The Effects of Dual Coding Theory on Social Studies Vocabulary and Comprehension in Elementary Education

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Article Info	Abstract
	The goal of this quasi-experimental study was to assess the effects of Dual-Coding Theory on domain-specific vocabulary and comprehension in a 5th grade social studies classroom. The pretest/posttest design research was conducted in a rural elementary school ($N = 49$). Twenty-three students participated in an intervention of dual-coding based strategies. This study sought to determine if the instructional strategies that incorporated dual coding were more effective than traditional social studies strategies to promote domain-specific vocabulary learning and academic achievement. In addition to the measures for vocabulary and comprehension, students completed a motivational questionnaire on their view of social studies to ascertain if their motivation and enjoyment changed after the experiment. ANCOVA analyses showed consistent, statistically significant results indicating that dual coding strategies benefitted students in the area of academic achievement. Dual coding strategies appeared to have had a positive impact on student vocabulary learning and academic achievement.

Introduction

Around the World with The Children (Carpenter, 1917) was a children's geography book. Though the book had only 4 pages of teacher instructions, the geography book repeatedly emphasized the importance of vocabulary throughout the instruction book. This book allowed children to see visually and read about many parts of the world from a global perspective. Many words that were unfamiliar to a child's geography or social studies vocabulary during this time would be introduced by this book. One hundred years later, vocabulary is still essential in content standards of instruction, especially in social studies. Georgia public school teachers are required to teach to the Georgia Standards of Excellence (Georgia Department of Education, 2018).

At the beginning of third grade, students are exposed to the scope of American history through four strands of content: history, geography, civics/government, and economics. Each strand contains domain-specific vocabulary that is very important to the understanding of the four strands of content. Harmon and Hedrick (2000) suggest that knowing word meanings is essential in understanding concepts in texts, and this demand increases in upper elementary and middle school social studies. Many studies have been dedicated to the importance of direct instruction in vocabulary acquisition (Beck & McKeown, 1991; Beck et al, 1987; Burnett & Cuevas, 2023; Graves, 1987; Stahl & Fairbanks, 1986).

The need to provide vocabulary instructional strategies that best meet the needs and learning of students is a priority for teachers. To understand the best strategies, it is important to have an understanding of cognitive theories of learning that are the foundation of strategies that teachers use in their classrooms, yet too often teachers may not use the most efficacious instructional methods (Cuevas, et al., 2023). A highly popular and controversial theory among teachers around the world is Howard Gardner's Multiple Intelligences (MI) Theory. Gardner (1983) introduced eight categories of intelligence. These eight categories are linguistic intelligence, logical-mathematical intelligence, spatial intelligence, bodily kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, naturalist intelligence. Gardner (2008) provides more explanation of the global impact of MI being used in the workplace and most importantly its implications educationally in the classroom. This theory has led to educators and researchers attempting to connect theory to instruction.

The learning styles hypothesis posits that students' unique learning style or multiple intelligence can be matched to instruction and produce optimal learning, more specifically in auditory, visual, and kinesthetic styles (Dunn et al., 1992). Howard-Jones (2014) reported that the popular hypothesis of learning styles is taught among 90% of teachers that reported in five countries. Though the learning styles hypothesis remains a popular teaching strategy among teachers in the UK and United States, the hypothesis is not supported by empirical evidence (Cuevas, 2015, 2016, 2016a; Cuevas et al., 2023, Pashler et al. 2009) and research indicates the approach is not effective for enhancing student learning (Cuevas & Dawson, 2018; Rogowsky et al., 2015), which should concern educators.

A different theory focusing on auditory and visual processing, that has not been as popular as the aforementioned, is Dual Coding Theory (DCT). Paivio (1971) suggests that our memory can be stored into visual and auditory systems. Though the systems are independent, his research suggests that the systems interact such that a word can evoke a mnemonic image thus providing two codes of memory. Research is needed to best understand the importance of best practices for teachers to help students retain domain-specific vocabulary knowledge across grade levels in social studies classrooms.

Theories of Intelligence and Learning

Over the past 200 years, psychologists have defined and determined intelligence by a variety of methods and means. According to Nicholas et al. (2013), William Stern became the first to phrase the term intelligence quotient or as we refer today "IQ". Alfred Binet at the turn of the 20th century made significant work on determining specific criteria of what children are capable of learning at specific ages. Binet created the first intelligence test in France to help the government to determine what school-aged children were able to accomplish from year to year. Spearman (1904) determined that people who performed well in one area of testing were likely to do well in other similar tests. On the other hand, people who performed poorly on certain tests consistently performed poorly on very similar tests. This evidence suggests, unlike the multiple intelligence theory, that people develop a general intelligence instead of multi-faceted manifestation on intelligence. Research indicates that the way students view intelligence can influence their academic performance (Jennings & Cuevas, 2021; Liming & Cuevas, 2017).

The Problem with Multiple Intelligences

Gardner (1983) introduced the multiple intelligence hypothesis to the educational community almost 80 years after Alfred Binet introduced the first intelligence test. Gardner (2006) made the claim that schools should have a larger view of intelligence in their classrooms. This hypothesis refutes the claim that intelligence can only be measured by an IQ score. Gardner (2008) has used Project Spectrum which measured the intelligence of young children and suggests that this knowledge could be beneficial to teachers. The influence of this book can be attributed to the popularity of teachers intentionally applying what they believe to be multiple intelligences strategies to their instruction to try to yield a positive effect on comprehension and learning. There is still no evidence that such strategies can yield positive effects on learning or comprehension.

It should be noted that a gap was found in empirical studies on the effectiveness of Multiple Intelligence Theory instructional strategies in education. Some empirical studies that were found lacked the types of inferential statistical analyses necessary to test the hypothesis. Furthermore, the lack of MI empirical studies with an adequate experimental design raises serious questions about the validity of the hypothesis. To date, there are no experimental studies conducted by Gardner to test his hypothesis that can be found in educational databases.

Problems with Learning Styles

The popularity of the learning styles hypothesis has led to studies to determine if instruction can be successfully matched to a student's preferred way of learning. Teachers tend to lean towards strategies that claim to support the learner uniquely. The problem with this idea is that teachers deliver instruction in a variety of ways and students may come to the belief that they can only learn in their specific learning style or need a variety of instructional strategies to learn (Scott, 2010). Though many studies have been published, in the vast majority of them an adequate experimental design was not used to answer or confirm the hypothesis. Minotti (2005) suggested in his research that students favored homework based on their matched learning styles. Yet the lack of evidence of the effectiveness of the matched learning style to the actual instructional assessment in this study illustrates the weakness of the learning styles hypothesis. An Allcock and Hulme (2010) study on college level students who were grouped by matched learning styles and ability indicated that neither learning style matched lessons or ability-directed lessons impacted student learning. In another study, Wilson (2012) found that matched learning styles to instructional strategies was not effective in promoting learning. The study concluded that learning styles was favored by teachers and their instructional strategies even without strong evidence to support the research.

Pashler et al. (2009) explored the type of evidence that is necessary to validate interventions based on learning styles, thus describing the criteria for an adequate design to conduct such studies and confirm the hypotheses. They found that there were few studies that followed the necessary steps to match learning styles to instruction, and as result there is a lack of reliable data to verify the hypothesis. Of the studies that did follow the necessary research design such as testing for an interaction between instructional method and an individual's learning style, the findings contradicted the learning styles hypothesis. The lack of empirical evidence supporting the learning styles hypotheses is not always based on an improper methodology. Willingham et al. (2015) also continued the

evaluation of learning styles hypotheses to search for empirical evidence that supports the hypothesis and why it is still widely used in educational settings. This investigation concluded from several reviews that the two main predictions of learning styles, a matched learning style prevalent across a variety of curriculum and greater cognitive gain when used with the preferred learning style, is not supported by research. The review also supported findings from Coffield et al. (2004) in which the study showed the lack of reliability of the learning styles instrument used in determining specific styles. Rogowsky et al. (2015) found that in the study of college-aged students there was no significant interaction effect indicating increased learning when linking the preferred learning style to direct instruction using the preferred learning style. Cuevas (2015) examined recent studies based on the learning styles hypothesis and found that those studies currently indicate that learning styles based instruction does not impact learning, and the more information we gather the clearer that becomes. Therefore, the learning styles hypothesis has not been determined to be effective teaching strategy. On the other hand, scientific evidence of combining words and visuals in a meaningful way during instruction called Dual Coding Theory has shown effective in student learning.

Dual Coding

Pavio (1971) originally asserted that Dual Coding Theory posits that visual and verbal information are processed differently when encoding in memory, and lines of research across several fields have provided support for the theory (Cuevas, 2016). This process can reduce what is called cognitive load. Sweller (1988) suggests that cognitive load is the amount of information that working memory can handle which is limited before it can be transferred to long term memory. More research has been done such as in the Cuevas and Dawson (2018) study where the results of the learning style matching hypothesis showed that when over 180 students were matched to their learning styles, no interaction effect was evident when they were asked to retain information based on their preferred learning style. Even further results showed that the VARK inventory could not predict student retention outcomes. Students who were asked to process the information visually outperformed students who were asked to process auditory information only. The study indicated that students who processed linguistic information as well as visual information were able to retain more information. The findings of this research shows strong evidence for Dual Coding Theory (DCT).

An important aspect of teaching is the instruction of vocabulary across content areas. Shen (2010) found that due to the use of DCT in teaching students Chinese as a foreign language students retained abstract words significantly better than concrete words. Pairing the visual with of the unknown term help students comprehend and remember the new foreign language vocabulary. Richardson (2013) found that concrete and abstract nouns are better recalled and understood in meaningful sentences using DCT than that of relational-distinctiveness processing theory. These studies further indicate that the use of DCT in classroom instruction to stimulate understanding of unknown and abstract terms is beneficial.

Based upon the work of Moody et al. (2018) to review articles on theories that underlie vocabulary instruction as well as used across grade levels, DCT represented only 32% of the articles that were examined in the present review. These researchers suggest that DCT is rooted more for teaching science, content-area vocabulary, and

used with older students. Their research lends to the idea that several theories are used to support full vocabulary instruction. DCT paired with vocabulary instruction has been found positive in recent research studies. Falter-Thomas and Lennox (2014) found that the use of dual coding when teaching vocabulary to 3rd grade students significantly impacted their learning of vocabulary and learning during classroom instruction. In the Cohen and Johnson (2012) study on the effects of dual coding and depth of processing of retention of key science vocabulary in a 5th grade classroom, students who participated in an Image Creation- Picture intervention where students created an image in regard to the vocabulary terms showed statistically significant differences in the immediate recall and delayed posttest when compared to the Word only group. Both the comprehension of key vocabulary and comprehension of material show students who participated in the intervention associated with a picture either given or drawn did significantly better in posttest scores. However, there was not a significant difference between the interventions that contained a picture to establish the superiority of one intervention over another.

Social Studies Vocabulary Strategies

Vocabulary acquisition is essential because it is associated with reading ability, and reading is a necessary skill for every content area (Cuevas, 2012; Cuevas, et al. 2012, 2014). There are various models of best practice vocabulary strategies within education. Beck, McKeown, and Kucan (2013) emphasize direct instruction of vocabulary impacts comprehension, as does Graves (1987) who also encourages using word parts to understand the meanings of words. Domain specific vocabulary can be understood as vocabulary within the context of a subject. Social studies domain-specific vocabulary can be found in four strands of social studies curriculum: history, geography, civics/government, and economics. McKeown et al. (1985) showed that children who have more opportunities to interact with difficult vocabulary across the curriculum and within the subject can comprehend the words more effectively than traditional instruction. Studies with a variety of school aged children have found that using pictures to teach vocabulary or unfamiliar phrases has been more effective than verbal instruction (Harmon, et al 2010; Mansourzadeh, 2014; Samburskiy, 2020). Research leans towards evidence that students who can pair the word with something visually show greater comprehension.

In a theoretical review of DCT as it relates to vocabulary, Sadoski (2005) suggests that DCT has had a significant effect on vocabulary instructional strategies not only in sight words, but also in learning meaningful vocabulary. The review also suggests that direct instruction of vocabulary using keyword methods "requires learners to form an interactive mental image of a definition to a new vocabulary word and a familiar concrete word that share a similar acoustic theme" (p.231). Tierney, et al (1990) described this strategy given the example of the word *potable*. The word can be broken down using the first part *pot* and referring to an image of a pot with fresh water for a weary traveler. This can later help the learner recall that potable means water that you are able to drink. Another widely-known and used strategy called the Frayer Model (1969) of vocabulary is a pairing of linguistic and visual modalities in the form of a graphic organizer. The student is asked to define the term, and provide a picture of the term, examples or synonyms of the term, and non-examples or antonyms of the term. The picture can be self-drawn or printed. A large box divided into four smaller boxes can be created with a vocabulary term written in a circle placed in the middle of the box. Each smaller box is given to provide space to write each of the constructs.

In the Sadoski, et al. (1997) study of concrete and abstract words, they found that when students in two experiments were asked to define concrete words they wrote more and reported that the strategy that helped to define the word was based on imagery. In defining abstract words, it was reported that students used more verbal strategies when writing the definitions. One question that is asked by teachers is whether abstract and/or domain-specific vocabulary should be taught explicitly in the curriculum compared to teaching vocabulary woven through content instruction. Teachers question whether the one or the other has significant impact on the comprehension of vocabulary. In a study conducted by Graham et. al (2015), after a 6-week intervention of explicit teaching on social studies domain-specific vocabulary in 4th grade classrooms it was found that the experimental groups showed greater gains in comprehension than the control groups. In another study on explicit vocabulary instruction, Baumann et al. (2003) conducted research with a study of ninety-two 5th grade students and found that direct teaching of morphemic and contextual analysis, or linguistic cues, of vocabulary had a positive effect on comprehension tests. Pairing explicit vocabulary instruction in content areas with DCT instructional strategies is found to be helpful with on grade level readers as well as students reading below grade level (Sadoski, 2005).

Kirkman et al. (2019) suggested in that when children at age 5 are presented with audiovisual modalities over redundant learning tasks they can learn at a faster rate. In turn, in the same experiment, they found that children aged 10 years were able to process more effectively with auditory cues. In the second experiment, the study showed that 5 and 10-year-old students learned more by visual cues rather than the auditory cues when tested separately. The 7-year-old age group did not show significant statistical differences in response to auditory cues or visual cues in either the first or second experiment. The implications of this study led to the question of whether explicit instruction of vocabulary with an overlay of visual modalities is beneficial to comprehension of vocabulary terms. The study found that learning was based on visual informative cues. Teachers desire to understand teaching strategies that have lasting impact on students' comprehension of vocabulary and desire to learn. Although learning styles hypotheses are widely accepted in k-12 classrooms, there is substantial amount of evidence that does not support significant impact on student learning. Current research suggests that DCT affects not only the acquisition of domain-specific content area vocabulary, but it is also effective in improving comprehension of the content standards.

Research Questions

In the review of literature, empirical studies have been examined to explain theories of intelligence, analyze current trends of the learning styles hypothesis and dual coding in reference to elementary education and the implications of best practices for how to instruct elementary students when learning vocabulary in domain content areas. Researchers have argued that instruction should be more strongly rooted in the cognitive science of learning (Cuevas, 2019; Cuevas et al., 2023). The work of Pashler et. al (2009) and Cuevas and Dawson (2018) among others have questioned the validity and noted the lack of empirical research on the learning styles hypothesis that is so prevalent in instructional strategies in K-12 schools. The learning styles hypothesis and DCT conceptually are diametrically opposed. Based on empirical studies, students learn better when exposed to visual information used to supplement linguistic information. Therefore, DCT has shown evidence of effectiveness in instructional strategies that could promote retaining information. The goal in this study was to examine the effects of the

layering of visual and auditory learning strategies in teaching specific-domain vocabulary in a 5th grade social studies classroom. The following research questions guided this study:

1. Are instructional strategies that incorporate dual coding more effective in 5th grade social studies classes in promoting domain-specific vocabulary learning rather than traditional social studies strategies?

2. Are instructional strategies that incorporate dual coding more effective in 5th grade social studies classes when testing for academic achievement in a unit of study than traditional social studies strategies?

3. Did using instructional strategies that incorporate dual coding affect attitudes for how students viewed social studies over the course of the unit of study?

Method

Contextual Factors

The study was conducted at a public elementary school in north Georgia. The school is a rural, Title 1 elementary school with approximately 608 students enrolled in grades kindergarten through 5th grade. The racial demographics are 90% Caucasian, 6.3% Hispanic, 2.3% Multi-racial, .7% Asian, and .2% Native American. The majority of students from this school represent a low socioeconomic household with 51% on free or reduced school lunch. The percentage of students meeting math and reading content standards in the previous school year was 80.9%, and the school has an overall school score of 77.6% based on the Georgia 2019 College and Career Ready Index (CCRPI).

The participants consisted of 49 students from two 5th grade classes. One comparison group consisted of 26 students with 12 boys and 14 girls. The experimental group consisted of 23 students with 12 girls and 11 boys. Students' ages ranged from 10-12 years old. The racial and socioeconomic demographics of both classes reflected the demographics of the school. The experimental group consisted of one Hispanic (non-English Language Learner) student, two gifted students, three students with a 504 plan, and three Early Intervention Program (EIP) students. The comparison group consisted of five students with disabilities, three gifted students, two students with a 504 plan, and three EIP students.

Materials and Measures

Materials

Students in both groups were given a list of domain-specific vocabulary terms based on the unit of study in the social studies classroom. The intervention required various types of strategies to be used in classroom instruction based on whole group, small group, and individual study. Students in the treatment group used graphic organizers such as ones based on the Frayer model of vocabulary in their social studies journals and other online formats such as Classroom Doodle for an online journal. Students used flash cards that contained an image provided on one side and the domain-specific vocabulary word and definition on the other. Students were provided with Google slides and PowerPoints that had an image of the related domain-specific vocabulary term, historical figure, and content related phrases that were used consistently when teaching on the specific term, figure or phrase. Students also created games with word-picture association with domain-specific vocabulary using their flashcards.

Exit tickets were given 3 times per week at the end of the lesson to access learning and image-to-word association.

Measures

There was a pretest and posttest for domain-specific content vocabulary for a unit of study based on 5th grade Georgia standards of excellence given to both the control and experimental groups. The test was untimed and consisted of 25 questions comprised of three sections. The first section of 15 questions was multiple choice. The second section consisted of 5 fill in the blank with the picture and definition. The student typed in the term in sentence format. The last section was matching the term with the definition. This test was constructed by a team of teachers at the school on the online learning platform, Schoology.

The second assessment administered to both student groups was a unit test based on content knowledge of the unit based on 5th grade Georgia standards of excellence. The test was untimed and constructed by a team of teachers at the school. The test consisted of 2 sections. The first section of the test consisted of 15, four-option multiple choice questions. The second section had 10 questions that were fill in the blank to assess important historical figures within the unit. Students had to match the historical figure to biographical information. The pretest was administered a week prior to beginning the unit of study. The posttest was administered at the end of the unit. This test was created in Schoology to have the flexibility of being taken in school or at home due to school closures. The test had the option to have randomized question order.

In this current research study students were asked to rate their attitudes towards social studies based on The Attitudes Toward Mathematics Inventory which was adapted so that the words "social studies" were substituted for "mathematics" (Tapia & March, 2004). Please see Appendix H for the survey. The survey was reduced in the number of items from 40 to 15 to make the scale grade appropriate. The four constructs of the ATMI are enjoyment, motivation, self-confidence, and value. Self-confidence, containing 15 questions, and value, containing 10 questions, constructs were removed from this study's survey to narrow the topic for elementary students. Motivation and enjoyment were the focus for the purpose of this study. There were 2 constructs on which students rated their attitudes: 10 questions on enjoyment of social studies and 5 questions on motivation for social studies. The questions were rated on a 5-point Likert scale with students choosing their range of satisfaction. Lim and Chapman (2013) reported that the reliability coefficient alpha of this measure was .97 in all grade levels. The Cronbach alpha of enjoyment was .89 and for motivation was .88.

Procedures

This study was conducted with two classrooms participating. Both classes were held daily for 50 minutes of social studies instruction. Teachers in the control group used traditional methods of Social Studies strategies. Both teachers followed the school district curriculum map and pacing guides and met weekly to collaborate on instruction.

Students in both groups learned "The Great Depression and New Deal" unit and "Another World War: World

War 2" unit. Each of the two units consisted of 10 days of instruction with one school day for assessment between units. All consented students in both the control and treatment groups were given a battery of tests prior to instruction to provide baseline data on motivation, vocabulary knowledge, and content knowledge. Students were given a pretest on vocabulary from the first unit, "The Great Depression and New Deal", and "Another World War: World War 2" vocabulary after the first unit of instruction. Students were given a pretest of content knowledge over "The Great Depression and New Deal".

After instruction and posttest of the first unit, students were given a pretest on content knowledge from the "Another World War: World War 2" unit. Only the implementation of the dual coding vocabulary strategies treatment, not the content or curriculum, differed between the two groups. Posttests on vocabulary and content were given to each after instruction and implementation. The post-motivation survey was completed by both groups after instruction and posttest of both groups.

Control Group

Students in this group completed all pretest and posttest measures for both units of study. The teacher of this group used traditional social studies strategies to instruct the class. Methods such as lecture, group note-taking, and hands-on activities were used in daily instruction. Group note-taking was conducted through a PowerPoint lesson whereas students were given a closed note study packet for each unit. Students were given a vocabulary list of 20 words for each unit of study and spent 15 minutes per day practicing. The online educational program, Quizlet, was used for learning and study of both sets of vocabulary lists. No further instruction of vocabulary was given during both units of study. Hands-on activities such as cut and paste, web quests, "I am, Who has" game, and biographies on historical figures were used during instruction in both units of study.

Treatment Group

The teacher in the treatment group administered a 15-minute vocabulary intervention every day during the 50-minute time allotted for daily social studies instruction. The intervention consisted of a survey of knowledge of vocabulary words at the beginning of each unit, the Frayer model vocabulary modeled and written in the students' daily social studies vocabulary journal, flashcards layered with vocabulary term and visual, and a daily exit ticket to draw an image related to a key element learned in the classroom that day.

Frayer Model Vocabulary Strategies and Flashcards: Students were introduced to the unit's vocabulary on the first day of the unit through a PowerPoint presentation in which every term was associated with a simple image of each term. For example, the term *soup kitchens* was paired with a picture of an old photograph of people waiting outside a soup kitchen in the Great Depression era. The method continued with all of the unit's 20 vocabulary terms list. During the whole class instruction, students used the Frayer model to write the term, definition, and picture of the term provided by the teacher. The teacher gave each student a cut-out image of the term. The students pasted the picture in the section of their Frayer model that was marked for the picture. The process was modeled by the teacher to ensure students were aware of the location of each section of the Frayer

model.

On the second day of instruction, the teacher gave each student a set of vocabulary flashcards with the image on one side and the definition on the other side. The students kept these cards through the entire unit and were expected to use them daily. During whole group instruction, students were encouraged to raise the vocabulary card of the term that was being spoken about on a cue from the teacher. For example, if the teacher was speaking of Herbert Hoover, the teacher said "cards". Students then raised the appropriate card with Herbert Hoover's face and definition on the back. Students alternated between two activities at the beginning of the class time for the first 15 minutes of each day. The first activity used the flashcards paired with a short passage based on unit content material or used a Nearpod activity with the vocabulary terms and images to play games matching the term or definition to the picture of the term. Students continued this strategy for 8 days out of the 10-day unit. The first day was dedicated to unpacking the vocabulary terms and the last day was used for accessing the unit vocabulary and content knowledge.

Exit Ticket: Three days a week students were given a Quick Draw Exit ticket (Appendix C) at the end of the day's lecture. The exit ticket asked students to quickly draw an image that represented a key element they learned in class that day. Students were given 5 minutes on a timer to draw quickly to keep students from adding too much detail. Students were given a paper or digital form to complete the Exit ticket. If given a digital form, the students drew using a drawing app on their iPad and uploaded the picture to the digital form. This information was used to clear up any misinterpretations of concepts and was discussed briefly the next day.

Results

Vocabulary

To determine if there was a difference as a result incorporating dual coding to promote domain-specific vocabulary learning rather than traditional social studies strategies over two separate units of study, the student test scores on the teacher-created vocabulary tests were analyzed on teacher-created vocabulary tests. An ANCOVA was run on the scores of the vocabulary tests for both groups. The first unit of study was the "Great Depression" and for the analysis, the post-test scores were entered as the dependent variable and the pretest scores as the covariate. The main effect was not significant, $F(1,43) = .563$, $p = .457$. Dual-coding was not an effective treatment in this unit of vocabulary learning.

The means and standard deviation may be found in Table 1 and the between-subjects effects in Table 2.

Table 1. Great Depression Vocabulary Learning Means and Standard Deviation

Dependent Variable: Great Depression Post

Condition	Mean	Std. Deviation	N
Control	92.1739	9.51388	23
Treatment	91.9565	10.41624	23
Total	92.0652	9.86442	46

Table 2. Great Depression Vocabulary Learning Results ANCOVA

Dependent Variable: Great Depression Vocabulary Post

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	634.154[a]	2	317.077	3.641	.035	.145
Intercept	31467.248	1	31467.248	361.340	.000	.894
GDPreVocab	633.610	1	633.610	7.276	.010	.145
Condition	49.001	1	49.001	.563	.457	.013
Error	3744.651	43	87.085			
Total	394275.000	46				
Corrected Total	4378.804	45				

a. R Squared = .145 (Adjusted R Squared = .105)

The second unit of study was over World War 2 vocabulary, and for the analysis, the post-test scores were entered as the dependent variable and the pretest scores as the covariate. Findings revealed a significant difference between groups, $F(1,43) = 78.7$, $p < .001$, $\eta^2 = .647$. This large effect size according to Cohen (1988) shows that this intervention had a beneficial effect on students' vocabulary acquisition. This suggests that using this intervention during this unit did a have a beneficial effect on the treatment group's domain-specific vocabulary knowledge. The means and standard deviations can be seen in Table 3 and the between-subjects in Table 4.

Table 3. World War 2 Vocabulary Learning

Dependent Variable: WW2PostVocab

Condition	Mean	Std. Deviation	N
Control	52.4348	20.65039	23
Treatment	91.7391	11.87135	23
Total	72.0870	25.92624	46

Table 4. World War 2 Learning Results ANCOVA

Dependent Variable: WW2PostVocab

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	20747.481[a]	2	10373.740	46.954	.000	.686
Intercept	44626.735	1	44626.735	201.991	.000	.824
WW2PreVocab	2981.915	1	2981.915	13.497	.001	.239
Condition	17398.618	1	17398.618	78.750	.000	.647
Error	9500.172	43	220.934			
Total	269288.000	46				
Corrected Total	30247.652	45				

a. R Squared = .686 (Adjusted R Squared = .671)

Academic Achievement

To determine if there was a difference in academic achievement in content knowledge during the two units of instruction between the comparison and treatment groups, the student test scores on the teacher-created assessment of content knowledge were analyzed. An ANCOVA was conducted on the scores for both groups, using the posttest for the dependent variable and the pre-test as the covariate. The main effect was statistically significant, $F(1,43) = 18.41$, $p < .001$, $\eta^2 = .300$. This large effect size according to Cohen (1988) shows that this intervention had a beneficial effect on students' academic achievement. This suggests that there was a substantial effect overall on students' academic achievement. The means and standard deviations for the academic achievement measure can be found in Table 5. The full ANCOVA statistics for this measure can be found in Table 6.

Table 5. Academic Achievement of Content

Dependent Variable: Post Content			
Condition	Mean	Std. Deviation	N
Control	52.4348	20.65039	23
Treatment	77.4783	13.22487	23
Total	64.9565	21.31349	46

Table 6. Academic Achievement of Content Results ANCOVA

Dependent Variable: Post-Content						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8775.076[a]	2	4387.538	16.171	.000	.429
Intercept	17609.110	1	17609.110	64.901	.000	.601
PreContent	1562.555	1	1562.555	5.759	.021	.118
Condition	4996.198	1	4996.198	18.414	.000	.300
Error	11666.837	43	271.322			
Total	214532.000	46				
Corrected Total	20441.913	45				

a. R Squared = .429 (Adjusted R Squared = .403)

Affective Traits

One research question was created to determine whether the attitudes of students whose instruction incorporated dual coding were affected over the course of the treatment. Constructs (enjoyment and motivation) were measured by survey data. An ANCOVA was run to compare the changes of each construct. The dependent variable was the post-survey scores and the covariate was the pre-survey scores.

Construct 1- An ANCOVA was run to compare the change in enjoyment. The dependent variable was the post-survey scores for enjoyment and the covariate was the pre-survey scores on enjoyment. There was not a significant

difference between groups, $F(1,43) = 2.83$, $p = .100$.

Construct 2- An ANCOVA was run to compare the change in motivation. The dependent variable was the post-survey scores of motivation and the covariate was the pre-survey scores on motivation. There was not a significant difference between the groups, $F(1,43) = 1.95$, $p = .169$.

Discussion

The purpose of this study was to examine the effects of a dual coding intervention in a 5th grade social studies classroom. Following two instructional units in social studies, students in the dual-coding intervention significantly improved their vocabulary in the second unit of study. Results of the first unit of study, The Great Depression vocabulary posttest, did not indicate a statistically significant difference in the treatment group over students in the traditional social studies instruction. This outcome could be due to not being acquainted with the intervention and its instructional strategies in the first unit of study. Due to the inconsistent findings in regard to this measure, it is important to be cautious in accepting the results or draw any definitive conclusions on the effectiveness of the intervention in vocabulary learning. In the second unit of study, World War 2 vocabulary test, students in the class receiving the dual-coding intervention significantly improved their vocabulary learning over students in the traditional social studies instruction. These findings could support the use of dual-coding intervention as a method to improve the vocabulary learning of in a fifth-grade social studies class. However, the wide disparity between the posttest scores of vocabulary learning in both units indicate a lack of inconsistency in the findings. Similar findings in a study by Falter-Thomas and Lennox (2014) are consistent with the current study which found that the intervention of dual-coding on domain-specific vocabulary in a 3rd grade elementary classroom was beneficial. In the current study similar findings emerged during the second unit of study. Additionally, Cohen-Johnson (2012) found the retention of science vocabulary in a 5th grade classroom using dual-coding intervention to be statistically significant.

The second research question investigated the acquisition of content knowledge over the course of two instructional units. Although both the treatment and control groups showed improved scores from the pretest to posttest, students who received the intervention performed approximately 25 points higher on average than the students receiving the traditional social studies instruction even after controlling for initial content knowledge. This was a significant difference and a very large effect. These results support the hypothesis that using the dual-coding intervention in a fifth-grade social studies classroom is a valuable method of instruction to substantially improve content knowledge. Samburskiy (2020) reported similar findings regarding comprehension of idioms with ESL and EFL students after a completion of a dual-coding intervention. This is relatable to the study above because students who learn unfamiliar domain-specific vocabulary may be similar to the ESL students who are learning new English language, therefore adding new terms to their vocabulary.

It is important to note the large effect size despite the short duration of the intervention. Cuevas and Dawson (2018) similarly found a large effect size which indicates a substantial influence of the dual coding intervention on retention in a study of additive effects of language processing and visual processing centers. Though this

current study was over the course of two-units in an upper-grades classroom, the above study was implemented very briefly in a college classroom. Both studies had findings of effectiveness of dual-coding in a variety of classroom settings and ages of students and over very brief durations. This suggests that, unlike many instructional strategies, the effects of dual coding may take effect immediately when students first encode information.

The third research question hypothesized that students' attitudes, both in enjoyment of and motivation for social studies, would improve. The findings did not support the hypothesis. Therefore, the intervention did not have an impact on enjoyment or motivation in the social studies classroom. Most students in both the treatment and control groups maintained a consistent attitude from pre- to post -survey scores. Despite the fact that statistical analyses showed no effects from the treatment, after the first unit of study it was observed that the students in the treatment group enjoyed participating in the intervention's instructional strategies. Students became more familiar with the method of instruction and looked forward participating in the vocabulary games and class discussion. In the Li and Tong (2020) study of 4th and 5th grade English speaking students learning a Chinese language, students were more motivated and found enjoyment in learning new vocabulary over a 19 -week experiment. This supports the findings that students find enjoyment when they are able to create word associations with an image when given a longer duration of treatment. However, in the present study, it could be that students enjoyed taking part in the instruction, but it did not translate into enhancing their views of social studies overall in such a brief duration. Enjoying the lessons during the unit of study is somewhat different than enjoying social studies overall and it is possible that enjoyment of lessons was positively impacted while interest in social studies was not. As a result, students can be motivated to continue to learn new vocabulary.

Limitations

There were several limitations to this study. The short duration of the treatment could have impacted the results of the study by limiting the time during which students' views may have changed. The small sample size is a limitation to the study, whereas other studies had significantly larger sample sizes and months of data to compare for study. The control classroom hosted three more special education students compared to the treatment group, which may have impacted the statistical analysis. Another factor to consider is teacher effect since there was only one teacher implementing the treatment.

Conclusion and Implications

Educational research is essential to providing teachers with guidance regarding instructional strategies that will benefit student learning. Many recent studies have focused on testing strategies designed to improve instruction for elementary level students through cognitively guided practices (Hughes & Cuevas, 2020; Moore & Cuevas, 2022; Skinner & Cuevas, 2023) with some directed specifically at social studies instruction (Dalton & Cuevas, 2019) and others on reading and language learning (Hendy & Cuevas, 2020; Tankersley & Cuevas, 2019; Zavala & Cuevas, 2019). The results of this study suggest that the dual coding intervention may be appropriate for upper elementary students. Further research is needed to support or reject the use of dual-coding in an upper elementary classroom. To understand the long-term impact on attitudes of students, a larger sample size and longer treatment

could possibly show greater effects. Despite the short duration of the intervention, students showed statistically significant growth in content knowledge. This would suggest that Dual Coding could be very effective in building content knowledge across curriculums, age groups, and diverse groups of students. The findings from this study could have specific implications on domain-specific vocabulary learning as well as content knowledge for students from a variety of academic backgrounds. Based on the findings, DCT could be effective in introducing new domain-specific vocabulary in social studies as well as across other curriculums and grade levels. The evidence of Dual coding Theory provided by this study suggests that is could be very beneficial to student learning. DCT appears to be a powerful instructional tool that has the potential to positively affect students' learning across broad educational environments.

Declarations and Compliance with Ethical Standards

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