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The Effects of Interactive Word Walls on English Language Learners' Academic Vocabulary Acquisition

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The Effects of Interactive Word Walls

on English Language Learners'

Academic Vocabulary Acquisition

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Abstract

The purpose of this study was to determine if the implementation of interactive word walls influenced student academic vocabulary acquisition and the academic achievement of students in a tenth-grade biology unit with a focus on English Language Learners (ELL). This study took place in a midsized suburban high school in a midwestern state with 64 tenth-grade biology students. A mixed methods research approach was employed that included analysis of pre- and post-tests, weekly formative assessments (quick writes), observation tallies of student word wall usage, student feedback, and a reflective teacher journal. The data showed that the interactive word wall was effective in helping students gain a stronger understanding of content-specific vocabulary. Both ELL and non-ELL students' academic vocabulary increased, however ELL students and traditionally low performing students benefited from the use of the word wall the most. It is recommended that implementation of interactive word walls be used in high school science settings.

Keywords: English Language Learners (ELL), academic vocabulary, content specific vocabulary

It is not uncommon for students in science classes to feel overwhelmed by all the new vocabulary they encounter and wonder why it feels like they are learning a new language. The sheer amount of content specific vocabulary in science courses can make science classrooms a daunting place for anyone. Throw in all of the other challenges students face, such as not speaking English as a first language, and learning science can seem like an insurmountable challenge. Content specific vocabulary, also known as academic vocabulary, is simply one component of learning and it is intertwined within larger, more complex concepts students encounter in school. Without understanding academic vocabulary, students quickly fall behind.

Educators have observed that students who are also an English Language Learner (ELL) struggle to meet their potential despite working hard. Minnesota Comprehensive Assessment (MCA) scores support these teacher observations; 2007 MCA data shows 54.2 percent of all students in Minnesota either meet or exceed the science standards compared to only 7 percent of Minnesota's ELL student population (MN Department of Education, 2017). Despite districts implementing afterschool and summer programs, there is a need to make changes to better support students' understanding of science. This has led to educators focusing on the question of how teachers can help students to get a stronger, more confident grasp on the academic vocabulary.

Language and vocabulary are crucial to literacy and academic success for all students (Biemiller, 2006; Nagy & Townsend, 2012); and while academic vocabulary is crucial for all students, it is especially crucial for the academic success of ELL students (Shanahan & Beck, 2006; Snow, 2009). Studies have shown that increasing the academic vocabulary proficiency of ELL students increases their understanding of content concepts (Kieffer, Lesaux, Rivera, &

Francis, 2009). In particular, the large amount of complex academic vocabulary associated with science is the cause of considerable challenges to the academic learning of science concepts for ELL students (Shanahan & Beck, 2006; Snow & Uccelli, 2009).

Research has shown that visual cues (Yates, Curthral, & Rose, 2011) and the pairing of ELL and native English speakers for cooperative work, which encourages student talk and the use of academic vocabulary, are successful in increasing student learning (Zarifi & Taghavi, 2016). Interactive word walls provide word rich environments that incorporate both visual cues and cooperative work resulting in benefits to all learners by increasing their understanding and application of vocabulary (Harmon, Wood, Hedrick, Vintinner, & Willeford, 2009; Vintinner, Harmon, Wood & Stover, 2015). Research shows that interactive word walls are an effective strategy for increasing the academic vocabulary, and thus overall academic achievement, for both native English speaker and ELL students (Jackson & Ash, 2012; Southerland, 2011; Zarifi & Taghavi, 2016).

Dewey's Theory of Constructivism (1963) states that knowledge is constructed by building on prior knowledge. If there is a gap between prior knowledge and the new content being learned, an individual will not be able to make the needed connections to learn the new material. ELL students have a gap between their prior academic vocabulary knowledge and the academic content language taught in school which causes a barrier to their learning.

Vygotsky's (1978) Theory of Social Constructivism states that a More Knowledgeable Other (MKO) can help to bridge the gap between a student's prior knowledge and content being learned. Vygotsky (1986) discussed the importance of language in the development of cognitive thought. He suggests that to fully engage in cognitive thought one needs to develop strong language skills. The pairing of an MKO and an ELL student during cooperative work, as well as

intentional guidance by a teacher encouraging interaction with a word wall/academic vocabulary, will help to bridge learning gaps related to academic vocabulary. Thus, the use of an interactive word wall targeting academic vocabulary helps to bridge the gap between prior knowledge and new content, and it helps to increase students' academic success.

The purpose of this action research study is to explore interactive word walls as a strategy to help ELL students learn academic vocabulary, while also aiming to benefit the non-ELL students. The research will strive to answer the following question: What effects does the implementation of interactive word walls have on student vocabulary acquisition and academic achievement of students in a tenth-grade biology unit, with a focus on English Language Learners? To answer this question, all students in a general biology course created and used an interactive world wall during an eight-week unit of study. The research took place in a 10th-grade general biology class in a traditional public high school setting. Student success was analyzed in subgroups with a focus on ELL students. The other subgroups analyzed consisted of traditionally low, middle, and high academic achievement subgroups.

It is important to specifically improve the educational experience for students that do not speak English as their home language because, if they do not qualify for ELL service, they are easily overlooked and not always given the support they need. Despite many ELL students speaking fluent conversational English, many still struggle with their academic vocabulary and academic language which affects classroom performance and learning. All students deserve a quality education and a positive school experience. Ensuring educators have the best tools to help struggling students is important because a student's experiences during their 12 years in the public schools can have a lasting effect on their future.

Review of Literature

The number of English language learners (ELLs) in the United States has risen over the past 50 years (Minnesota Department of Education, 2017). This, paired with the low academic achievement of ELL students in the mainstream high school setting, has made the question of how best to serve ELL students in the general education classroom a critical one (Minnesota Department of Education, 2017). There are many different strategies specific to ELL students instructors can use within their lessons. Knowing which strategies are the most effective is a challenge. Teachers may find themselves asking, 'What are effective ELL strategies that increase vocabulary, understanding, and conceptual knowledge?' Using effective strategies is important because quality teaching increases learning in the classroom and better prepares all students for a successful future.

This literature review will explore the role of content specific academic vocabulary in student success with an emphasis on ELL students and examine interactive word walls as a teaching strategy. Literature has shown that academic language is one of the essential components to success for ELL students' academic achievement (Kieffer et al., 2009).

Academic Vocabulary

There are many factors that hinder the teaching/learning of science in general, and biology teaching/learning specifically, but the importance of academic vocabulary stands out as one of the most difficult. Studies have shown that high school general biology courses involved the learning of more vocabulary than first-year foreign language courses (Groves, 1995; Yager, 1983). Through the analysis of textbooks, Thonney found that within a biology course students are expected to know between 1694 to 1899 new terms per course with an estimate of 2.42-2.96

new terms per full page of text (Thonney, 2016). This was more than all the other subjects examined with the exception of first-year Spanish and French classes. According to Snow (2010), the impact of academic vocabulary on student learning is amplified in biology because the vocabulary is layered, with new terms referring to new concepts and the understanding of the new vocabulary dependent on the students' prior knowledge of science vocabulary (Thonney, 2016). A large amount of complicated academic vocabulary in biology is the cause of considerable challenges to the learning of biology concepts for ELL students (Shanahan & Beck, 2006; Snow, 2009).

    Academic vocabulary in general has more nouns and complex abstract words that are not commonly used in everyday conversational English (Nagy & Townsend, 2012). Academic vocabulary, otherwise known as cognitive academic language proficiency (CALP), takes longer to master than conversational vocabulary, also known as basic interpersonal communicative skills (BICS), with a lag of five to seven years (Collier, 1989; Cummins, 1981). New research suggests it takes five to 10 years for emergent bilinguals to achieve linguistic skills equivalent to their monolingual peers (Collier & Thomas, 2002). ELL students that received instruction in their home language for two to three years took four to seven years to achieve CALP fluency while ELL students who did not receive any instruction in their home language took seven to 10 years (Collier & Thomas, 2002). Research by Levin and Shohamy (2008) found that it may take even longer for ELL speakers to achieve native speakers' level of CALP skills, and that this level of achievement could take as long as 11 years. The research on the CALP-BICS gap demonstrates that classrooms have students that may sound like fluent, native speakers during conversations yet, due to their unapparent deficiency in CALP skills, their struggles with school go unnoticed and they do not receive the appropriate support.

Language and vocabulary are key to literacy, reading comprehension, and academic success (Biemiller, 2006; Nagy & Townsend, 2012). Kieffer et al. (2009) completed a meta-analysis and found a connection between academic vocabulary and academic science achievement of ELL students. High achievement was associated with high academic language proficiency. When students increase their academic language, they gain a better understanding of content concepts (Kieffer et al., 2009).

Intervention: Interactive Word Walls

Importance of visual cues. A traditional word wall is a visual tool used to post academic vocabulary on the wall of a classroom (Jackson & Narvaez, 2013; Jackson, Trepp, & Cox, 2011; Jackson, Wise, Zurbuchen, & Gardner, 2017). An interactive word wall is a traditional word wall that groups words based on relationships to one another forming a graphic organizer, word map, or diagram (Jackson et al., 2011; Yates et al., 2011). Grouping the words helps students to make connections between words increasing academic language acquisition (Jackson et al., 2011; Yates et al., 2011). Word walls can take many forms and can include images, (e.g., drawings and photographs), as added visual cues (Jackson et al., 2011). They can include real items, also called realia, when items are available and appropriate to display (Jackson & Narvaez, 2013; Jackson et al., 2011). Examples of realia on a word wall related to physical properties of insulation included a styrofoam cup, ceramic mug, wooden spoon, and plastic spoon (Jackson & Narvaez, 2013). Literature has also shown that interactive word walls implemented within the general education classroom are an effective strategy for increasing content specific academic vocabulary (Harmon et al., 2009; Jackson & Ash, 2012; Southerland, 2011; Vintinner et al., 2015; Yates et al., 2011) and are an effective teaching tool because they

act as scaffolding that includes, but is not limited to, visual cues and authentic interactions of academic vocabulary (Jackson & Ash, 2012; Southerland, 2011).

Importance of interacting with word walls. Interactive word walls provide word rich environments that benefit not just ELLs but all learners by increasing students' understanding and application of vocabulary (Harmon et al., 2009; Jackson, 2014; Vintinner et al., 2015; Yates et al., 2011). The interactive aspect of word walls is essential in creating a word rich environment that lends itself to increased cooperative learning and authentic use of vocabulary. This occurs as students refer to the wall within breakout sessions and any number of class activities (Vintinner et al., 2015). According to research by Jackson and Ash (2012), when interactive word walls were used in an authentic, engaging manner there was an increase in high stakes test scores for all students, including ELL students. Harmon et al. (2009) found similar positive effects of interactive word walls on student learning. Their research was completed over a six-week period with 44 seventh graders. They found that the students receiving instruction with an interactive word wall, "demonstrated a sustained higher level of understanding of the word meanings and were able to successfully apply them to the meaningful prompts" (Harmon et al., 2009, p. 406).

There are endless variations and opportunities for creative interactions with word walls. Yates et al. (2011) examined word wall use within a rural public middle school. The entire 8th-grade teaching staff implemented interactive word walls in their classrooms while simultaneously creating a multi-content word wall in the hallway. After this intervention was implemented, all eighth-grade students achieved proficiency in all of the state-tested content areas. Additionally, science scores increased by a staggering 17.8 percent (Yates et al., 2011). The middle school went from not meeting Adequate Yearly Progress (AYP) before word

wall implementation in 2007-2008, to meeting AYP in 2008-2009 (Yates et al., 2011). As a result of their research, Yates et al. (2011) recommended interactive word walls be used in classrooms to boost academic language and learning.

Jackson (2013) conducted in-depth research with 115 sixth grade students to determine the effectiveness of interactive word walls as a teaching strategy. They found that when interactive word walls were used, "the percent of students passing is expected to increase by 25 percent and the mean test scores are predicted to increase by 12.56 points" (Jackson, 2013, p. 22). As a result of the implementation of interactive word walls, students qualifying for 504, ELL, or special education services benefited to the same degree as the general education students (Jackson, 2013).

It is important that students participate in the creation of a word wall. Jackson et al., (2017) stated,

> Interactive word walls are planned by teachers but constructed by students. As students
> create interactive word walls, the process enables them to build on prior knowledge, have
> multiple encounters with new academic vocabulary, and connect learning to inquiry
> activities and the real world. (p. 72)

During the creation stage, Vintinner et al., (2015) suggested that having the students create word cards with images and allowing them to decide how to group the vocabulary into relationships that make sense to the students is important.

After students have helped to create a word wall, it is imperative they continue interacting with it (Harmon et al., 2009; Vintinner et al., 2015). For word walls to be most effective, they need to be more than a reference (Vintinner et al., 2015). Research shows that student interaction with word walls needs to be authentic and allow for repetitive use of

academic vocabulary words through writing, speaking, discussing, and listening (Fránquiz &

Salinas, 2013; Vintinner at al., 2015). According to Zarifi and Taghavi (2016), cooperative

learning increased the learning of ELL students. They completed an 8-week research study with

50 English as a foreign language (EFL) students. In the study, half of the students learned

grammar through cooperative learning and the other half through traditional methods. The

results of their study showed the students in the cooperative learning group achieved

significantly higher scores on their exams (Zarifi & Taghavi, 2016). Using cooperative learning

to interact with academic vocabulary on an interactive word wall is beneficial to ELL students as

it provides them opportunities to listen and speak in an authentic way (Fránquiz & Salinas, 2013;

Vintinner at al., 2015).

Conclusion

Current research suggests that increasing academic vocabulary and language proficiency

with the help of interactive word walls can increase ELL students' academic achievement

(Jackson & Ash, 2012; Southerland, 2011; Zarifi & Taghavi, 2016). Word walls increase

academic vocabulary and language proficiency through student interactions with the wall. These

interactions include the creation and maintenance of the wall, utilizing visual cues that include

connections between words, cooperative learning that encourages student talk, and authentic use

of the vocabulary (Jackson & Ash, 2012; Southerland, 2011; Zarifi & Taghavi, 2016).

There is a significant amount of literature on the effectiveness of interactive word walls

at the elementary level and some research at the middle school level. However, there is a gap in

the literature as very little research has been conducted related to the effectiveness of interactive

word walls in grades 9-12, specifically within mainstream biology courses. Additionally, very

little quantitative research has been conducted related to the effectiveness of interactive word walls.

The literature has overwhelmingly supported the idea that understanding academic vocabulary is crucial to the academic success of all students, but is especially crucial for the success of ELL students (Kieffer et al., 2009). Research shows that interactive word walls are an effective strategy for increasing students' understanding of academic vocabulary and thus the overall academic achievement of both native English speakers and ELLs (Harmon et al., 2009; Jackson & Ash, 2012; Southerland, 2011; Vintinner at al., 2015; Yates et al., 2011).

Methodology

Participants

This research was conducted in a suburban high school with 940 students in a Midwestern state. In the school 5.57% of the students received free and reduced lunch. The research included 64 students between the ages of 15 and 17 in a 10th-grade biology course consisting of three sections. All three sections had the same instructor and curriculum. Of the 64 students included in the study, 83% were white/non-Hispanic, 8% were Hispanic, 3% were Asian/Pacific Islander, 5% were Black, and 1.6% identified with two or more ethnicities. ELL students made up 9.4% of the research participants, speaking Spanish, Vietnamese, and Amharic as their first languages. The research was conducted during an eight-week human anatomy and physiology unit.

After data for all 64 students was collected, 24 students were randomly selected for data analysis. Six students from each of the following subgroups were analyzed: historically high performing students, historically average performing students, historically low performing students, and ELL students. The subgroup size was limited by the total number of ELL students

(n=6) in the course. For each subgroup, all the students' names from that subgroup were put in a box and 6 names were randomly drawn. Though only 6 students from each subgroup were selected for data analysis, word wall strategies were implemented in the same way for all students in the class, ensuring the action research was fair and equal for all students. The students included in the study did not have to do anything above and beyond the other students since all aspects of the study, including data collection tools, were part of the regular class procedures.

Data Collection

To get a baseline for comparison, students took a pre-test before the start of the unit (Appendix A). The pre-test was identical to the post-test given at the end of the unit. The pre- and post-tests were used to measure students' learning during the unit and to help determine whether the word wall affected student achievement.

Student feedback was collected to help understand student perceptions related to the effect interactive word walls had on their learning of content-specific academic vocabulary. Student feedback also provided information related to students' confidence in using content-specific academic vocabulary words. Feedback was collected prior to the implementation of the word wall and its interactive strategies during the unit (Appendix B), and the at the end of the unit (Appendix C). Feedback from the end of unit included two extra questions specific to word walls. Data from both student feedback forms helped to determine what role students believed word walls played in their learning of content-specific academic vocabulary. It also acted as a participatory tool, allowing adjustment of word wall implementation techniques.

Implementation of the interactive word wall began the first day of the eight-week human anatomy unit and continued throughout the entire unit. All classroom strategies used during the creation of the interactive word wall, as well as ongoing interactions with the word wall throughout the unit, were completed with students as a normal aspect of the class. The class created the word wall together as academic vocabulary was introduced. This process became a part of learning the vocabulary. While taking into consideration the meaning and relationships of the words, the class gave input as to where the words should be placed on the word wall. Students also included visuals, such as drawings or pictures, to enhance visual connection for many of the words.

For the first three sets of words included on the word wall, the teacher provided a list of the words to be included and students worked within informal cooperative groups to come up with suggestions for word placement and visual enhancements (e.g., drawings or diagrams). Once the class agreed upon a plan, students were encouraged to volunteer to add to the wall in various ways. Students who excelled in drawing volunteered to draw pictures, others printed out images, some students wrote words on papers, others cut out the various paper shapes, and some directed and oversaw the process.

Once the students had gained an understanding of what interactive word walls were and how they worked, the teacher stopped providing the list of vocabulary words to be included on the word wall. The students were then responsible for creating the list of words that would be added to the word wall. Guidance was provided when necessary, however. For example, when students included too many words not connected to the learning topic, or if students missed a key vocabulary word, the teacher intervened. One adjustment occurred after the second week of the study. This adjustment included formalization of the cooperative teams during use of the

interactive word wall by assigning groups of three to four. Once each cooperative group came

up with a list of words to include on the wall, the class came together as a whole, combining lists

and agreeing on one final version. This same process was used for decisions related to the

grouping and placement of words as well as the visuals that were included on the word

wall. Once a set of words were added to the word wall, students referred back to the wall as

needed during labs, animal dissections, classroom activities, and formative assessments.

Formative assessments, called quick writes, were completed four times throughout the

research study for a total of four quick writes (Appendix D). In each quick write, students were

given a list of four academic vocabulary words and were asked to define or explain the given

words to the best of their ability. The four words were randomly chosen, and only represented a

few of the total words added to the word wall from the week. The quick write data provided

information related to students' understanding of academic language over the course of the

unit. The quick writes were completed by the students after the words had been learned in class

and included on the word wall.

An observation tally of student word wall usage was completed once a week for 10

minutes during class. This was done to determine whether students utilized the word wall

independently during class to help them remember academic vocabulary. To allow the

teacher/researcher to meet the needs of all students during class, the observation was completed

by recording a video of the students which was later analyzed.

Lastly, a reflective teacher journal (Appendix E) was kept to document students' daily

struggles and successes related to academic vocabulary. The teacher journal included photos

documenting the evolution of the word wall. This journal allowed the teacher to reflect on the

process of creating and implementing the interactive word wall. Teacher reflection was

completed on a bi-weekly basis throughout the research study and helped to determine whether the strategy was manageable and beneficial in a high school setting.

Analysis of Data

To best answer the question, "What effects does the implementation of interactive word walls have on student vocabulary acquisition and academic achievement of students in a tenth-grade biology unit with a focus on English Language Learners?", a mixed methods research approach was used that included both primary and secondary data sources. Pre- and post-tests, quick writes, observation tallies, and student feedback were used as primary data sources. Student feedback, reflective teacher journal, and photographs of the word wall were used as secondary data sources. The methods of data analysis will be described in the first portion of this section followed by the findings.

Analysis

To analyze the pre and post-tests, the tests were corrected and each test was given a total score. Each student had two scores, one for their pre-test and one for their post-test. Numeric comparisons between the students' pre- and post-test scores were used to help answer the research question.

Quick writes were a formative assessment given once a week. Each quick write consisted of four content-specific vocabulary words randomly selected from the many words students incorporated on the word wall for that week. Since only a small portion of the academic vocabulary words added to the word wall were assessed, the quick writes acted as a weekly mini-check of students' understanding of the unit's content vocabulary. The quick writes were coded using a standardized method (Appendix F). This coding method assigned a point value of zero through four for each of the four words on the quick write. A score of zero indicated the student

did not attempt to explain the word. A score of one meant they attempted to explain the word, but their explanation was incorrect. A score of two represented a partially correct answer. A score of three indicated the answer was correct at a basic level, and a score of four represented an exemplary explanation demonstrating a deep understanding of the word and its related concepts. The scores for all four vocabulary words were added up for a total score out of a possible 16 points each week. The total score was recorded weekly for each student. Numeric comparisons for each student across the weeks were then conducted.

The video observation tally of student word wall usage was also coded using a standardized method. The ELL subgroup and a randomly selected set of students were observed, and a tally was recorded of how many times each of the selected students looked at or referenced the word wall (Appendix G). To randomly select students for observation, all students' names (not identified as ELL) were put in a box, and six students were randomly drawn. Numeric comparison of tallies across the ELL subgroup and the non-ELL subgroup were then made.

The student feedback consisted of responses to open-ended questions as well as qualitative and quantitative Likert Scale questions. The open-ended responses were coded and categorized based on commonalities. The number and type of categories varied depending on the nature of the question. If a student response spanned different categories, the response was divided between the categories. A percent of the number of responses was then tallied for each student subgroup. The Likert Scale questions included the responses of strongly agree, agree, disagree, and strongly disagree. Student responses were analyzed using word counts. Each response within the Likert Scale was tallied and compared to student subgroups. Both categories and word counts were then compared within the questions and between the pre- and post-unit feedback.

The teacher observation journal was used as a secondary data source. Quotes of teacher observations, statements, and questions from the written portion of the journal were used to support analysis of the primary data. Within the teacher observation journal, photographs of the word wall were used to show key developments in the word wall throughout the unit.

Findings

All students' median test scores increased from pre-test to post-test (Figure 1). ELL students had a median pre-test score of 19 out of 42 (or 45%) correct and demonstrated their gain in knowledge by increasing their median score on the post-test to 29 out of 42 (or 69%) correct. The non-ELL students had a median pre-test score of 21 out of 42 (or 50% correct) and a median post-test score of 33 out of 42 (or 78.6%) correct.
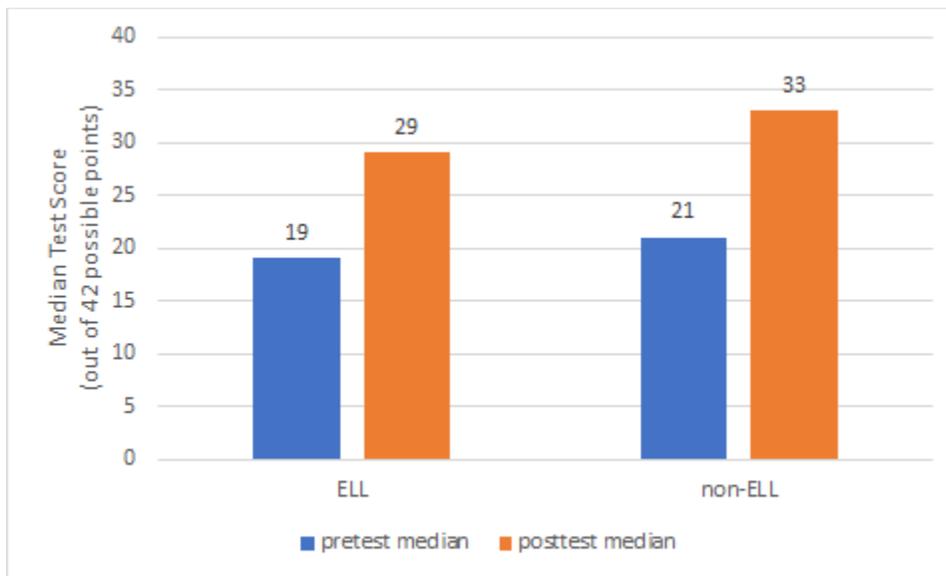

Figure 1. Comparison of median pre-test and post-test scores for ELL and non-ELL students.

ELL students increased their performance from pre-test to post-test by 23.8% (Figure 2). Non-ELL students increased their medial test scores by 28.6% from pre-test to post-test, resulting in a 4.8% higher gain than the ELL students. This is very minimal considering the extra challenges ELL students face.
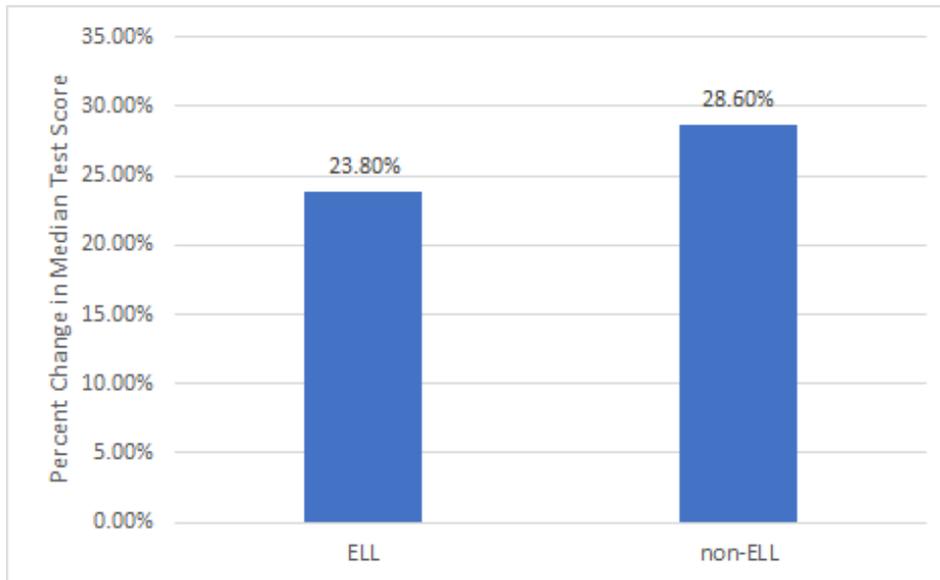

Figure 2. ELL and non-ELL students' percent increase in median test scores from pre-test to post-test.

The results from quick writes one, two, three, and four were broken down into two student subgroups: ELL students and non-ELL students (Figure 3). ELL students' showed success on the quick writes with median scores of 8 to 10 points out of 12 total possible points. The ELL scores were only slightly lower than the non-ELL students' whose scores ranged from 10 to 11 points. ELL students' median scores on quick writes two, three, and four only were one point lower than non-ELL students' median scores. On quick write one ELL students' median scores were two points lower than non-ELL students.
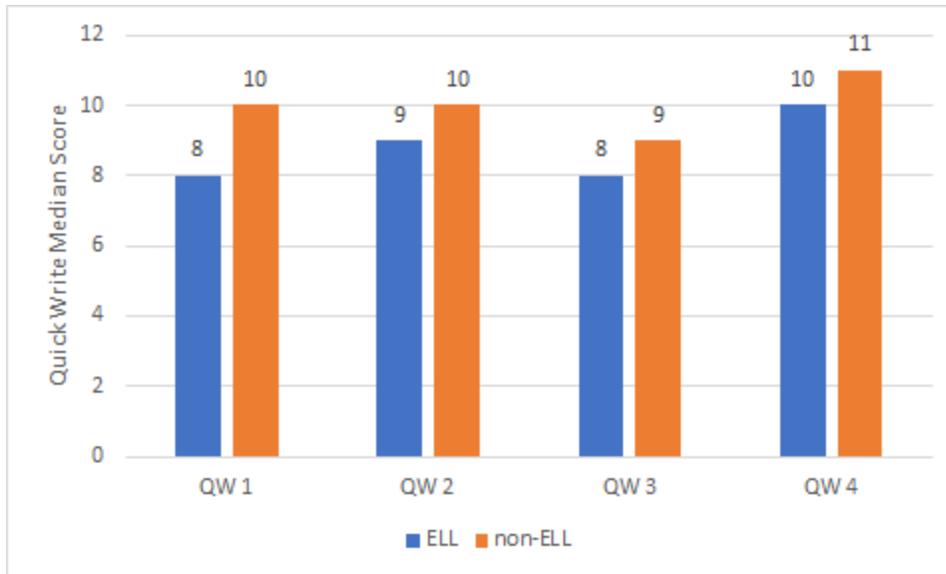
Figure 3. ELL and non-ELL student median quick write scores.

Comparison of student feedback responses from before and after the implementation of the word wall will be discussed first. The average (mean) student responses to the question: "How do you feel about learning new biology vocabulary on a scale of one (overwhelmed, low confidence) to five (Great! Bring it on! High confidence)", demonstrated a shift in attitude for all four student subgroups (Figure 4). ELL students' confidence was affected the most with their mean scores increasing by 0.9 demonstrating the positive effect of the interactive word wall. This increase in confidence level was explained by two of the ELL students, "It (the word wall) helps identify the words we'll need to know" and "The pictures on the wall help me remember what the words mean, especially the ones I drew." The low performing students also increased their confidence level by a mean of 0.5 (Figure 4). The word wall had the least effect on the confidence of the traditionally average and high performing students. Apart from one student, the confidence in the traditionally average subgroup did not change throughout the study. The traditionally high performing students showed a decrease in their confidence by a mean score of 0.7 (Figure 4). This is not surprising due the high achieving nature of the students

in this subgroup. High performing students are often highly self-critical and frequently voice the

need to improve despite their high level of performance. A traditionally high performing student

explained their feeling toward content specific vocabulary:

> Vocabulary makes me feel a bit stressed. I worry about having to remember all the details
>
> and I just want to do good on the test and don't think I will be ready, but I usually do
>
> good on the tests but still get some wrong.
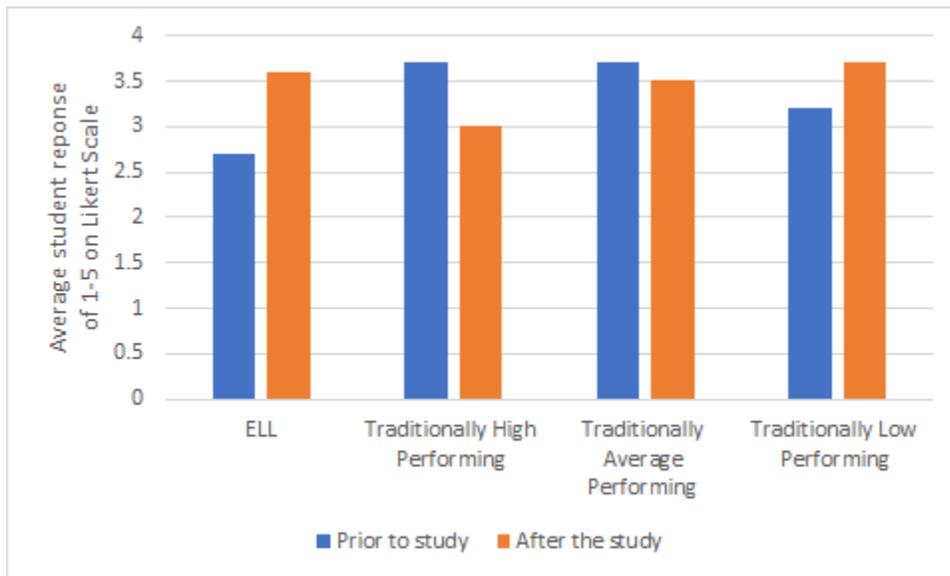
Figure 4. Mean (average) student responses to the question: "How do you feel about learning
new biology vocabulary on a scale of one (overwhelmed, low confidence) to five (Great! Bring it
on! High confidence)."

Student responses to the question: "I think my teacher should continue using word walls",

on a scale from strongly disagrees to strongly agrees, demonstrated that 68.8% of all biology

students in this study either strongly agreed or agreed with the statement (Figure 5). Students

that disagreed or strongly disagreed with the continued practice of word walls made up 14.6% of

all students, while 16.7% of the students remained neutral toward the statement (Figure 5).

Figure 5. Percent of all biology students' responses to the statement, "I think my teacher should continue using word walls."

This same student feedback data was broken down by student subgroup for further

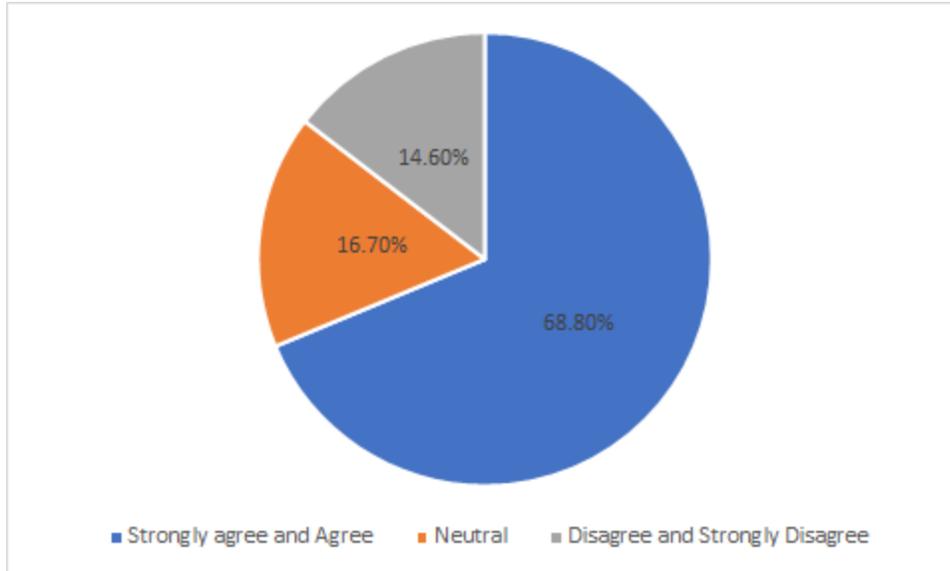analysis (Figure 6). An overwhelming 100% of ELL students strongly agreed or agreed that

world walls should continue to be used by the teacher. One ELL student suggested, "it (the word

wall) helps identify the words we'll need to know, and the pictures help me understand the words

better." Eighty-three point three percent of the traditionally low students agreed or strongly

agreed that the teacher should continue the practice of word walls, only 16.7% of the

traditionally low students responded with neutral feelings, and 0% disagreed or strongly

disagreed that word walls should continue to be used in the classroom. The traditionally average

and high student subgroups showed the largest variation in student opinion toward the word

wall. Fifty percent of the traditionally high performing students supported the continued use of

word walls in class, 16.7% responded neutrally, and 33.3% of the high performing students

disagreed or strongly disagreed with continued use of word walls. Thirty-three percent of

traditionally average performing students agreed or strongly agreed with continued use of word

walls, 50% were neutral on the topic, and 16.7% disagreed or strongly disagreed that the teacher

should continue using word walls (Figure 6).
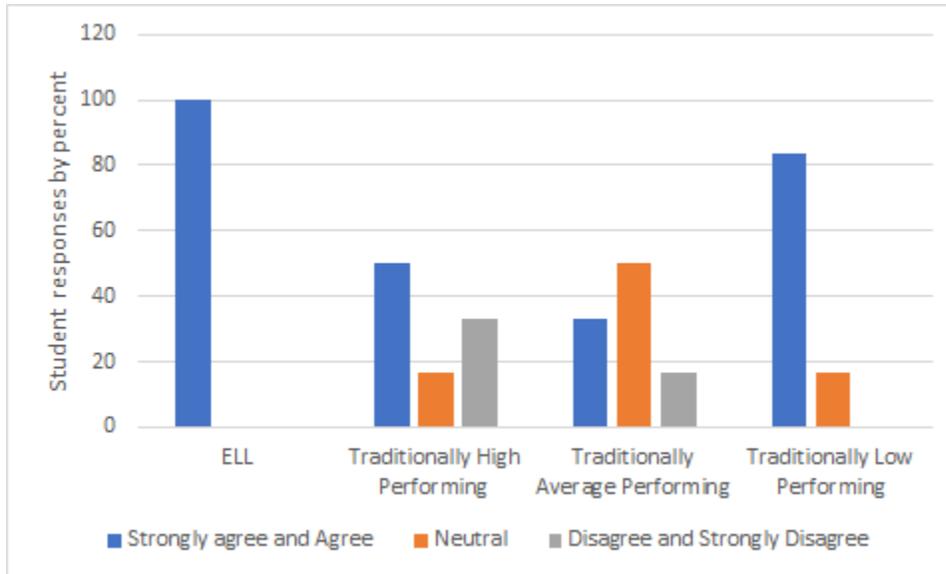
Figure 6. Percent of student responses to the statement, "I think my teacher should continue
using word walls."

       Student feedback indicated that the visuals and word placements on the interactive word

wall were helpful in allowing students to make connections and see relationships between

words. In response to the statement: "The word wall helps me to see the relationships between

words", a staggering 100% of ELL students agreed that the word wall helped them make

connections between academic vocabulary words.

       The video observation tally of student word wall usage provided a wide variation of

results ranging from observations with constant use to observations with zero use of the word

wall (Table 1). The variations depended on the nature of the lesson or activity. Observation

three had the highest word wall use with ELL students accessing the word wall an average of 10

times in a 10-minute time period. Non-ELL students averaged slightly higher at 10.8 times

within the same 10-minute time period. During observation three, students dissected a sheep

heart. Understanding the anatomy of the heart was necessary for students to be able to follow the

dissection directions. Students preferred to look at the word wall to identify vocabulary related

to heart anatomy instead of touching their notebooks/handouts with dirty hands. Observation

one had the second highest recorded observation rate. This observation included an activity

related to the skeletal system. ELL students accessed the word wall an average of 5.2 times in a

10 minute time period and non-ELL students accessed the wall an average of 5.7 times over the

same 10 minutes. Observation five included a review session in the form of a Kahoot! game.

During the 10-minute observation, ELL and non-ELL students all accessed the word wall an

average of four times. During observations two and four, students did not access the word wall

at all within the 10-minute observations. Observation two included a lab where students

measured their own reaction times and in observation four students read an article on the topic of

biomedical engineering. The vocabulary on the word wall was not needed for the completion of

these two lessons and resulted in the students not utilizing the word wall.

Table 1
Average Number of Times Students Accessed/Looked at the Word Wall During a 10-Minute
Observation Period.

Observation	One	Two	Three	Four	Five
Lesson Type	Bone Stations Activity	Reaction Time Lab	Sheep Heart Dissection	Reading a Science Article	Kahoot! Review
ELL	5.2	0	10	0	4
Non-ELL	5.7	0	10.8	0	4

The word wall developed slowly over the course of 8 weeks. Week one did not include any images and just included 16 vocabulary words grouped by function (Figure 7). Additions made during week two included six images and 11 vocabulary words. The words continued to be grouped by function as they were in week one.
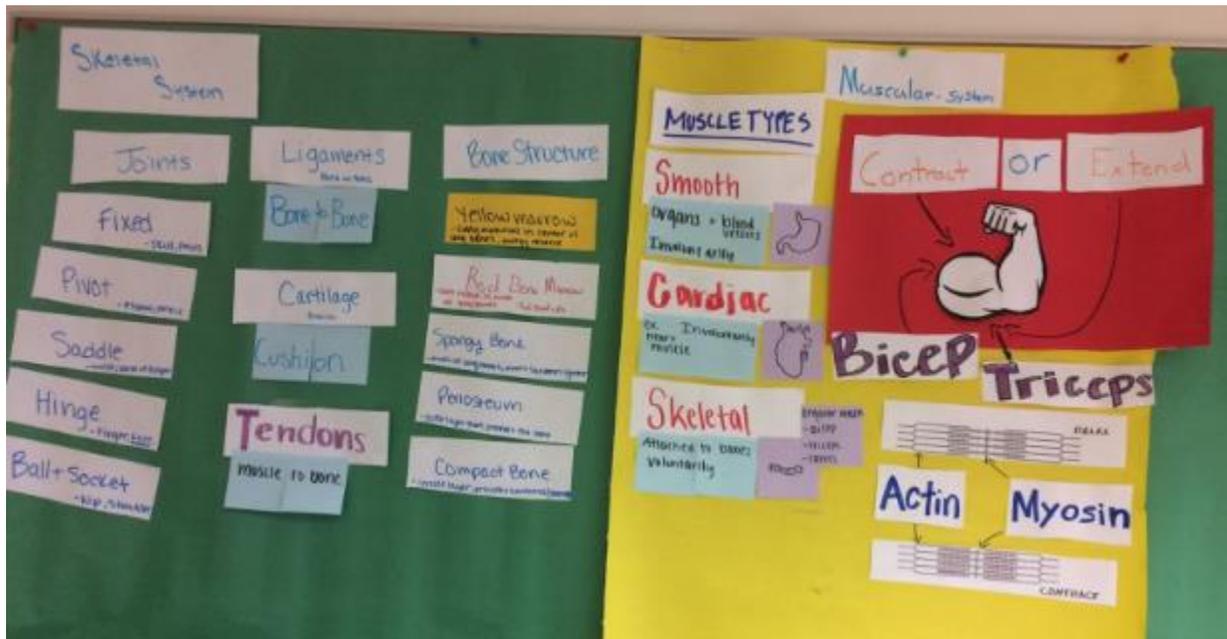
Figure 7. Photograph of the word wall from week one and week two. Week one is located on the green paper on the left and week two is on the yellow paper on the right.

Additions made during week three included 11 vocabulary words and two images (Figure 8). One of the images added this week was hand drawn by a student and the other was printed by a student and added to the wall. Week four additions to the word wall included 10 vocabulary words and one image. Four of the words from this week were represented in the image and four words did not include any visual cues.
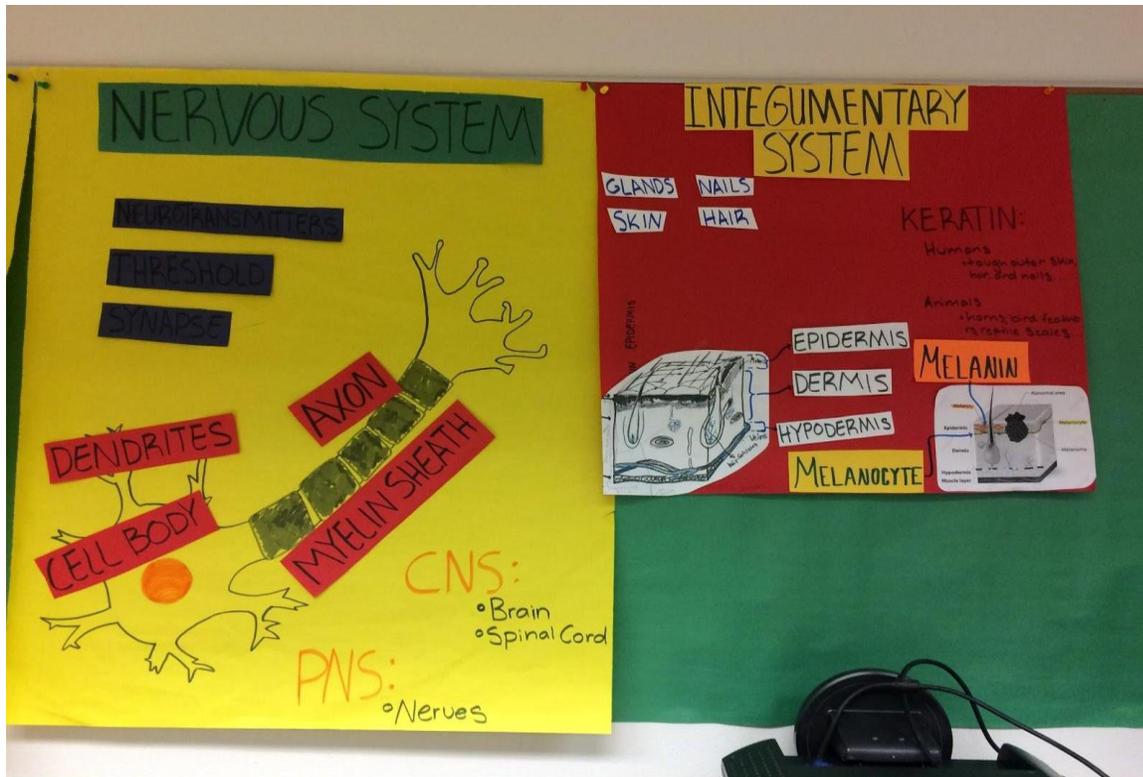
Figure 8. Photograph of the word wall from week three and week four. Week three is located on the red paper on the right and week four is on the yellow paper on the left.

Additions made in week five included six vocabulary words with each word represented on a

hand drawn diagram. Additions made during week six included 13 words all represented on a

hand-drawn diagram (Figure 9). As the unit progressed, the word wall expanded. Each week's

words were created on a separate large sheet of paper and then added to the word wall (Figure

10).
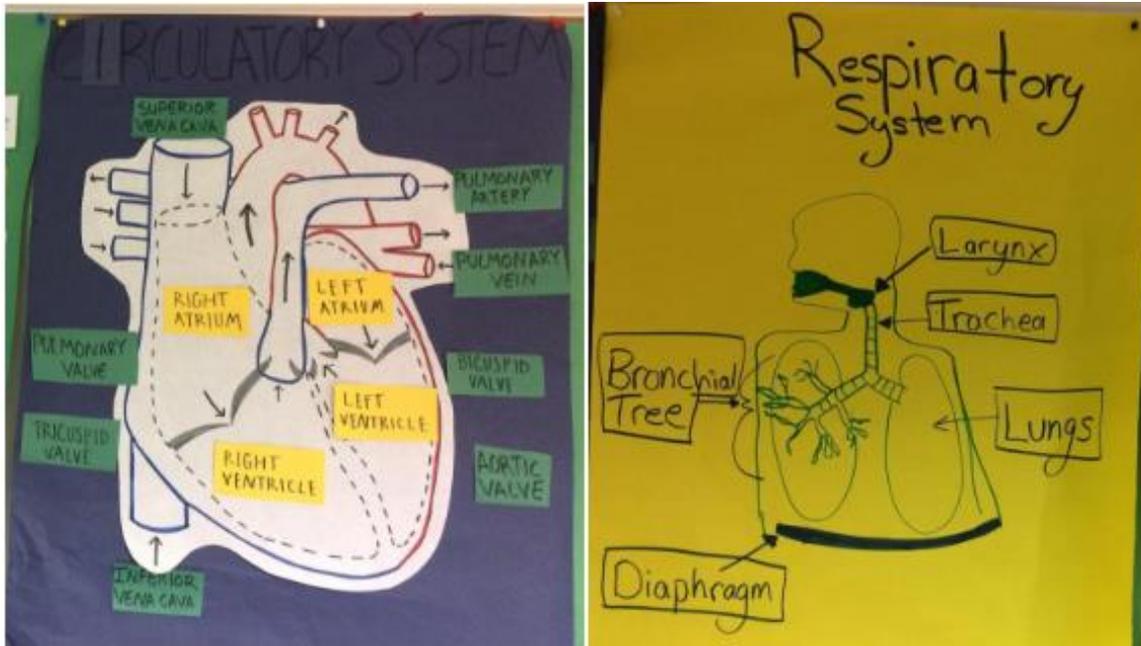
Figure 9. Photograph of the word wall from Week five and week six. Week five is located on the yellow paper on the right and week six is on the blue paper on the left.

Figure 10. Photograph of the completed word wall at the end of the unit.

Analysis of the reflective teacher journal focused on reflections specific to the successes and challenges of students. Overall, teacher reflections demonstrated more successes than challenges and indicated exciting moments when students used the word wall independently during labs and dissections. One excerpt from the reflective teacher journal stated:

Today the students completed their chicken wing dissection and I observed them

regularly walking over to the word wall to help them answer questions and to understand

the dissection instructions. Normally I am running around the classroom answering

questions, but because of the word wall students could figure out the answers without my

help. As a result, students didn't have to wait for my help and could work more

independently than past years.

The reflections also indicated that on three different days many students took pictures of the wall

to access at home to help with completing assignments or studying for the test.

The combination of quantitative and qualitative data tells a story that supports an answer

to the research question. Overall, the interactive word wall had a positive effect on student

vocabulary acquisition and academic achievement of students in a tenth-grade biology unit. This

was evident not only with the general student population but even more so with the ELL

students.

Action Plan

The purpose of this action research study was to explore interactive word walls as a

strategy to help ELL students learn academic vocabulary while also benefiting non-ELL

students. The research strived to answer the following question: What effects does the

implementation of interactive word walls have on student vocabulary acquisition and the

academic achievement of students in a tenth-grade biology unit with a focus on English

Language Learners? To answer this question, all students in a general biology course created

and used an interactive world wall during an eight-week unit of study.

Increased scores on the post-test when compared to pre-test scores and students'

improved quick write scores were indicative of the positive impact of the interactive word wall

on student achievement. Evidence of this positive impact was supported by positive student

feedback on word walls, observation tallies that showed student use of the word wall as needed,

and positive teacher reflections. The data showed that the interactive word wall was effective in helping students gain a stronger understanding of content-specific vocabulary. Both ELL and non-ELL students' academic vocabulary increased, yet ELL students and traditionally low performing students benefited from use of the interactive word wall the most. Student feedback from both the ELL students and the traditionally low performing students indicated they thought the word wall was helpful and that the teacher should continue using word walls in the future. The remainder of the students benefited from use of the interactive word walls, but not to the same degree. Feedback from these students showed that their feelings were neutral toward the word wall. Despite their ambivalence and mixed feelings, very few displayed a dislike of the word wall or recommended that the practice be discontinued.

Student feedback indicated that the visuals and word placements on the interactive word wall were helpful in allowing students to make connections and see relationships between words. A staggering 100% of ELL students agreed that the word wall helped them make connections between academic vocabulary words.

Independent student use of the word wall was documented through video analysis. Results of this analysis showed that students independently engaged with the word wall by accessing the word wall as a resource when it was needed. This benefited the students by empowering them to be confident, independent learners.

This action research study had limitations. Data analysis was limited by the small number (n=6) of ELL students in the study as well as student absences. It is recommended that this study be replicated in a context where the number of ELL students are higher and in which student absences occur less frequently. In response to this action research, I will continue using

an interactive word wall in my classroom as a strategy to help students learn academic

vocabulary.

After careful reflection on the student feedback, I will be adjusting implementation of the

interactive word wall. I will attempt to increase student interactions with the word wall using

cooperative learning activities to increase "student talk" in connection with content specific

academic vocabulary. Additionally, I will incorporate student self-assessment into my

curriculum. Students will self-assess their academic vocabulary knowledge by looking at the

wall to make a list of the words they know and understand and a list of the words that they still

need to work on. Each week we will have a word wall check-in and students will update and add

to their lists. Lastly, I will start taking pictures of the word wall and posting them on our class

website to ensure students have access from home or their devices.

The many successes of this study were accompanied by some difficulties, most of which

stemmed from the difficulty of implementing the interactive word wall within the structure of a

traditional high school setting. The biggest difficulty was having three different sections/classes

creating just one word wall and still engaging all students in the process. Next year I will

continue trying new ideas such as having the three sections rotate between making the large

version of the word wall and making a personalized hand-held version for their science

journal.

During data analysis it was observed that ELL students were absent more frequently than

their peers. Not only did the high rates of absences create difficulties in collecting data for this

action research, but also created more barriers for students as they attempted to learn the

academic vocabulary. It would be beneficial for future research to focus on ELL students'

absenteeism and why these increased number of absences may be occurring. There are many

possible causes that should be considered (e.g., family responsibilities, difficulty of the work, if these students feel less connected to the school culture and community than their non-ELL peers.) If we understand the reasons why ELL students are frequently absent, we will be better prepared to provide appropriate support to ensure the success of these students.

Additionally, more research is needed related to effective ways to implement interactive word walls in a traditional, mainstream classroom at the high school level. Much of the research has focused on the use of interactive word walls at the elementary level with some studies conducted at the middle level. Challenges unique to the high school setting require further research.

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Appendix A
Pre/Post Unit Test

Human Anatomy/Physiology Test Chapters 30-34
Multiple Choice

1. Which of the following is _**not**_ correct concerning the skin?
    a. the dermis is usually thicker than the epidermis
    b. the epidermis is composed of dead keratin
    c. the subcutaneous or hypodermis layer is between the dermis and epidermis
    d. the dermis contains smooth muscle and nerve tissue

2. As the cells are pushed from the deeper portion of the epidermis toward the skin surface

    a. they are more alive   b. their supply of nutrients improves
    c. they tend to die   d. they get more blood vessels

3. The dermis is composed largely of
    a. nerves, muscle, and blood vessels
    b. loose connective tissue and no blood vessels
    c. dead cells filled with keratin
    d. tissue with no nerves

4. When you are cold the smooth muscle in your skin contracts, standing your hair up. This is commonly
   called?
    a. Sweating   b. Goosebumps
    c. Sleeping   d. Ducklumps

5. The dermis layer is located
    a. above the epidermis   b. between the epidermis and hypodermis
    c. inside the femur   d. beneath the hypodermis

6. The skin functions to
    a. provide a barrier against infection   b. remove waste products
    c. regulate body temperature   d. all the preceding

7. The blood vessels that supply oxygen to the skin cells are found in the
    a. epidermis alone   b. epidermis and the dermis
    c. muscles alone   d. dermis and hypodermis layer

8. Sweat glands
    a. are only found in the armpits and groin
    b. respond to elevated body temperatures
    c. respond to emotional stress
    d. both b and c

9. Which of the following is a normal response of your body when you are cold?
    a. dermal blood vessels become constricted (goosebumps)
    b. sweat glands become inactive
    c. skeletal muscles contract involuntarily (shiver)
    d. all of the preceding

10. The main function of melanin is to
    a. remove dead cells by phagocytosis   b. help control body temperature
    c. protect cells from ultraviolet (UV) light   d. produce vitamin D

11. The muscles move bones by a connection to the bone called a
    a. tendon   b. unconnective tissue
    c. ligament   d. antagonistic muscle

12. The **skeletal** system consists of each of the following except
    a. bones   b. cartilage   c. muscles   d. ligaments

13. The joint between the leg and hip bones is a
    a. ball and socket joint   b. hinge joint   c. saddle joint d. gliding joint

14. The skeleton of a human embryo is made of
    a. cartilage   b. keratin   c. muscle tissue   d. bone

15. The process of digestion begins in the
    a. mouth with saliva b. stomach   c. small intestine   d. large intestine

16. In the stomach, fats are broken down by a dark green enzyme stored by the liver that is
    called
    a. pepsin   b. saliva   c. breaker downer   d. bile

17. Most of the digestion and absorption of nutrients occurs in the
    a. small intestine   b. stomach   c. pancreas   d. large intestines

18. Bile or bile salts helps the small intestine break down
    a. proteins   b. fats   c. carbohydrates   d. sugars

19. Which organ in the digestive tract re-absorbs the fluids (when it fails to do the job the person
    experiences bouts of diarrhea)
    a. mouth   b. stomach   c. small intestine   d. large intestine or colon

20. In the human heart you find four chambers, two of the chambers are ventricles and two
    are_____
    a. pulmonaries   b. atriums   c. cardiacs   d. systemics

21. Which of the four chambers of the heart pumps oxygenated blood through the whole body?
    a. left ventricle   b. right ventricle   c. vena cava   d. aorta

22.What carries unoxygenated "blue" blood back to the heart?
     a. tubes   b. veins   c. arteries   d. both veins and arteries

23.What is the system called that removes the metabolic wastes from the system?
     a. sweat   b. excretory   c. urinary   d. intestinal

24. A lab technician performs a urine analysis and notes the patient should be tested for diabetes. What was present in the urine sample?
     a. low levels of protein   b. crystallized calcium deposits
     c. high levels of glucose   d. antidiuretic hormones

25.The insulated sheath around the axon is called
     a. myelin   b. neuron   c. axon   d. dendrites

26. The long fiber that carries the impulses away from the cell body are
     a. myelin   b. neuron   c. axon   d. dendrites

27. The simplest response to a stimulus is called a
     a. effector   b. reflector   c. receptor   d. reflex

28. Why are the lungs made up the many tiny air sacs (alveoli) instead of one large sac?
     a. To decrease surface area   b. To increase surface area
     c. Allows you to breathe faster   d. Nobody knows

29. The flap on the top of the larynx that prevents food and water from going down the wrong pipe is the
     a. pyloric valve   b. sphincter   c. epiglottis   d. peristalsis

30.The tube from the mouth to the bronchial tree is called the?
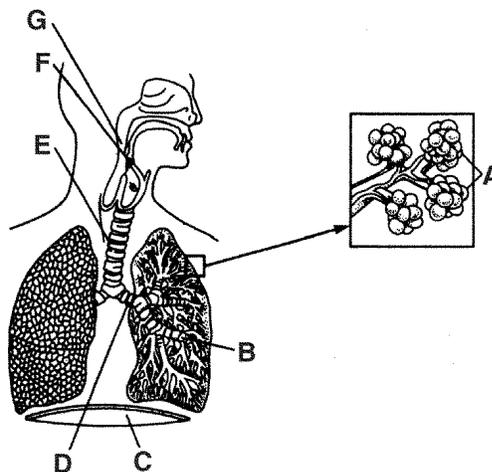   a. esophagus   b. urethra   c. trachea   d. eusteacian

Figure 1

31. When you blow out candles on a birthday cake (exhale), which muscular structure in figure one relaxes?

Completion

32. The soft tissue located in the ends of long bones, and that produce blood cells is called _____ (yellow bone marrow or red bone marrow)

33. Circle your name on the answer sheet for a free point.

34. The epidermal cells are pushed toward the surface, cells then fill with a protein called _____. (melanin or keratin)

35. _____ is a pigment produced on the border between the epidermis and the dermis.

36. The likelihood of skin cancer is increased by exposure to _____ rays.

Put the correct number from column A on the diagram on the test answer sheet for the following organs!
Column A
37. stomach   **[Put answers on answer sheet]**
38. pancreas
39. large intestine
40. gallbladder
41. liver
42. Esophagus

Appendix B
Student Feedback Questions Prior to Word Wall Use

Vocabulary in Biology
Please answer questions honestly. Your responses will have no effect on my views of you as a person/student or on your grade in this course and will be confidential.

1) What is your student identifier number? (this will be provided by your teacher)

2) How do you feel about learning new biology vocabulary?

1	2	3	4	5
Overwhelmed, low confidence				Great! Bring it on! high confidence

3) Explain how you feel when we learn new vocabulary words in class.

4)

Learning Vocabulary in Biology: Choose an answer that best shows how you feel about each statement.

	strongly agree	agree	disagree	strongly disagree	I do not understand what this means.
Learning new vocabulary in biology is easy	O	O	O	O	O
I get all the vocabulary words mixed up	O	O	O	O	O
It is hard for me to visulize the connections between the different vocabulary words	O	O	O	O	O
I know exactly what words I am expected to know	O	O	O	O	O

Appendix C
Student Feedback Questions (Midway and End of Unit)

Vocabulary and Word Walls

Please answer questions honestly. Your responses will have no effect on my views of you as a person/student or on your grade in this course and will be confidential.

1. What is your student identifier number? (this will be provided by your teacher)

2)

How do you feel about learning new biology vocabulary?

	1	2	3	4	5	
Overwhelmed, low confidence	○	○	○	○	○	Great! Bring it on! high confidence

 3) Explain how you feel when we learn new vocabulary words in class.

4)

Learning Vocabulary in Biology: Choose an answer that best shows how you feel about each statement.

	strongly agree	agree	disagree	strongly disagree	I do not understand what this means.
Learning new vocabulary in biology is easy	○	○	○	○	○
I get all the vocabulary words mixed up	○	○	○	○	○
It is hard for me to visulize the connections between the different vocabulary words	○	○	○	○	○
I know exactly what words I am expected to know	○	○	○	○	○

5)

Word Walls: Choose an answer that best shows how you feel about each statement.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	I do not know what this means
The class word wall helps me remember the vocabualry	○	○	○	○	○	○
The word wall helps me to see the relationships between words	○	○	○	○	○	○
The word wall does not help me at all	○	○	○	○	○	○
The word wall make me more confused	○	○	○	○	○	○
The word wall makes class less confusing	○	○	○	○	○	○
I think my teacher should continue using word walls	○	○	○	○	○	○

6) What is most helpful about using a word wall in class?

7) What could we do to make the word wall better? or How could we improve the use of words walls in our class?

Appendix D
Quick Write

Name_____ Hour_____

Quick Write/Exit Slip #1

Here are academic vocabulary words from the week. Write out the meaning or explain the given words the best you can.

1. Red marrow

2.   Ligaments

3.   Actin and myosin

4.   Smooth muscle

Appendix E

Reflective Teacher Journal

Include a photo journal to demonstrate the evolution of the word wall.

Date:
What was done today in class with word walls? **a.   Creation: (added words, made connections/grouping of words, added visuals, or removed/retired words)**   **b.   Interactions with the wall**
Did these word walls seem to work with all of the students?
What successes and challenges did the students have during class today in relation to the word wall or academic vocabulary? • **Challenges:** • **Successes:**
Any additional reflections or observations:

Appendix F

Coding of Vocabulary Quick Writes

Date	
Student identifier	
Quick write number	

Demonstrated knowledge of the words
0= did not attempt, 1= attempted but incorrect, 2= partially correct, 3= correct at basic level, 4= exemplary

	Awarded point value
Word # 1	
Word # 2	
Word # 3	
Word # 4	
Total points	

Appendix G

Student Word Wall Usage Observation Tally

Student Identifier:

Date					
Number of time student looked at the word wall					

Student Identifier:

Date					
Number of time student looked at the word wall					

Student Identifier:

Date					
Number of time student looked at the word wall					

Student Identifier:

Date					
Number of time student looked at the word wall					

Student Identifier:

Date					
Number of time student looked at the word wall					