesto para hacer para palabra **layer**. Parece que cada mano es otra capa encima de la mano anterior. Quiero que hagas este gesto para **layer**.
1. **Wardrobe** 2. A **wardrobe** is a place where you keep your clothes. 3. For example, we can say “Put your clean clothes in the wardrobe.” 1. In Spanish, **wardrobe** is *el armario.* 2. Un armario es un lugar donde guardas tu ropa. 1. Ahora, escribe la palabra **wardrobe** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **wardrobe**. Parece que estoy abriendo las puertas del armario. Quiero que hagas este gesto para **wardrobe**.
1. **Survey** 2. A **survey** is used to get our opinions on different things. 3. For example, we can say “Complete this survey about your favorite foods.”
1. In Spanish, **survey** is *la encuesta.* 2. Una encuesta se utiliza para obtener nuestras opiniones sobre diferentes cosas.
1. Ahora, escribe la palabra **survey** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **survey**. Parece que estoy respondiendo diferentes preguntas en una encuesta. Quiero que hagas este gesto para **survey**.
1. **Diver** 2. A **diver** is someone who swims underwater 3. For example, we can say “The man takes his sailboat on the ocean.” 1. In Spanish, **sailboat** is *el velero.* 2. Un velero es un barco con velas que utiliza el viento para moverse.

1. Ahora, escribe la palabra **sailboat** en tu papel. 1. Ahora, les mostraré un gesto para hacer con la palabra **sailboat**. Parece que mi mano es una vela y el barco está siendo empujado por el viento. Quiero que hagas este gesto para **sailboat**.
1. **Acknowledge** 2. To **acknowledge** is to recognize when someone does a good job. 3. For example, we can say "The teacher **acknowledged** the student's good work."
1. In Spanish, **acknowledge** is *reconocer.* 2. Reconocer es reconocer cuando alguien hace un buen trabajo.
1. Ahora, escribe la palabra **acknowledge** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **acknowledge**. Parece que estoy apuntando a mi cabeza y pensando '¡buen trabajo!' Quiero que hagas este gesto para **acknowledge**.
1. **Bias** 2. **Bias** is when someone has an unfair opinion of someone else. 3. For example, we can say "The teacher was **biased** against the students."
1. In Spanish, **bias** is *la parcialidad.* 2. La parcialidad es cuando alguien tiene una opinión injusta de otra persona.
1. Ahora, escribe la palabra **bias** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **bias**. Parece que estoy juzgando algo, pero no siendo justo. Quiero que hagas este gesto para **bias**.
1. **Enhance** 2. To **enhance** something is to make it better. 3. For example, we can say "I **enhanced** my room by painting it a new color."
1. In Spanish, **enhance** is *mejorar.* 2. Mejorar algo es hacerlo mejor.
1. Ahora, escribe la palabra **enhance** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **enhance**. Parece que mi mano está en espiral hacia arriba, lo cual es un símbolo de mejora. Quiero que hagas este gesto para **enhance**.
1. **Release** 2. To **release** something is to let it be free. 3. For example, we can say "I **released** the animal from the cage." 1. In Spanish, **release** is *librerar.* 2. Liberar algo es dejar que sea libre.
1. Ahora, escribe la palabra **release** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **release**. Parece que estoy dejando libre a un animal. Quiero que hagas este gesto para **release**.
1. **Task** 2. A **task** is a job that you have to do.

3. For example, we can say “I have to do a **task** before I leave work.”
1. In Spanish, **task** is *la tarea.* 2. Una tarea es un trabajo que tienes que hacer.
1. Ahora, escribe la palabra **task** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **task**. Parece que me estoy poniendo una mochila llena de trabajo sobre los hombros. Quiero que hagas este gesto para **task**.
1. **Kerf** 2. The **kerf** is the width of a blade. 3. For example, we can say “Use a blade with a thin kerf to cut wood.”
1. In Spanish, **kerf** is *el corte.* 2. El corte es el ancho de una cuchilla.
1. Ahora, escribe la palabra **kerf** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **kerf**. Parece que estoy midiendo el ancho de algo, como el ancho de un cuchillo. Quiero que hagas este gesto para **kerf**.
1. **Screed** 2. A **screed** is a board used to smooth concrete. 3. For example, we can say “Make the concrete smooth using a **screed**.”
1. In Spanish, **screed** is *una regla*. 2. Una regla es una tabla que se utiliza para alisar el hormigón.
1. Ahora, escribe la palabra **screed** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **screed**. Parece que estoy alisando hormigón. Quiero que hagas este gesto para **screed**.
1. **Bellows** 2. **Bellows** are used to blow air on a fire to make it bigger. 3. For example, we can say “Use the **bellows** to make the fire bigger.”
1. In Spanish, **bellows** are *los fuelles*. 2. Los fuelles se utilizan para soplar aire en un fuego para hacerlo más grande.
1. Ahora, escribe la palabra **bellows** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **bellows**. Parece que estoy usando los fuelles para hacer un fuego más grande. Quiero que hagas este gesto para **bellows**.
1. **Caliper** 2. A **caliper** is used to measure round objects, like a ball. 3. For example, we can use “Use the **caliper** to measure the soccer ball.”
1. In Spanish, **caliper** is *la pinza*. 2. Una pinza se usa para medir objetos redondos, como una pelota.
1. Ahora, escribe la palabra **caliper** en tu papel.

1. Ahora, les mostraré un gesto para hacer con la palabra **caliper**. Parece que voy a medir qué tan grande es algo usando una pinza. Quiero que hagas este gesto para **caliper**.
1. **Vellum** 2. **Vellum** is paper made from animal skin used in old books. 3. For example, we can say "Old books are often written on **vellum**."
1. In Spanish, **vellum** is *la vitela.* 2. La vitela es un papel hecho de piel de animal que se usa en libros antiguos.
1.Ahora, escribe la palabra **vellum** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **vellum**. Parece que estoy abriendo un libro hecho de piel. Quiero que hagas este gesto para **vellum**.
1. **Foreground** 2. The **foreground** is a part of picture that looks close to the viewer. 3. For example, we can say "The flower is in the **foreground** of the drawing."
1. In Spanish, **foreground** is *el primer plano.* 2. El primer plano es una parte de la imagen que se ve cerca del espectador.
1.Ahora, escribe la palabra **foreground** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **foreground**. Parece que estoy mirando una imagen y señalando el objeto de la imagen más cercano a mí. Quiero que hagas este gesto para **foreground**.
1. **Jingle** 2. A **jingle** is a short song used in advertisements. 3. For example, we can say "The **jingle** for McDonald's is 'I'm Lovin' It'." 1. In Spanish, **jingle** is *una canción.* 2. Un jingle es una canción corta que se usa en los anuncios. 1. Ahora, escribe la palabra **jingle** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **jingle**. Parece que estoy moviendo las manos como lo hace un compositor. Quiero que hagas este gesto para **jingle**.
1. **Leaven** 2. To **leaven** bread means to let the bread get bigger from the yeast. 3. For example, we can say "You must **leaven** the bread before you bake it."
1. In Spanish, **leaven** is *leudar.* 2. Levantar pan significa dejar que el pan se haga más grande a partir de la levadura.
1. Ahora, escribe la palabra **leaven** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **leaven**. Parece que el pan se hace cada vez más grande. Quiero que hagas este gesto para **leaven**.
1. **Blurb** 2. A **blurb** is a short description on the back of a book. 3. For example, we can say "The **blurb** said it was the best fantasy book written."

1. In Spanish, **blurb** is *el texto publicitario*. 2. El texto publicitario es una breve descripción en la contraportada de un libro.
1. Ahora, escribe la palabra **blurb** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **blurb**. Parece que estoy leyendo la contraportada de un libro para ver lo que otras personas han dicho al respecto. Quiero que hagas este gesto para **blurb**.
1. **Embezzle** 2. To **embezzle** is to steal money from a business when you are a worker. 3. For example, we can say "The workers **embezzled** a lot of money from their job."
1. In Spanish, **embezzle** is *malvarsar*. 2. Malversar es robar dinero de una empresa cuando se es trabajador.
1. Ahora, escribe la palabra **embezzle** en tu papel.
1. Ahora, les mostraré un gesto para hacer con la palabra **embezzle**. Parece que estoy tomando dinero y bajándome la manga, como si lo estuviera robando. Quiero que hagas este gesto para **embezzle.**