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Vocabulary Retention and Color Effect Differences Among Developmental Community College Students

Eric Scott Coleman
Walden University

Walden University

College of Psychology and Community Services

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Eric Scott Coleman

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Review Committee
Dr. Jesus Tanguma, Committee Chairperson, Psychology Faculty
Dr. Sandra Street, Committee Member, Psychology Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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Abstract

The completion of developmental community college (DCC) courses is a crucial step in community college education to reach the national goal of increasing college success. DCC students are a unique population who require specific strategies such as vocabulary retention (VR) to achieve academic success. Prior research on vocabulary has been limited to VR and color effects. However, there is a lack of research on the intersection of these two variables (VR and color effects). This quantitative research study used the theoretical lens feature integration theory (FIT) to examine the effects that text color has on VR among DCC students. Additionally, this study included 87 participants between the ages of 18 and 55 who were enrolled in developmental English classes. This study also used the one-way analysis of variance (ANOVA) to analyze the color effects (red text, black text, and red and blue text combinations) on VR. The results of this study revealed that there was a significant difference in red text, compared to black text, and red and blue text combinations, respectively. Moreover, the results may assist communities, institutions, and students to save money. Thus, propelling students to move towards the national goal of increasing college success.

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Acknowledgments

First giving honor to God, my Lord and Savior, I want to thank you for giving me the strength, courage, and guidance to complete this faith walk. I would also like to honor my mother for always encouraging me to stay on track. I'd like to acknowledge all the people who guided and encouraged me along the way. Thank you so very much for your support. I would also like to acknowledge the added support from my friends and family. Finally, I would like to thank my committee members, without your support, this dream would not have been realized. To GOD be the glory.

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Chapter 1: Introduction to the Study

Introduction

The problem I addressed in this research was the gap in the literature concerning vocabulary retention (VR) and color effect differences among developmental community college (DCC) students. It is generally recognized from experts in the field that student educational achievement in community college increases the rate of success in 4-year college settings for DCC students (see Bailey et al., 2010). Females represent 56% of first-year DCC students (see Fernandez et al., 2014). However, contrary to such consensus, these rates often do not trickle down to a distinct population of community college students, namely DCC students (see Bailey et al., 2010). DCC students are students who need to improve their reading proficiency to advance to a college level (see Scrivener & Coghlan, 2011). Bailey et al. (2010) stated that 40% of developmental students who were referred to a developmental reading course completed all developmental college classes in 3 years. Bailey et al. also found that the completion of developmental courses is a crucial step in community college education to reach the national goal of increasing college success. Multiple studies have cited two major yet intersecting domains that appear to have consequences as they pertain to the success of DCC students: text color effect and its interaction with VR (see Elliot et al., 2007; Elliot et al., 2014; Roskes et al., 2014). More specifically, past research has been consistent in its findings that text color influences educational academic performance (see Elliot et al., 2007; Roskes et al., 2014). Text color affects the academic performance of DCC students (see Elliot et al., 2007; Roskes et al., 2014). Elliot et al. (2007) suggested that the color

red triggers avoidance motivation (AM). AM is a behavior that moves a person away from a negative outcome (see Elliot, 2006). Roskes et al. (2014) also indicated that AM causes adverse classroom effects. According to Van Yperen (2006), 33.6% of adult learners experience mastery of AM in academic settings. Haeffel (2011) noted that AM is higher among females compared to males. Additionally, Fernandez et al. (2014) stated that females represent 56% of first year DCC students. Roskes et al. also noted that AM causes negative classroom effects. The findings of these studies suggest that text color influences academic performance (see Elliot et al., 2007; Roskes et al., 2014).

VR was investigated given the literature that strongly suggests that VR affects student performance (see Elliot et al., 2007; Roskes et al., 2014). Elliot et al. (2007) suggested that the color red triggers AM. According to Elliot and Covington (2001), AM is a subtype of motivation. Laufer and Hulstijn (2001) argued that VR and motivation are underresearched areas. Moreover, Willingham and Price (2009) noted that VR is needed for academic success. Similarly, Remedios and Richardson (2013) found that AM decreased classroom grades and increased drop-out rates among adult students. According to Chemers et al. (2001), motivation affects student performance. Chemers et al. also found that student performance affected college academic success.

Together, past researchers have suggested that VR needs to be examined (see Chemers et al., 2001; Laufer & Hulstijn, 2001; Remedios & Richardson, 2013; Willingham & Price, 2009). Thus, while past research in these areas has been relatively robust in isolation (see Chemers et al., 2001; Laufer & Hulstijn, 2001; Remedios & Richardson, 2013; Willingham & Price, 2009), the manner in which these factors interact

and may potentially lead to improved educational success for DCC students has not been researched and is worthy of further study.

The positive social change implication in this study is that communities, institutions, and students can save money (see Scrivener & Coghlan, 2011), and DCC students can move towards the national goal to increase college success (see Bailey et al., 2010). The positive social change implication in this study was based on research that the color red triggers AM (see Elliot et al., 2007). AM decreases classroom performance (see Roskes et al., 2014), VR is needed for academic success (see Willingham & Price, 2009), and text color increases VR (see Farley & Grant, 1976). The major sections in Chapter 1 include the background, problem statement, purpose of this study, theoretical framework, research questions, hypothesis, nature of the study, definition of terms, assumptions, scope, delimitation, limitation, and the summary.

Background

I addressed the gap in the literature concerning VR and color effect differences among DCC students' performance in this study. Multiple scholarly articles in the areas of academic achievement, barriers to academic success, behavioral sequel related to academic underperformance, and general outcomes for DCC were searched. DCC students were incorporated in this study based on research that stated that DCC students need to raise their reading proficiency to a college-level (see Scrivener & Coghlan, 2011); however, females who struggle in reading are a neglected population (see Graff, 2009) considering that females tend to be stronger than males in reading (see Taha, 2006). Joshi (2005) stated that vocabulary is a subtype of reading. According to Joshi,

vocabulary is a major component of reading, considering that vocabulary effects fluency and comprehension. In addition, Beck et al. (1982) stated that vocabulary increases reading comprehension. Moreover, Willingham and Price (2009) noted that DCC students need VR to increase written and oral communication; however, no study has focused on strategies to increase VR among DCC students. Thus, the relevance of this study was to examine the association between DCC students' performance and VR.

The color red triggers AM (see Elliot et al., 2007). AM has different effects on females compared to males (see Haeffel, 2011). More specifically, females have higher levels of AM compared to males (see Haeffel, 2011). Red words triggered AM on a computer-based IQ test (see Elliot et al., 2007). Females' test scores remained constant after multiple exposures to a red progress bar on a web-based general knowledge test; however, males' test scores decreased after multiple exposures to a red progress bar on a web-based general knowledge test (see Gnambs et al., 2010). This research revealed a need to test the effects of red text on AM and VR among DCC students.

Problem Statement

The problem this research addressed was the gap in the literature concerning VR and color effect differences on DCC students. The color red triggers AM (see Elliot et al., 2007). AM is a behavior that moves a person away from a negative outcome (see Elliot, 2006). Adverse classroom effects on students' performances are caused by AM (see Roskes et al., 2014; Ryan et al., 2001). Roskes et al. (2014) found that AM causes attention to negative information, disengagement, and low performance. Ryan et al. (2001) also found that AM discourages students from seeking help and asking questions.

According to Haeffel (2011), AM is higher among females compared to males. In light of past research, the problem that I addressed was the effect of the color red on DCC students' performance.

The color red and AM influences educational settings (Elliot et al., 2007). According to Elliot et al. (2007), the color red is associated with AM. Elliot et al. found that red words on a computer-based IQ test cover triggered AM. AM may also increase worry, fear, and threat (see Elliot et al., 2007). Furthermore, according to Elliot et al., the color red decreases test scores. Collectively, the color red affects educational settings considering that the color red triggers AM (see Elliot et al., 2007).

The effects the color red have on AM in educational settings may be different for females over time (see Elliot et al., 2007). Gnambs et al. (2010) stated that the color red may decrease test scores for females after one exposure; however, the color red had no effect on test scores for females after multiple exposures (see Gnambs et al., 2010). Moreover, researchers have started to study AM among adult students in light of research stating that AM is one factor may that decrease classroom grades and increase the drop-out rates (see Remedios & Richardson, 2013). Past research has revealed a connection between red text and AM among adult females (see Elliot et al., 2007; Gnambs et al., 2010; Remedios & Richardson, 2013). The need to test the association between red text and AM among DCC students over time was addressed through the problem in this study.

Color effects influence educational settings (see Elliot et al., 2007). Color effects change students behavioral and psychological function when they interact with other colors (see Elliot et al., 2007). Noiwan and Norcio (2006) found that color combinations

that lack interest and appeal decrease attention and increase errors and search time. Additionally, Wang and Chen (2003) noted that red and blue color combinations should be avoided considering that red and blue color combinations decreased performance and were uncomfortable to view. Wang and Chen also noted that red and blue color combinations are on opposite ends of the color spectrum. Taking into account past research, the problem I addressed in this study was the effect that the color combinations red and blue have on AM and post-test VR among DCC students.

The colors red, blue, and black have different color effects (see Hall & Hanna, 2003; Mehta & Zhu, 2009). The color red increases arousal and excitement (see Labrecque & Milne, 2010); however, the color red also triggers AM and decreases test scores in academic settings (see Elliot et al., 2007). Additionally, red color cues narrow attention (see Friedman & Forster, 2010). Narrowed attention is attention that processes relevant cues and blocks irrelevant cues in a high arousal situation (see Janelle et al., 1999). Past researchers have found that narrowed attention increases the focus of goal attainment (see Cole et al., 2014). Red color cues have different effects than blue or black color cues (see Hall & Hanna, 2003; Mehta & Zhu, 2009). Blue color cues increase creativity and confidence (see Mehta & Zhu, 2009; Recours & Briki, 2015). Black color cues increase readability (see Hall & Hanna, 2003). Taking into account the color effects of red (see Labrecque & Milne, 2010), blue (see Mehta & Zhu, 2009; Recours & Briki, 2015), and black (see Hall & Hanna, 2003), the effects of color (see Hall & Hanna, 2003; Mehta & Zhu, 2009) on AM and posttest VR among DCC students' performance was addressed through the problem in this study.

VR influences the educational outcome of DCC students (see Willingham & Price, 2009). VR is needed for college academic success (see Douglas, 2016). VR is the ability to encode and retrieve words in different language contexts (see Keshta & Al-Faleet, 2013). According to Willingham and Price (2009), DCC students need VR to increase written and oral communication. DCC students are students who need to improve their reading proficiency to advance to a college level (see Scrivener & Coghlan, 2011). Bailey et al. (2010) noted that the national goal is to increase college success. According to Fernandez et al. (2014), female community college students represented 52% of the first-year student population and 56% of first-year developmental students. Bailey et al. also indicated that 40% of developmental students who were referred to a developmental reading course completed a college-level class in 3 years. Bailey et al. found that the completion of developmental courses is a crucial step in community college education to reach the national goal of increasing college success. Thus, I addressed VR in this study in light of research indicating that color affects VR.

Purpose of the Study

The purpose of this quantitative research was to address the gap in the literature concerning VR and color effect differences on DCC students. This research examined color effect differences between VR on DCC student performance (see Elliot et al., 2007; Farley & Grant, 1976; Roskes et al., 2014; Willingham & Price, 2009). The challenges of color effect differences and VR on DCC student performance (see Elliot et al., 2007; Farley & Grant, 1976; Roskes et al., 2014; Willingham & Price, 2009) are not new to the

literature; however, there has been no known attempt to integrate such well-known problems with focused attention to color effect differences and VR interaction.

Further, prior research (see Chemers et al., 2001; Laufer & Hulstijn, 2001; Remedios & Richardson, 2013; Willingham & Price, 2009) has not filled the gap between color effect differences (red text, black text, and red and blue text combinations) and VR, nor has it provided a research method that may assist DCC students to succeed in 2-year college settings. This under researched area of study (color effects and VR) will enhance the literature related to the role of color effect differences and VR as these variables pertain to academic success.

This research is unique in its scope due to its focus on the potential positive social change implications for DCC students, community colleges, and 2-year college institutions (see Bailey et al., 2010; Scrivener & Coghlan, 2011). Hence, this study helped fill a gap in the literature by focusing on text color and VR. As a result, I addressed the purpose of this study considering that there is a gap in the literature on VR and color effect differences among DCC students' performance (see Elliot & Covington, 2001; Gnambs et al., 2010; Laufer & Hulstijn, 2001).

Research Question

Research question (quantitative): Are there group differences in posttest VR scores among DCC students who use red text, black text, and red and blue text combinations?

Hypothesis

$H1_0$: There is no statistically significant mean group difference for posttest VR scores, as measured by the Vocabulary Knowledge Scale (VKS) and analyzed by the one-way analysis of variance, in DCC students who use one study material printed in red text, another black text, and one red and blue text combinations.

$H1_a$: There is a statistically significant mean group difference for posttest VR scores rates as measured by the VKS and analyzed by the one-way analysis of variance, in DCC students who use one study material printed in red text, another black text, and one red and blue text combinations.

Theoretical Framework

Feature integration theory (FIT) is the theoretical base that I used in this study. FIT is a cognitive theory developed by Treisman and Gelade (1980). FIT states that objects are divided into different features in the preattentive stage and bind together to form shapes and objects in the attentive stage (see Treisman & Gelade, 1980). Features are a set of perceptual units that assist with recognition and encode a stimulus (see Prinzmetal, 1981). According to Treisman (2006), color features guide attention to relevant information. Treisman and Gelade also noted that attention could be narrowed to focus on specific features or broadened to focus attention on a group of features. Narrowed attention is attention that processes relevant cues and blocks irrelevant cues in a high arousal situation (see Janelle et al., 1999). Friedman and Forster (2010) noted that attention is narrowed with red color cues and broadened with blue color cues. Thus, I

used FIT as the theoretical framework in this study in light of research suggesting that features control attention.

Colors contain color features (see Singh & Preet Kaur, 2016). Color features also guide attention to relevant information (see Treisman, 2006). Furthermore, color features in red text influence attention and educational outcomes (see Elliot et al., 2007; Kuniecki et al., 2015). According to Kuniecki et al. (2015), red pictures attract attention in an emotional context. Similarly, red words on a computer-based IQ test activate AM to decrease test scores (see Elliot et al., 2007). Hence, I used FIT in this study considering that color features in red text influence AM and VR.

Color features in black text influence student performance (see Hall & Hanna, 2003; Singh & Preet Kaur, 2016). According to Hall and Hanna (2003), black text increases readability. Moreover, Uccula et al. (2014) stated that black ink is common in books. Ramadan (2011) found that black text increases comprehension among college students who read e-books in Arabic. Thus, I used FIT to examine if black color features in black text affect AM and VR.

Past research has suggested that color features in the colors red and blue have different color effects (see Mehta & Zhu, 2009; Singh & Preet Kaur, 2016). Red pictures attract attention in an emotional context (see Kuniecki et al., 2015). The color red also activates AM to decrease test scores (see Elliot et al., 2007). However, the color blue increases confidence and creativity (see Mehta & Zhu, 2009; Recours & Briki, 2015). Additionally, Wang and Chen (2003) stated that red and blue combinations should be avoided considering that red and blue color combinations decreased performance and

were uncomfortable to view. Wang and Chen also noted that red and blue are on opposite ends of the spectrum. In this study, FIT was used to determine if red and blue color features in red and blue text combinations have color effects on AM and posttest VR among DCC students' performance.

Finally, FIT was used as the theoretical base in light of research suggesting that colors have color effects (see Elliot et al., 2007). Color effects change their behavioral and psychological function when they interact with other colors (see Elliot et al., 2007). Color combinations decrease attention and increase error when they lack interest and appeal (see Noiwan & Norcio, 2006). Red and blue text color combinations may influence AM and VR in light of research that color effects change attention and error when they are guided to color combinations that lack interest and appeal (see Elliot et al., 2007; Noiwan & Norcio, 2006; Treisman, 2006).

Nature of the Study

The nature of this quantitative research was to examine color effect differences on VR among DCC students. This study consisted of one experiment. I examined if there were mean group differences of posttest VR scores with the VKS by using the one-way ANOVA. I used the first 2 weeks of preparation before this research was conducted to recruit instructors and participants and to consider threats to testing validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013). This study also used the following 3 weeks of instruction to compare color effect differences in VR among DCC students. The one-way ANOVA in this study was used to measure mean differences of the VKS for the posttest VR scores of each group (red text, black text, red and blue text color combinations). If a

statistically significant one-way ANOVA was determined for the one-way ANOVA in this study, then the post-hoc Tukey honestly significant difference (HSD) tests were used for the mean differences of the posttest VKS scores to determine where the significant differences were within the groups (red text, black text, red and blue text color combinations). If a statistically significant one-way ANOVA was not determined for the mean differences of the posttest VKS scores, then the post-hoc Tukey HSD tests were not used to determine where the significant differences are within the groups (red text, black text, red and blue text color combinations). Together, the results of the one-way ANOVA and post-hoc Tukey HSD tests, assuming that the one-way ANOVA showed significant differences (see Ruxton & Beauchamp, 2008; Saville, 1990), measured student vocabulary for posttest VR scores if a statistically significant one-way ANOVA was determined.

DCC students were included in this study in light of research that DCC students need to improve in reading proficiency to advance to a college-level (see Scrivener & Coghlan, 2011). Graff (2009) noted that females who struggle in reading are a neglected population considering that females tend to be stronger than males in reading. Joshi (2005) found that vocabulary is a subtype of reading. According to Joshi, vocabulary is a necessary component of reading because vocabulary is needed for fluency and comprehension. Beck et al. (1982) found that vocabulary increases reading comprehension because vocabulary increases the speed and accuracy of processing words and decreases the time for decisions. Douglas (2016) suggested that VR is needed for

academic success. DCC students were used in this study considering that DCC students need to increase VR to assist in reading and experience academic success.

Red text, black text, and red and blue text color combinations are the independent variables (see Elliot et al., 2007) in this study. Red text, black text, and red and blue text color combinations were used in this study considering that colored text increases VR (see Stitt & Pula, 2013); however, color effects change their behavioral and psychological function when they interact with other colors (see Elliot et al., 2007). Stitt and Pula (2013) found that red text increases VR. Labrecque and Milne (2010) indicated that the color red increases excitement and arousal. Elliot et al. (2007) also found that the color red decreases test scores in academic settings (see Elliot et al., 2007). I used red text in this study because the color red increases arousal (see Labrecque & Milne, 2010) and decreases test scores in academic settings (see Elliot et al., 2007). I used red text to teach the keyword method (see Rodriquez & Sadoski, 2000) in this study. The keyword method is a vocabulary instructional strategy in which a keyword is chosen to remember the definition of a vocabulary word (see Rodriquez & Sadoski, 2000). The keyword method was used as an instructional strategy (see Rodriquez & Sadoski, 2000) in this study to assist the participants with learning the keywords in the definition and the synonyms associated with the definition. I used red text in this study for the vocabulary words and the associated synonyms in this study.

Hall and Hanna (2003) stated that black text increases readability. Ramadan (2011) found that black text increases comprehension among college students who read e-books in Arabic. According to Uccula et al. (2014), black ink is common in books. I

used black text in this study because black text increases readability (see Hall & Hanna, 2003), the color black increases comprehension (see Ramadan, 2011), and black ink is common in books (see Uccula et al., 2014). I used black text to teach the vocabulary words and the associated synonyms in this study.

Additionally, Mehta and Zhu (2009) found that the color blue increases creativity, and the color red increases attention to detail. Elliot et al. (2007) noted that colors interact with other colors to change the behavioral and psychological function of color effects. I combined red and blue text color combinations because the color blue increases creativity, the color red increases attention to detail, and colors change their behavioral and psychological function when they interact with other colors (see Elliot et al., 2007; Mehta & Zhu, 2009). I used red text to teach the vocabulary words and blue text to teach the associated synonyms in this study. VR was the dependent variable in my study (see Douglas, 2016; Willingham & Price, 2009). VR was used in this study because VR is needed for academic success (see Douglas, 2016) among DCC students (Willingham & Price, 2009). The nature of this study was to examine color effect differences and VR among DCC students.

The original design in this study was changed. The original design of this study focused on developmental female community college students; however, this study was changed from the original design of developmental female community college students to DCC students, which includes both male and female DCC students. I made changes to this study to avoid gender bias (see Holdcroft, 2007). The changes that I made to my study from developmental female community college students to DCC students did not

change the overall goal of my study because the focus of my study was to investigate color effect differences on learning vocabulary. Additionally, the changes that I made to this study broadened the population that I used for this research. The nature of this study was to examine color effect differences, and VR remained unchanged although the original design in my study was changed from developmental female community college students to DCC students. As a result, the nature of this study was to examine color effect differences and VR among DCC students.

Definition of Terms

Attention: A visual mechanism used to highlight a specific location that allows for stimuli to be processed (see Tsal & Lavie, 1988).

Avoidance motivation: Behavior that moves a person away from negative outcomes (see Elliot, 2006).

Black: A color that is associated with elegance, dignity, power (see Grobelny & Michalski, 2015; Labrecque & Milne, 2010), and increased readability (see Hall & Hanna, 2003).

Blue: A color that is associated with intelligence, logic, trust (see Labrecque & Milne, 2010), and increased confidence and creativity (see Mehta & Zhu, 2009; Recours & Briki, 2015).

Bottom-up control: Attention that is focused on physical features (see Awh et al., 2012).

Color cue: Attention that is guided to a specific-colored location (see Ansorge & Becker, 2014).

DCC students: Students who need to improve in reading proficiency to advance to a college-level (see Scrivener & Coghlan, 2011).

Feature integration theory: A cognitive theory developed by Treisman and Gelade, which states that features guide attention to relevant and irrelevant information through the preattentive and attentive stage (see Treisman & Gelade, 1980).

Features: A set of perceptual units that assist with recognition and encoding a stimulus (see Prinzmetal, 1981).

Narrowed attention: Attention that processes relevant cues and blocks irrelevant cues in a high arousal situation (see Janelle et al., 1999).

Red: A color that is associated with excitement in the area of advertisement, marketing, and business (see Labrecque & Milne, 2010); however, a color that triggers AM and decreases test scores in academic settings (see Elliot et al., 2007).

Retrieval: Stored information that is accessed (see Barcroft, 2015).

Self-handicapping behavior: Behavior that occurs before a performance that serves as an excuse for failure (see Urdan & Midgley, 2001).

Top-down control: Attention that is focused on a goal (see Awh et al., 2012).

Visual presentations: The nonspoken instructional information in a classroom (see Flevares & Perry, 2001).

Vocabulary retention: To encode and retrieve vocabulary words in various contexts for an extended period (see Keshta & Al-Faleet, 2013).

Assumptions

I examined color effect differences in VR among DCC students in this study. The assumptions in this study were that DCC students attended class until completion, the instructors implemented the correct teaching strategies, and outside classroom factors would not influence study materials and test scores. The assumptions in this study were necessary considering that red text, black text, and red and blue text color combinations changed AM, VR, and color effects (see Elliot et al., 2007). The assumptions in this study also included that the dependent measure (VR) was continuous (see Erceg-Hurn & Mirosevich, 2008). The independent variables in this study had two categorically matched pairs, the groups in this study were normally distributed, the variance between the groups in this study was equal, and the samples in this study were independent in the one-way ANOVA (see Erceg-Hurn & Mirosevich, 2008).

Scope and Delimitations

This study focused on color effect differences in VR among DCC students. DCC students are college students who need additional help in reading proficiency to advance to a college-level (see Scrivener & Coghlan, 2011). This study focused on DCC students, considering that female students who struggle in reading are a neglected population (see Graff, 2009) and past researchers have suggested that females are stronger than males in reading (see Taha, 2006). Joshi (2005) found that vocabulary is a subtype of reading. According to Joshi, vocabulary is a necessary component of reading in light of research, which suggested that vocabulary is needed for fluency and comprehension. Beck et al. (1982) suggested that vocabulary increased reading comprehension. According to

Willingham and Price (2009), DCC students need VR to improve written and oral gcommunication; however, no study has focused on strategies to increase DCC students who struggle in VR.

The color red was another focus of this study when considering the effects of the color red on females' test scores (see Gnambs et al., 2010). Gnambs et al. (2010) stated that the color red decreases test scores for females after one exposure; however, the color red has no effect on test scores for females after multiple exposures (see Gnambs et al., 2010). The color red was the focus of this study in light of research, which suggested that in general, the color red changes test scores among females (see Gnambs et al., 2010).

VR (see Douglas, 2016; Willingham & Price, 2009) was an additional focus of this study. VR is needed for academic success (see Douglas, 2016). Willingham and Price (2009) suggested that VR is needed by DCC students to increase written and oral communication. Joshi (2005) noted that vocabulary is a subtype of reading. According to Joshi, vocabulary is a necessary component of reading, considering that vocabulary is needed for fluency and comprehension. Additionally, Beck et al. (1982) suggested that vocabulary improves reading. DCC students are community college students who need improvement in reading (see Scrivener & Coghlan, 2011). VR was included in this study because VR fills the need among DCC to increase reading and academic success (see Beck et al., 1982; Douglas, 2016; Scrivener & Coghlan, 2011).

Internal validity was addressed in this study, considering that I used participants who had similar test results in reading in this study. The testing threat to the internal validity was also addressed. Willson and Putnam (1982) stated that pre- and post-tests

influence the outcome of a study. Willson and Putnam also indicated that pre- and post-tests, which are the same, produce the most substantial increase for cognitive tests when the participants practice the study material. This study addressed internal validity in light of research suggesting that my study used the same posttests (see Willson & Putnam, 1982) for each group (red text, black text, and red and blue text color combinations).

Limitations

This study examined color effect differences in VR among DCC students. The limitations in my study were that my study included DCC students from one school. Students and instructors who agreed to participate in this study will try new methods to increase VR, and the outcome of this study may not be generalized to other schools and populations.

Significance of the Study

This study was significant considering that this study compared color effect differences in VR among DCC students. Elliot et al. (2007) suggested that the color red decreases test scores in an academic setting. Gnambs et al. (2010) stated that the color red has different effects on females compared to males. According to Gnambs et al. (2010) the color red decreases test scores of females after one exposure; however, the color red did not affect test scores of females after multiple exposures. Gnambs et al. (2015a) also stated that the color red interferes with the learning tasks of females during encoding and retrieval after one brief exposure; however, the color red did not interfere with the learning tasks of females during encoding and retrieval after multiple exposures (see Gnambs et al., 2015a). According to Gnambs et al. (2015a), brief exposures for encoding

and retrieval of new material are not common in academic settings. This study was significant, considering that this study compared color effect differences in VR among DCC students in 3 weeks compared to a brief exposure. This study used the first 2 weeks of preparation before the research was conducted to recruit participants and instructors and to consider threats to testing validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013). This study used the following three weeks of instruction to compare color effect differences in VR among DCC students.

This study was significant, considering that it compared color effect differences in VR among DCC students. Elliot et al. (2007) found that color combinations change their behavioral and psychological effects when they interact with other colors. Noiwan and Norcio (2006) stated that color combinations that lack interest and appeal decrease attention and increase errors and search time. Red and blue are color combinations (see Wang & Chen, 2003) with different motivational effects (see Mehta & Zhu, 2009). According to Wang and Chen (2003), red and blue color combinations should be avoided considering that red and blue color combinations decrease performance and were uncomfortable to view. Wang and Chen also noted that red and blue colors are on opposite ends of the color spectrum. This study was significant considering that this study compared color effect differences in VR among DCC students who were grouped by use of one study material printed in red text, another in black text, and one in red and blue text color combinations. The significance of this study was the comparison between red text that activates AM and decreases test scores (see Elliot et al., 2007), black text, which increases readability (see Hall & Hanna, 2003), and red and blue text, which should be

avoided considering that red and blue colors are on opposite ends of the color spectrum (see Wang & Chen, 2003).

Summary

The problem this research addressed was the gap in the literature concerning VR and color effect differences among DCC students. The purpose of this quantitative research was to address the gap in the literature concerning VR and color effect differences among DCC students. I used FIT as the theoretical base for this study, considering that color features guide attention to relevant information (see Treisman, 2006). The assumptions in this study were that DCC students would attend the developmental reading class until completion, the correct implementation of teaching strategies was used among DCC instructors, and outside classroom factors would not influence the study materials and test scores (see Erceg-Hurn & Mirosevich, 2008). The limitations were that this study included DCC students from one community college in Northeastern United States, the students and instructors would try new methods to increase VR, and the outcome may not be generalized to other schools and populations. The significance of this study can help determine if there are color effect differences in VR among DCC students. The literature has shown that researchers need to address the gap in the literature concerning VR and color effect differences among DCC students who use one study-material printed in red text, another in black text, and one in red and blue text. Chapter 2 includes a review of the literature.

Chapter 2: Literature Review

Introduction

The problem I addressed in this research was the gap in the literature concerning VR and color effect differences among DCC students. The purpose of this quantitative research was to address the gap in the literature concerning VR and color effect differences among DCC students. Community college is increasingly a path forward for many Americans in their quest for higher education. As the cost of a 4-year college education has increased exponentially, many view community colleges as a viable alternative (see Bradburn et al., 2001). However, for many community college students, the ultimate goal is to earn a 4-year college degree as the datum shows that earning a 4-year college degree is more likely to increase occupational choices and incomes (see Bradburn et al., 2001). While this goal has generally been attainable for a proportion of the community college population, community students have significantly lagged in this pursuit (see Bailey et al., 2010). These statistics have demonstrated a need for educators to address the gaps that exist for DCC students. A review of the literature has shown that a study that seeks to narrow the community college to 4-year college success achievement gap (see Bailey et al., 2010) lies in a better understanding of the interacting effects of color and VR for DCC students and strategies for assisting DCC students in overcoming the challenges these areas present for them. For example, Farley and Grant (1976) detailed how text color increased retention. Similarly, Elliot et al. (2007) stated that colors interacted with other colors to change the behavioral and psychological function of the color effect. This research revealed that colors have an impact on

academic outcomes, which shows the relevance of examining red text, black text, and red and blue text (see Elliot et al., 2007; Farley & Grant, 1976).

According to Friedman and Forster (2010), the color red has more than one psychological function. Kuhbandner et al. (2015) quantified how the color red increases memory and attention to detail. The color red also narrows attention as the color red is said to signal danger (see Friedman & Forster, 2010). Narrowed attention is attention that processes relevant cues and blocks irrelevant cues in a high arousal situation (see Janelle et al., 1999). Cole et al. (2014) stated that narrowed attention increases the focus on goal attainment. The color red narrows attention and raises concern to avoid mistakes (see Friedman & Forster, 2010). According to Elliot et al. (2007) the color red also decreases test scores considering that the color red triggers AM. AM is a behavior that moves a person away from a negative outcome (see Elliot, 2006). AM is associated with low classroom performance, disengagement, and attention to negative information (see Roskes et al., 2014). The color red causes multiple psychological responses, which affect academic outcomes (see Elliot et al., 2007; Friedman & Forster, 2010; Kuhbandner et al., 2015).

Blue and black colors have different psychological functions than the color red (see Beaven & Ekstrom, 2013; Kuhbandner et al., 2015; Mehta & Zhu, 2009). The color blue increases confidence and creativity (see Mehta & Zhu, 2009; Recours & Briki, 2015). Moreover, blue colored light increases alertness (see Beaven & Ekstrom, 2013). Similarly, black text increases readability and comprehension (see Hall & Hanna, 2003; Ramadan, 2011). Compared to blue and black colors, red colors increases memory and

attention to detail (see Kuhbandner et al., 2015); however, the color red also decreases test scores (see Elliot et al., 2007). This research showed that blue and black colors differentiate from the psychological functions of the color red.

Color influences memory and retention (see Farley & Grant, 1976; Wichmann et al., 2002). Wichmann et al. (2002) found that color increases recognition memory in natural scenes considering that color transfers information into short-term memory. Farley and Grant (1976) found that color increases retention. Stitt and Pula (2013) also found that colored text increases VR. Additionally, Spence et al. (2006) found that color increases visual memory in natural scenes. This research showed that color and VR had an influence on recognition and visual memory.

This literature review begins with a description of FIT and continues with color and learning. The literature review relates color to the following: (a) retention, (b) memory in natural scenes, (c) attention, (d) and exam performance. The review addresses how the color red relates to (a) task performance (b) and retention. Finally, this review discusses how the colors red, black, and red and blue relate to learning. This review forms the basis for understanding the gap in the literature concerning VR and color effect differences among DCC students. The resources used for research in this literature review are the Walden University library for online journals and Google Scholar. The sites included in this research are Science direct, SAGE premier, PsycINFO, PsychARTICLES, PsycBOOKS, PsycEXTRA, Academic Search Complete, Google Scholar, Education Research Complete and Primary Search. The terms used in the Walden Universities Library included *the color red and achievement, the red effect,*

colors and learning, attention and red, blue and meaning, black and meaning, attention, and *vocabulary retention.* The parameters of the time frame for this research included the last 10 years to develop a solid foundation for color research and included seminal works. I conducted exhaustive research until no new information was discovered.

FIT

FIT is a cognitive theory developed by Treisman and Gelade (1980), grounded in the hypothesis that color features direct attention to relevant information during the preattentive stage (see Treisman, 2006). Features are a set of perceptual units that help to encode and recognize a stimulus (see Prinzmetal, 1981). Color features direct attention to relevant information during the preattentive stage (see Prinzmetal, 1981; Treisman, 2006).

FIT stated that color features direct attention to relevant information during the preattentive stage (see Treisman, 2006). Features are a set of perceptual units that help to encode and recognize a stimulus (see Prinzmetal, 1981). This research addressed the gap in the literature concerning VR and color effect differences among DCC students considering that color features direct attention to relevant information during the preattentive stage (see Prinzmetal, 1981; Treisman, 2006).

The pre-attentive stage is the first stage of FIT (see Treisman, 2006). Treisman (2006) found that the preattentive stage encodes color features through feature maps and top-down control. Top-down control is attention that is focused on a goal (see Awh et al., 2012). Feature maps are the organized spatial information of features (see Quinlan, 2003). Gazzaley and Nobre (2011) found that color features direct attention to

information before awareness. Treisman (2006) found that color features separate relevant and irrelevant information. According to Prinzmetal et al. (1986), attention helps encode and integrate features during the preattentive stage. The preattentive stage uses color features to direct attention to relevant information so that color features can be encoded and integrated into feature maps (see Gazzaley & Nobre, 2011; Prinzmetal et al., 1986; Treisman, 2006).

The second stage of FIT is the attentive stage (see Treisman & Gelade, 1980). Treisman and Gelade (1980) found that the attentive stage binds features' together through attention. According to Treisman and Gelade, the attentive stage uses features to create shapes and objects. Treisman and Gelade found that attention encodes between one and four features. Bravo and Nakayama (1992) stated that the attentive stage uses top-down and bottom-up control to direct attention and create objects. Bottom-up control is attention that is focused on physical features (see Awh et al., 2012). Top-down control is attention that is focused on task completion (see Awh et al., 2012). Bottom-up control identifies relevant features and top-down control suppresses irrelevant features (see Gazzaley & Nobre, 2011). The second stage of FIT binds and encodes features through directed attention from top-down and bottom-up controls (see Bravo & Nakayama, 1992; Treisman & Gelade, 1980).

DCC Students

DCC students are students who need improvement in reading to advance to a college level (see Scrivener & Coghlan, 2011). Females who struggle in reading are a neglected population (see Graff, 2009) considering that researchers found that females

are stronger than males in reading (see Taha, 2006). Joshi (2005) stated that vocabulary is a subtype of reading. According to Joshi, vocabulary is a necessary component of reading in light of research suggesting that vocabulary affects fluency and comprehension. Beck et al. (1982) found that vocabulary increases reading comprehension. This research revealed the need to improve DCC students' reading proficiency through vocabulary considering that females who struggle in reading are a neglected population.

DCC students represented more than half of the community college population (see Fernandez et al., 2014). Fernandez et al. (2014) stated that females represented 56% of first-year DCC students. Bailey et al. (2010) reported that 40% of students referred to developmental reading courses completed college-level courses in 3 years. Bailey et al. also stated that the national goal is to increase college success through DCC courses. This datum supports the need to examine DCC students because a high percentage of DCC students will take at least 3 years to reach the national goal, which is to complete college-level courses and experience college success (see Bailey et al., 2010; Fernandez et al., 2014).

The Color Red and AM

The color red triggers AM (see Elliot et al., 2007). AM is a behavior that moves a person away from a negative outcome (see Elliot, 2006). Red words activate AM on a computer-based IQ test (see Elliot et al., 2007). AM is higher among females than males (see Haeffel, 2011). Elliot and McGregor (1999) stated that AM causes anxiety. According to Elliot and McGregor, females have higher levels of anxiety than males. Elliot and McGregor stated that higher levels of anxiety led to decreased test scores.

Elliot and McGregor also reported that AM decreases test scores among college students in light of research suggesting that AM caused worry and test anxiety. According to Elliot and Harackiewicz (1996), AM decreases concentration and involvement. The findings from these studies showed that AM produces different effects among females (see Elliot et al., 2007) and affects educational outcomes (see Elliot & McGregor, 1999; Haeffel, 2011).

The color red triggers AM (see Elliot et al., 2007). AM decreases intrinsic motivation (see Elliot & Harackiewicz, 1996). Intrinsic motivation is a behavior that moves a person to complete a task (see Ryan & Deci, 2000). Intrinsic motivation is associated with an increase in academic achievement (see Lemos & Verissimo, 2014). AM affects intrinsic motivation, which decreased classroom achievement (see Elliot & Harackiewicz, 1996).

The color red was included in this study considering that AM is activated by red words on a computer-based IQ test (see Elliot et al., 2007) and causes adverse classroom effects on students' performance (see Roskes et al., 2014). According to Roskes et al. (2014), AM causes low classroom performance, attention to negative information, and disengagement. Ryan et al. (2001) found that AM decreases student questions and increases help avoidance. Help avoidance is when students avoid help in the classroom (Ryan et al., 2001). Ryan et al. (2009) stated that help avoidance decreases academic achievement. Skandrani-Marzouki et al. (2012) found that AM decreases participation, paraphrasing, comprehension, and the percentage of correct answers. AM also increases self-handicapping behavior (see Ommundsen, 2004). Self-handicapping behavior is a

behavior that occurs before a performance that serves as an excuse for failure (see Urdan & Midgley, 2001). Self-handicapping behavior leads to lower self-esteem, procrastination, and less effort (see Ommundsen, 2004). The color red triggers AM (see Elliot et al., 2007), and AM influences classroom behaviors (see Roskes et al., 2014; Ryan et al., 2001; Skandrani-Marzouki et al., 2012).

VR

VR is the ability to encode and retrieve the meanings of words in various contexts for an extended period (see Keshta & Al-Faleet, 2013). VR is needed for college academic success (see Douglas, 2016) to emphasize written and oral communication skills through essays and presentations (see Willingham & Price, 2009). Researchers have revealed that community college students need VR to experience academic success (see Douglas, 2016).

VR increases through visual presentations (see Levine & Reves, 1990). Visual presentations are the nonspoken instructional information in a classroom (see Flevares & Perry, 2001). Visual presentations have an important role in education (see Flevares & Perry, 2001). Flevares and Perry (2001) found that teachers used visual presentations to remediate student confusion. Visual presentations increased VR in color compared to black and white (see Farley & Grant, 1976) in light of research suggesting that color cues guide attention (see Ansorge & Becker, 2014). A color cue is a stimulus that directs attention to a specific-colored location (see Ansorge & Becker, 2014). Visual presentations use color cues to distinguish figure and background (see Saarela & Landy, 2012). Red text, black text, and red and blue text are color cues considering that red text,

black text, and red and blue text guide attention to a specific location (see Ansorge & Becker, 2014; Snowden, 2002). Gegenfurtner and Rieger (2000) found that visual presentations in color increase encoding, increase the speed of recognition, and add another cue for retrieval. Visual presentations have an effect on VR.

Students often prefer to learn vocabulary through visual presentations (see Levine & Reves, 1990). According to Levine and Reves (1990), VR is higher for visual presentations compared to auditory presentations. Nemati (2009) stated that students prefer visual presentations compared to auditory presentations, suggesting that visual images increase long-term retention. These studies showed that students have a preference for learning VR through visual presentations.

According to Farley and Grant (1976) the colors red, black, and red and blue increase long-term retention of study material. Farley and Grant found that color increased long-term retention of nursing study materials. Stitt and Pula (2013) stated that color increased VR. Hanna and Remington (1996) found that color is stored in long-term memory, color increases accuracy for recognition memory, and that color and form have separate encodings. This research showed that color affects memory and retention.

Colors increase visual memory in natural scenes (see Spence et al., 2006). Spence et al. (2006) found that color assists visual recognition and memory in natural scenes. Wichmann et al. (2002) found that color improves recognition memory in natural scenes by 8% compared to black and white images. According to Wichmann et al., prior knowledge of the natural scene and color increases recognition memory. Wichmann et al.

also stated that color increases attention and improved recognition memory. Thus, this research showed that color improved visual and recognition memory.

Color produced mixed results on test scores (see Sinclair et al., 1998; Skinner, 2004; Tal et al., 2008). Sinclair et al. (1998) found that red exams decrease test scores and blue exams increase test scores. Tal et al. (2008) found that blue exams decrease test scores. Skinner (2004) found that red printed paper increased test scores compared to blue printed paper. These data reveal that red and blue exams have different effects on test scores.

Color Red

The color red influences emotions in advertisements, marketing, and business (see Labrecque & Milne, 2010). According to Labrecque and Milne (2010), the color red is associated with excitement in advertisements, marketing, and business. Hemphill (1996) found that the color red is associated with positive responses and excitement. Kuhbandner et al. (2015) also found that the color red increases memory. According to Bellizzi et al. (1983), people moved closer to the color red. The color red increases excitement and the color red is associated with new, exciting and “up-to-date” emotions (p. 38). Gruber (2018) found that the color red did not affect the fear of failure. It is equally important to note that Kaspar et al. (2017) found the color red increased approach motivation towards new coverage. This research showed that there are different responses to the color red.

The color red is preferred among infants (see Maier et al., 2009). Maier et al. (2009) also found that the color red is preferred in a “hospitable” context and is not

preferred in a “hostile” context (see Maier et al., 2009, p. 737). Franklin et al. (2012) found that infants have a preference for the color red. Franklin et al. also found that the preference for the color red was not context-specific. This datum shows that infants have a preference for the color red.

The color red increases creativity and the expectation of success (see Rook, 2014) and is remembered better than yellow, blue, and green (see Kuhbandner et al., 2015). Rook (2014) found that the color red increases creativity and the expectation of success. This research reveals that the color red increases cognitive processes.

Behavioral Effects of the Color Red

The color red has different behavioral effects (see Elliot et al., 2011; Gnambs et al., 2015b; Kuniecki et al., 2015; Stone & English, 1998). Stone and English (1998) found that participants preferred the color red for monotonous, low demand tasks. Similarly, Gnambs et al. (2015b) found that the color red decreases risk behavior in an online setting. According to Shi and Huang (2017), the color red decreases time perception compared to the color blue. Elliot et al. (2011) found that the color red reduces heart rate and test scores. Kuniecki et al. (2015) also found that the color red captures attention, increases quick and precise responses, and connects features to the emotions of an image. Berthold et al. (2017) stated that the color red increases the perception of self-attractiveness. This research shows that the effects of the color red on behavior are situational (see Berthold et al., 2017; Gnambs et al., 2015b; Kuniecki et al., 2015; Stone & English, 1998).

Color Black

The color black has different meanings (see Grobelny & Michalski, 2015; He, 2011; Labrecque & Milne, 2010). According to He (2011), the color black represents sadness, darkness, and mystery. The color black also represents elegance, dignity, and power (see Grobelny & Michalski, 2015; Labrecque & Milne, 2010). Hall and Hanna (2003) found that black text does not increase retention of study materials; however, black text is rated the highest for readability (see Hall & Hanna, 2003). Ramadan (2011) found that black text increases comprehension among college students who read e-books in Arabic. Uccula et al. (2014) suggested that black ink is ordinary in books. The various meanings of the color black caused different educational outcomes (see Grobelny & Michalski, 2015; Hall & Hanna, 2003; He, 2011; Labrecque & Milne, 2010; Ramadan, 2011).

Behavioral Effects of the Color Black

Past research reveals that the color black has behavioral effects (see Frank & Gilovich, 1988; Ramadan, 2011; Valdez & Mehrabian, 1994). Valdez and Mehrabian (1994) found that the color black increases dominance and decreases pleasant feelings compared to white and grey. Frank and Gilovich (1988) found that black outfits increased dominance and aggression compared to nonblack outfits. Ramadan (2011) found that black text increased comprehension. The behavioral color effects of the color black changed the psychological outcome of past studies (see Frank & Gilovich, 1988; Ramadan, 2011; Valdez & Mehrabian, 1994).

Color Blue

The color blue has different meanings (see Labrecque & Milne, 2010; Steinhardt, 1997). According to Steinhardt (1997), the color blue is passive, quiet, and slow. The color blue represents intelligence, logic, competence, and trust (see Labrecque & Milne, 2010). The Remote Associates Test (RAT), is a test that measures creativity (see Lee et al., 2014). Mehta and Zhu (2009) found that the color blue increases creativity on the RAT. Beaven and Ekstrom (2013) also found that blue colored light increases alertness. Noiwan and Norcio (2006) stated that blue banners increase the retention of words; however, blue banners also cause distractions in the search for words (see Noiwan & Norcio, 2006). The situational meanings of the color blue produced different responses (see Labrecque & Milne, 2010; Mehta & Zhu, 2009; Noiwan & Norcio, 2006; Steinhardt, 1997).

Behavioral Effects of the Color Blue

The color blue affected behavior (see Beaven & Ekstrom, 2013; Mehta & Zhu, 2009; Noiwan & Norcio, 2006; Stone, 2001; Stone, 2003). Stone (2001) found that blue rooms increased positive mood compared to red rooms in an open plan study environment. Mehta and Zhu (2009) found that the color blue increases creativity. Beaven and Ekstrom (2013) also found that blue colored light increases alertness. According to Stone (2003), blue rooms increase errors in low demand tasks compared to red rooms. Noiwan and Norcio (2006) stated that blue banners increase the retention of words. Gruber (2018) found that the color blue decreased the fear of failure. Past research

showed that the color blue caused an increase in behavioral effects (see Beaven & Ekstrom, 2013; Mehta & Zhu, 2009; Noiwan & Norcio, 2006; Stone, 2001; Stone, 2003).

Colors Red and Blue

Red and blue color combinations have different color effects than blue color effects and red color effects (see Mehta & Zhu, 2009; Woods & Rourke, 2004). Red and blue color combinations have different color effects on motivation (see Mehta & Zhu, 2009). Color effects change their behavioral and psychological function when they interact with other colors (see Elliot et al., 2007). Noiwan and Norcio (2006) noted that color combinations which lack interest and appeal decrease attention and increase errors and search time. Khouw (2002) found that red and blue colors create distraction and confusion. Red and blue color combinations have different effects on motivation in light of research which stated that attention, error, and search times change when interest and appeal are removed from color combinations (see Elliot et al., 2007; Mehta & Zhu, 2009; Noiwan & Norcio, 2006).

The color blue broadens attention and the color red narrows attention (see Friedman & Forster, 2010). The color blue decreases concerns for errors and the color red increases concerns for errors (see Mehta & Zhu, 2009). The color blue increases confidence and trust (see Labrecque & Milne, 2010; Recours & Briki, 2015) and the color red increases worry and anxiety (see Elliot et al., 2007; Elliot & McGregor, 1999). The color blue increases creativity and the color red increases performance on detailed-oriented tasks (see Mehta & Zhu, 2009). According to Franklin et al. (2012), red and blue are preferred colors; however, females were less likely to prefer blue colors compared to

males (see Ellis & Ficek, 2001). There is a difference in the color effects of red and blue (see Elliot et al., 2007; Elliot & McGregor, 1999; Friedman & Forster, 2010; Labrecque & Milne, 2010; Mehta & Zhu, 2009; Recours & Briki, 2015).

Attention

Attention influences FIT (see Treisman, 2006; Treisman & Gelade, 1980; Tsal & Lavie, 1988). Tsal and Lavie (1988) suggested that attention is processed information that highlights a specific location. FIT stated that color features guide attention to relevant and irrelevant information during the pre-attentive stage (see Treisman, 2006). FIT also stated that attention binds features' together to create objects (see Treisman & Gelade, 1980). FIT uses attention in the pre-attentive and the attentive stage (see Treisman, 2006; Treisman & Gelade, 1980).

Attention influences AM and VR (see Ahmadvand & Nejadansari, 2014; Roskes et al., 2014). Roskes et al. (2014) suggested that AM causes attention to negative information. Moreover, Ahmadvand and Nejadansari (2014) stated that attention to word form and the meaning of a word increases VR. Thus, this research reveals that attention directed AM and increased VR (see Ahmadvand & Nejadansari, 2014; Roskes et al., 2014).

Color influences attention (see Kuniecki et al., 2015; Wichmann et al., 2002). Pan (2010) found that color has a stronger effect on attention than the shape of a word. Wichmann et al. (2002) also found that color increases attention. Kuniecki et al. (2015) found that the color red increases attention to red in an emotional context. Friedman and Forster (2010) stated that attention is narrowed with the color red and broadened with the

color blue. According to Treisman and Gelade (1980), attention can be narrowed to focus on specific features or broadened to focus attention on a group of features. Cole et al. (2014) found that narrowed attention increases the focus on goal attainment. Color influenced and directed attention (see Friedman & Forster, 2010; Kuniecki et al., 2015; Wichmann et al., 2002).

Attention improves performance (see Galletti et al., 2010). Attention increases accuracy and decreases the number of available responses (see Prinzmetal et al., 1998). Jost et al. (2005) stated that attention identifies relevant information to be processed. Jost et al. also noted that attention increases encoding. According to Prinzmetal et al. (1986), attention determined the amount of information that was learned. Prinzmetal et al. also suggested that attention influences feature integration, considering that attention assists with binding features together. Past research showed that attention supported psychological processes and improved performance (see Galletti et al., 2010; Jost et al., 2005; Prinzmetal et al., 1986).

Summary

This research addressed the gap in the literature concerning VR and color effect differences among DCC students. FIT stated that color features direct attention to relevant information during the pre-attentive stage (see Treisman, 2006). FIT also stated that attention binds features' together during the attentive stage (see Treisman & Gelade, 1980). The color red triggers AM (see Elliot et al., 2007). Roskes et al. (2014) found that AM causes negative classroom effects. Elliot and Harackiewicz (1996) also found that AM decreases intrinsic motivation. Elliot et al. (2007) stated that the color red triggers

AM. Douglas (2016) reported that VR was needed for college academic success. Levine and Reves (1990) found that VR increased through visual presentations. Levine and Reves also found that students prefer to learn vocabulary through visual presentations. According to Spence et al. (2006), colors increase visual memory in natural scenes; however, color produced mixed results on test scores (see Sinclair et al., 1998; Skinner, 2004; Tal et al., 2008). Elliot et al. found that the color red decreased test scores. Mehta and Zhu (2009) also found that blue increases creativity. Hall and Hanna (2003) noted that black text increases readability. Mehta and Zhu also found that the colors blue and red have different color effects considering that the colors blue and red have different effects on motivation. According to Elliot et al., color effects change their behavioral and psychological function when they interact with other colors. This research addressed the gap in the literature concerning VR and color effect differences among DCC students. Chapter 3 includes an explanation of the methodology.

Chapter 3: Research Method

Introduction

The problem that I addressed in this study was the gap in the literature between VR and color effect differences among DCC students. I used a quantitative approach in this study when I determined the problem that I wanted to understand (see Creswell, 2003). Additionally, I formed the design, collection method, and analysis of this study after I created the research question that I wanted to answer (see Huberty & Morris, 1989). Finally, I used the posttest VKS to examine if there was an influence between VR and color effect differences among DCC students (see Ardasheva & Tretter, 2017; Bruton, 2009; Huberty & Morris, 1989; Laufer & Goldstein, 2004). In short, I used the problem, research question, and posttest VKS in this study to address the gap in the literature between VR and color effect differences among DCC students.

The one-way ANOVA and post-hoc Tukey's HSD tests were included in this study. I used the one-way ANOVA (see Eberly & Telke, 2011) and post-hoc Tukey HSD tests in this study under the assumption that the results would show that significant differences existed (see Ruxton & Beauchamp, 2008; Saville, 1990). I used the one-way ANOVA in this study to compare the mean differences of groups (see Eberly & Telke, 2011). I also used the post-hoc Tukey HSD tests because the post-hoc Tukey HSD tests are the most preferred post-hoc method for the one-way ANOVA, the tests make all pairwise comparisons, and they also adequately control for Type 1 error (see Kim, 2015). I decided that if the findings of the one-way ANOVA for the VKS indicated significant differences, then I would use the post-hoc Tukey HSD tests (see Ruxton & Beauchamp,

2008; Saville, 1990) to determine where the statistically significant differences are within the groups (red text, black text, red and blue text). I was able to use the post-hoc Tukey HSD tests (see Ruxton & Beauchamp, 2008; Saville, 1990) because the results of the one-way ANOVA showed that significant differences existed.

Additionally, I examined DCC students in this study. I determined the population that I wanted to examine (DCC students) through the problem and research question (see Creswell, 2003; Farrokhi & Mahmoudi-Hamidabadd, 2012; Huberty & Morris, 1989) that I created. The population that I examined consisted of DCC students enrolled in a developmental reading program (see Scrivener & Coghlan, 2011). In this study, a convenience sample (see Farrokhi & Mahmoudi-Hamidabadd, 2012) was used to save on time and money (see Etikan et al., 2016). The sample size had a minimal of 42 students based on the a priori power analysis for a one-way ANOVA, which was determined with an effect size of 0.50 and power at 0.80 (see Cohen, 1988; Eberly & Telke, 2011; Erdfelder et al., 1996). The minimal sample size of 42 students in this study represented DCC students who were enrolled in a developmental reading program (see Erdfelder et al., 1996; Farrokhi & Mahmoudi-Hamidabadd, 2012; Scrivener & Coghlan, 2011). The major sections in Chapter 3 are the research approach (see Field, 2006; Wesche & Paribakht, 1996), design approach, setting, sample, treatment, instrumentation, materials (see Huberty & Morris, 1989), reliability (see Wesche & Paribakht, 1996), validity (see Field, 2006; Wesche & Paribakht, 1996), threats to validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013), and ethical procedures (see Creswell, 2003; Mandal & Parija, 2014).

Research Design and Approach

The problem that I addressed in this quantitative research was the gap in the literature concerning VR and color effect differences among DCC students. My problem statement determined the approach (see Field, 2006; Wesche & Paribakht, 1996) of this study. The research question that I used determined the design, collection, and analysis (see Huberty & Morris, 1989) of this study. This study was completed in 5 weeks. I used the first 2 weeks of this study to recruit participants, instructors, and to consider threats to testing validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013). I used the following 3 weeks of this study to collect data that compared color effect differences and VR among DCC students. The results of this study showed that there was a difference between the two variables (color effects and test scores).

The one-way ANOVA and post-hoc Tukey HSD tests were included in this study to examine the variables (color effects and test scores). I used the one-way ANOVA (see Eberly & Telke, 2011) and post-hoc Tukey HSD tests in this study under the assumption that the one-way ANOVA would show that significant differences existed (see Ruxton & Beauchamp, 2008; Saville, 1990). The one-way ANOVA showed that there were differences between text color. The data from this study were evaluated using SPSS (Version 27) to perform the one-way ANOVA and post-hoc Tukey HSD tests. The values for colored text (red text, black text, red and blue text) and VR mean differences (coded 1, 2, and 3) for the posttest VKS in this study were entered into SPSS (Version 27). I analyzed the results of this study with a post-hoc Tukey HSD tests under the assumption that the results of the one-way ANOVA would show that significant differences existed

(see Eberly & Telke, 2011; Saville, 1990). The results of the post-hoc Tukey HSD tests showed where the significant difference lie.

Additionally, I chose to incorporate academic vocabulary words in this study. I used 24 academic vocabulary words taken from the official College Board ACT/SAT list to examine VR and measure the change in vocabulary (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004) considering that the participants were DCC students. The participants who partook in this study were taught eight vocabulary words per week for 3 weeks based on Miller (1956), who stated that the capacity for memory is seven plus or minus two. The eight academic vocabulary words were used intentionally because they fell in between Miller's seven plus or minus two. I used the first 2 weeks of this study to recruit participants and instructors and to consider threats to testing validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013). Next, I used the following 3 weeks of this study to collect data that compared color effect differences on VR among DCC students. The results of this study showed that there was a difference between color effect and VR among DCC students.

The instructional method that was taught to the participants in this study was the keyword method (see Rodriquez & Sadoski, 2000). The keyword method is a vocabulary instructional strategy in which a keyword is chosen to remember the definition of a vocabulary word (see Rodriquez & Sadoski, 2000). Rodriquez and Sadoski (2000) found that the keyword method was beneficial to students with low vocabulary knowledge. I used the vocabulary posttests (VKS) in this study to measure vocabulary knowledge (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004).

This study was intentionally conducted 30 minutes prior to the participants' weekly developmental reading class (Weeks 3-5). I chose to conduct this study 30 minutes prior to the developmental reading class so that it did not interfere with daily weekly instruction. The instructors in this study used the first 15 minutes of each weekly class (Weeks 3-5) to teach eight academic vocabulary words using the keyword method. Next, the instructors in this study used the second 15 minutes of each weekly class (Weeks 3-5) to administer the VKS. At the end of this study, I analyzed the results to examine posttest VR and measured if there was a change in VR (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004). The last day of this study was used for questions, answers, and an overall summary of the study (see Ramjan et al., 2016).

A debriefing form was used in this study. I made sure that each participant received an electronic debriefing form (see Ramjan et al., 2016) 1 week after this study was completed. In the debriefing form, I included the hypothesis, results, a phone number to call if any participant had questions, and a reference for more information on the topic. In short, I used the debriefing form as a tool for teaching and learning in this study.

I had one experiment in this study. The intent in this experiment was to determine if there were group interactions between colored text and VR. I used a one-way ANOVA for the between-subjects design, and I used the mean differences of the posttest VR scores to measure the VKS. I used these measures (VR and VKS) over 3 weeks as the interval-ratio dependent variable. Red text, black text, and red and blue text were the nominal independent variable in this study. There was no carryover effect in this study because I used a between-subjects design. The posttest VKS was the test that I used to

measure VR. The VKS was administered as a posttest and used to measure vocabulary scores through a composite score of the mean differences within the groups (red text, black text, and red and blue text). I used these scores to measure the difference between text color and test scores.

Moreover, I used text color in this study to examine VR. Red text was used for vocabulary words and synonyms in this study considering that the color red increased arousal (see Labrecque & Milne, 2010) and decreased test scores (see Elliot et al., 2007). Black text was used for vocabulary words and synonyms in this study in light of research that suggested that the color black increased readability (see Hall & Hanna, 2003) and comprehension (see Ramadan, 2011) and the fact that black ink is common in books (see Uccula et al., 2014). Red text was used for vocabulary words, and blue text was used for synonyms in this study considering that blue increased creativity, the color red increased attention to detail, and colors changed their behavioral and psychological function when they interacted with other colors (see Elliot et al., 2007; Mehta & Zhu, 2009).

I used the one-way ANOVA in this study because the one-way ANOVA examined multiple comparisons (see Eberly & Telke, 2011). The assumption of homogeneity of variance was tested with Levene's Test for Homogeneity of variance in this study. If I had found that the assumption of homogeneity of variance (heteroscedasticity) was violated in this study, then I would have used the Brown and Forsythe's Test to correct the violation (see Brown & Forsythe, 1974; Gastwirth et al., 2009). I also tested the assumption of normality with Kolmogorov-Smirnov tests in this study (see Lilliefors, 1967). If the assumption of normality had been violated in this

study, then I would have used the Kruskal-Wallis Test to analyze these data (see Van Hecke, 2010). The post-hoc Tukey HSD tests were used to determine where the statistically significant differences are within the groups (red text, black text, red and blue text) assuming that the results of the one-way ANOVA showed that significant differences exist (see Eberly & Telke, 2011). The assumptions for the post-hoc Tukey HSD tests are that the groups (red text, black text, red and blue text) are independent, the groups are normally distributed, and that there is heteroscedasticity among groups (see Jaccard et al., 1984). If there had been unequal groups with the sample, then I would have used the Tukey-Kramer method (see Ruxton & Beauchamp, 2008) in this study. In the end, I used the one-way ANOVA and post-hoc Tukey for this study.

I considered the effect size as I developed the research design of this study. I ran an a priori power analysis before I conducted this study. The a priori power analysis indicated that 42 participants for a one-way ANOVA would be an adequate sample to obtain power greater than 0.80 with an effect size equivalent to 0.50 for Experiment 1 (see Cohen, 1988; Eberly & Telke, 2011). The effect size for the a priori power analysis for this experiment was based on prior research, research design, and standardized settings (see Cohen, 1988; Gnambs et al., 2010; Van Voorhis & Morgan, 2007). Cohen (1988) stated that a small effect size was 0.20, a medium effect size was 0.50, and a large effect size was 0.80. Mehta and Zhu (2009) found a large effect size for response times of avoidance related anagrams in the red condition (Cohen's $d = 0.96$). Mehta and Zhu also found a large effect size for the activation of AM (Cohn's $d = 1.05$). Gnambs et al. (2010) found that the color red had a nontrivial effect on academic performance when effect size

ranged from small to medium. Rosnow and Rosenthal (1989) stated that context determined the difference between trivial and nontrivial effects. Van Voorhis and Morgan (2007) noted that financial costs, time, and access to sample influenced the size of the sample. Based on Cohen's (1988) prior research (as cited in Gnambs et al., 2010), financial cost, time, and access to samples (see Van Voorhis & Morgan, 2007), this experiment used a minimal of 48 participants (3 groups/16 participants) for the one-way ANOVA (see Eberly & Telke, 2011). As a result, the effect size was accounted for in this study.

Setting and Sample

The population that I used in this study was made up of DCC students who were enrolled in a developmental reading program (see Scrivener & Coghlan, 2011). Based on prior research, the community college that I used in this study is located in Northeastern United States and was made up of 9,203 students. Additionally, I found from prior research (see Scrivener & Coghlan, 2011) that full-time students typically make up 65% of the population, and part-time students make up 35% of the population. Finally, I found that the ratio of female to male students in this study was 6:4. Past researchers have also suggested that minority students in this study would make up 88% of the population. The age of the students in this study ranged from 18 to 55. The population in this community college reflected the diversity number of an average Northeastern United States community college based on prior research. As a result, the population that I used (DCC students) represented part of the community college population.

DCC students were used in this study. These students (DCC) have been identified in the literature as students who are in need of improvement in reading proficiency to advance to a college-level (see Beck et al., 1982; Douglas, 2016; Graff, 2009; Joshi, 2005; Scrivener & Coghlan, 2011). Additionally, these participants who ranged between 18 and 55 in age were recruited from a local community college. The developmental reading program in this study was made up of four levels. The four levels in the developmental reading program used in this study ranged from 070 to 073. I examined participants in 072 and 073 developmental reading courses. The DCC students in this study were placed in the developmental reading course based on standardized test scores from the community college. I sent out emails and met with instructors over the phone in this study. The instructors in this study taught DCC classes at a local community college in Northeastern United States. The instructors sent out recruitment information to the students who were involved in this study. The participants were informed that their participation was solely voluntary and that negative consequences would not be applied for opting out of this study. Additionally, participants were told that they could withdraw from the study at any time they so choose. I recruited nine to 16 students in each class for this study. The participants were sent debriefing forms after I collected the data.

I used a convenience sample in this study (see Farrokhi & Mahmoudi-Hamidabadd, 2012). A convenience sample is a nonrandom sample that uses criteria to select the target population (see Farrokhi & Mahmoudi-Hamidabadd, 2012). Etikan et al. (2016) suggested that a convenience sample also describes the participants who did not meet the criteria for a study. Creswell (2003) stated that in past research, convenience

samples allowed participants to volunteer for a study. Etikan et al. noted that a convenience sample saved time and money. Convenience samples (see Etikan et al., 2016) were used in this study to save time and money and to allow students to volunteer.

The instructors, participants, groups, and sample size in this study were selected based on the criteria of this study. The instructors in this study were selected based on their experience (see Farrokhi & Mahmoudi-Hamidabadd, 2012). The instructors had at least 3 years of experience at the community college-level in this study. The participants in this study were selected based on their level of education (see Farrokhi & Mahmoudi-Hamidabadd, 2012). The participants in this study were DCC students who were enrolled in a developmental reading course. The participants in this study were placed into groups. The groups in this study were determined based on color treatment (see Farrokhi & Mahmoudi-Hamidabadd, 2012). The participants in this study were grouped into three sections. The three sections in this study were Groups 1, 2, and 3. The three treatment groups in this study were expected to show differences based on past color research (see Hall & Hanna, 2003; Mehta & Zhu, 2009). The sample sizes for this study were selected based on a priori power analyses (see Erdfelder et al., 1996; Farrokhi & Mahmoudi-Hamidabadd, 2012). The sample sizes for this study were determined with power analyses for this experiment (see Erdfelder et al., 1996). The power analyses in this study accounted for 5% error, 95% confidence levels, and 0.50 effect size (see Erdfelder et al., 1996). The power analyses for this study determined that a minimal of 42 participants were needed for this experiment (see Erdfelder et al., 1996).

Treatment

The treatment variable in this study was color. Creswell (2003) stated that in an experiment one variable needs to be dedicated as the treatment. Red text, black text, and red and blue text was used as the treatment variables (see Creswell, 2003) in this study. Red text was used in this study based on research, which stated that the color red increased arousal (see Labrecque & Milne, 2010) and decreased test scores (see Elliot et al., 2007). The color red decreased test scores (see Elliot et al., 2007); however, the color red had no effect on test scores for females after multiple exposures (see Gnambs et al., 2010). Black text was used in this study based on research which suggested that black text increased readability (see Hall & Hanna, 2003) and comprehension (see Ramadan, 2011) in addition to the common use of black ink in books (see Uccula et al., 2014). Red and blue text was used in this study based on research which suggested that the color blue increased creativity, the color red increased attention to detail (see Mehta & Zhu, 2009) and colors changed their behavioral and psychological function when they interacted with other colors (see Elliot et al., 2007). Red text, black text, and red and blue text have different color effects on educational outcomes (see Elliot et al., 2007; Hall & Hanna, 2003; Labrecque & Milne, 2010; Mehta & Zhu, 2009; Ramadan, 2011).

Instrumentation and Materials

The instrument used in this study was the VKS (see Ardasheva & Tretter, 2017; Bruton, 2009; Kramer & Yoon, 2007). The VKS is reliable, considering that the reliability coefficient for the test-retest of content words was 0.89 and the reliability coefficient for the test-retest of connective words was 0.82 (see Wesche & Paribakht,

1996). These reliability coefficients, 0.89 for content words and 0.82 for connective words (see Wesche & Paribakht, 1996), are acceptable values for test-retest reliability considering that these test-retest reliability values are greater than 0.75 (see Broglio et al., 2007; Randolph et al., 2005). According to Koo and Li (2016), reliability coefficients between 0.50 and 0.75 are considered moderate values. The VKS was used to measure post-test vocabulary scores (see Bruton, 2009; Wesche & Paribakht, 1996). The vocabulary tests were used to measure VR (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004). The instrument that was used in this study measured VR (see Ardasheva & Tretter, 2017; Bruton, 2009; Kramer & Yoon, 2007; Laufer & Goldstein, 2004).

The VKS in this study was used to measure post-test vocabulary scores of VR (see Bruton, 2009). The VKS is reliable and valid considering that the reliability coefficient for the test-retest reliability of content words was 0.89, the reliability coefficient for the test-retest of connective words was 0.82 and the pilot study showed gains in one semester (see Wesche & Paribakht, 1996). These reliability coefficient values are acceptable for test-retest reliability, considering that these test-retest reliability coefficient values are greater than 0.75 (see Broglio et al., 2007; Randolph et al., 2005). The post-test VKS in this study was graded on a scale of one to five (see Stahl & Bravo, 2010). A score of 1 in this study was assigned when the word was not recognized (see Wesche & Paribakht, 1996). A score of 2 in this study was assigned when the word was recognized, but the meaning was unknown (see Wesche & Paribakht, 1996). A score of 3 in this study was assigned when the participant attempted to define the word (see Wesche

& Paribakht, 1996). A score of 4 in this study was assigned when the definition was known (see Wesche & Paribakht, 1996). A score of 5 in this study was assigned when the definition was used in a sentence (see Wesche & Paribakht, 1996). The scores in this study were tallied and ranked against other scores with a data chart (see Wesche & Paribakht, 1996). The results of the post-test VKS in this study measured vocabulary for VR (see Bruton, 2009). The composite scores for each group (red text, black text, red and blue text) were used to measure post-test vocabulary scores for VR in this study. The composite scores for the post-test VKS in this study included the mean scores and the standard deviation of each group (red text, black text, red and blue text).

The VKS post-tests in this study was also used to measure VR (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004). The vocabulary post-test in this study was administered each week (see Ardasheva & Tretter, 2017). Ardasheva and Tretter (2017) found that vocabulary increased when vocabulary tests were administered each week. The vocabulary post-tests in this study measured VR (see Laufer & Goldstein, 2004). Laufer and Goldstein (2004) stated that vocabulary tests administered each week determined vocabulary gains. The vocabulary post-tests in this study were administered weekly for three weeks and used to measure VR (see Ardasheva & Tretter, 2017; Laufer & Goldstein, 2004). The first two weeks of this study was used to recruit participants and instructors, and to consider threats to testing validity (see Dimitrov & Rumrill, 2003; Liu et al., 2013). The following three weeks of this study was used to collect data that compared color effect differences on VR among DCC students. The composite scores for the VKS post-tests in this study were used to measure VR scores. The composite scores

for the vocabulary post-tests in this study were achieved with the mean scores and the standard deviation of the weekly vocabulary post-tests.

The vocabulary post-tests were administered in a multiple choice (MC) format (see Hoshino, 2013) in this study. Hoshino (2013) stated that the MC format is a common method of assessment in light of research, which suggested that the MC format is easy to grade and decreased inter and intra-rater reliability. The MC format were five answer choices (see Vegada et al., & Desai, 2016) in this study. Vegada et al. (2016) found that five answer choices for the MC format increased student performance and decreased selection time for answer choices. The vocabulary post-tests were administered in MC format with five answer choices (see Hoshino, 2013; Vegada et al., 2016) in this study.

The participants in this study were instructed to mark one of the answer choices. The results were weighted and analyzed using a 5-point Likert Scale (see Vegada et al., 2016) in this study. A score of 1 in this study was assigned when the word was not recognized (see Wesche & Paribakht, 1996). A score of 2 was assigned when the word was recognized, but the meaning was unknown (see Wesche & Paribakht, 1996). A score of 3 was assigned when the participant attempted to define the word (see Wesche & Paribakht, 1996). A score of 4 was assigned when the definition was known (see Wesche & Paribakht, 1996). A score of 5 was assigned when the definition was used in a sentence (see Wesche & Paribakht, 1996). The results of this study were scored and analyzed. The effects of red text, black text, and red and blue text on VR were measured with a one-way ANOVA and post-hoc Tukey HSD tests, assuming that the results of the one-way

ANOVA showed that significant differences exist (see Eberly & Telke, 2011; Saville, 1990).

Reliability

An instrument used in research must be considered reliable (see Creswell, 2003). This study used the VKS which is a reliable instrument (see Wesche & Paribakht, 1996). Wesche and Paribakht (1996) found that the VKS is reliable, considering that the reliability coefficient for the test-retest correlation of content words was 0.89. Wesche and Paribakht (1996) also found that the VKS is reliable, considering that the test-retest correlation for connective words was 0.82. Stewart et al. (2012) found that the VKS is reliable, considering the results from the Rasch partial credit model. These values are acceptable for test-retest reliability, considering that the test-retest reliability value is greater than 0.75 (see Broglio et al., 2007; Elliot et al., 2007; Randolph et al., 2005). The reliability of the VKS was checked against the data collected in this study after the Institutional Review Board (IRB) approved the collection and analysis of data Walden University IRB for this study (Approval Number: 03-17-21-0115463) and the approval from the participating college's IRB (Approval Number: 2020-003).

Validity

An instrument used in research must be considered valid (see Creswell, 2003). The VKS, which was used in this study, is a valid instrument (see Field, 2006; Wesche & Paribakht, 1996). Wesche and Paribakht (1996) found that the VKS was valid when the pilot study showed gains in a one-semester study with 38 students. The validity of the VKS was checked against the data collected in this study after Walden IRB approved

collection and analysis of data (Approval Number: 03-17-21-0115463) and the approval from the participating college's IRB was also gained (Approval Number: 2020-003).

Threats to Validity

A researcher must consider threats to validity when conducting research (see Christ, 2007). Threats to validity were considered in this study, in light of research, which suggested that confounding effects influence the outcome (see Dimitrov & Rumrill, 2003; Liu et al., 2013). Maturation was considered (see Christ, 2007), considering that this study contained a between-subject design which applies the same influence to all results and accounts for the percentage of error. History was considered (see Christ, 2007), considering that this study was conducted at the same time during each class. Testing was considered (see Christ, 2007), considering that this study used two weeks of instruction before this research was conducted.

Ethical Procedures

Ethical procedures are an important aspect of research design (see Creswell, 2003). I used ethical procedures in this study to protect the identity of the school, participants and instructors (see Creswell, 2003; Mandal & Parija, 2014). I obtained informed consent from the school, participants and instructors (see Creswell, 2003; Mandal & Parija, 2014) in this study. The school, participants and instructors were informed about the nature (see Mandal & Parija, 2014) of this study. The informed consent letter was signed by the school, participants and instructors (see Mandal & Parija, 2014) in this study. The name of the school, participants and instructors were kept confidential (see Creswell, 2003) in this study. The participants and instructors in this

study were identified with a number. The test scores used a code to identify the number of each participant and instructor (see Creswell, 2003) in this study. The groups were assigned by letter (see Creswell, 2003) in this study. The letters used a code to identify each group (see Creswell, 2003) in this study. Each participant received an electronic debriefing form (see Ramjan et al., 2016) after this study was completed. The debriefing form included the hypothesis, the results of the participants in each condition, the expected results of the study, a phone number to call if the participants had questions pertaining to the results of the study and a reference for more information on the topic (see Ramjan et al., 2016). The debriefing form was used as a tool for learning and teaching (see Tannenbaum & Cerasoli, 2013). The identity of the school, participants, instructors, groups and test scores will be kept in a locked cabinet for 7 years (see Creswell, 2003) in this study. The data will be shredded after 7 years (see Bergren & Murphy, 2005) in this study.

Summary

I addressed the gap in the literature concerning VR and color effect differences among DCC students. The problem determined the approach (see Creswell, 2003) of this study and the research questions determined the design, collection and analysis (see Huberty & Morris, 1989) of this study. I used the one-way ANOVA to compare mean color effect differences of VR scores among DCC students in this study (see Eberly & Telke, 2011). I also used the post-hoc Tukey HSD tests to determine where the significant differences were within the groups (red text, black text, red and blue text) and

if the one-way ANOVA for the VR scores showed a significant difference in this study (see Ruxton & Beauchamp, 2008; Saville, 1990).

This study had one experiment. This experiment examined if text color affected VR group interactions (red text, black text, red and blue text) with a one-way ANOVA and the Tukey HSD tests assuming that the results of the one-way ANOVA showed that significant differences exist (see Eberly & Telke, 2011; Saville, 1990).

The VKS is reliable and valid considering that the test-retest correlation of content words was 0.89, the test-retest correlation of connective words was 0.82, and the pilot study for the VKS showed gains in a one-semester study with 38 students (see Wesche & Paribakht, 1996). The reliability and validity were checked against the collected data after Walden IRB approved the collection and analysis of data (Approval Number: 03-17-21-0115463), and the participating college's IRB approved the collection and analysis of data (Approval Number: 2020-003). Threats to validity were considered (see Dimitrov & Rumrill, 2003; Liu et al., 2013) considering that this study used two weeks of instruction before this research was conducted, this study had a between-subject design so the influence would be applied to all results and accounted in the percentage of error, and this study was conducted at the same time during each class (see Christ, 2007).

This study used ethical procedures to protect the identity of the school, participants and instructors (see Creswell, 2003). Informed consent letters were signed by the participants, school and instructors (see Mandal & Parija, 2014) in this study. The identity of the participants and instructors were kept confidential (see Creswell, 2003). The identity of the school, participants, instructors, groups and test scores were kept in a

locked cabinet (see Creswell, 2003), and the data will be shredded after seven years (see Bergren & Murphy, 2005) in this study. Chapter 4 includes an analysis of the data.

Chapter 4: Results

Introduction

The purpose of this quantitative research was to investigate VR and color effect differences. My initial research question was developed to examine if red text, black text, and red and blue text color combinations had an effect on VR of DCC students. Next, I used the hypothesis in my study to determine if there was a statistically mean group difference for posttest VR among red text, black text, and red and blue text color combinations. Finally, I used the one-way ANOVA to test the following null hypothesis versus the alternative hypothesis:

$H1_0$: There is no statistically significant mean group difference for posttest VR scores.

$H1_a$: There is a statistically significant mean group difference for posttest VR scores rates.

In this chapter, I will describe the data collection process, assumptions, and descriptive statistics. Here, I begin with my original purpose of the study and the adaptation of data collection due to COVID-19. Next, I will continue with the variation of the proposed data collection plan. Additionally, I will present the data collection plan followed by missing data and out of range values. I will also discuss the one-way ANOVA, post hoc Tukey HSD tests, and the results of the study. Once the methods have been presented, I will discuss the descriptive statistics of the study variables. I will then present my summary and explanation of the one-way ANOVA and post-hoc Tukey HSD tests results to present my findings (see Ruxton & Beauchamp, 2008; Saville, 1990). I

will also discuss the analysis of my research question, the one-way ANOVA, and the post-hoc Tukey HSD tests. Finally, I will discuss the results of my data analysis.

The original purpose of my study was to investigate VR and color effect differences among developmental female community college students; however, following feedback from the Walden IRB, the population of my study was expanded to include all DCC students. Thus, I had to change the original population of my study from developmental female community college students to DCC students regardless of gender. The overall goal of my study remained unchanged though the following results now reflect VR and color effect differences among DCC students. The change in my population from developmental female community college students to DCC students did not change the overall goal of my study because the focus of my study was to investigate color effect differences on learning vocabulary. In the end, the change in my population broadened the original population for my study.

The adapted research question, which included both male and female participants, ranged between the ages of 18 and 55. I developed this adapted research question to examine if red text, black text, and red and blue text color combinations had an effect on VR of DCC students. The revised research question and corresponding hypothesis that guided my research is as follows:

Research question: Are there group differences in posttest VR scores among DCC students who use red text, black text, and red and blue text?

$H1_0$: There is no statistically significant mean group difference for posttest VR scores.

$H1_a$: There is a statistically significant mean group difference for posttest VR scores rates.

Data Collection

Variation From Proposed Data Collection

The alternate data collection plan that I used for recruitment and data collection was through online emails and phone conversations. This recruitment plan first included reaching out by email and telephone to community college professors who were teaching developmental reading classes. I reached out to the community college instructors that were involved in my study so that I could discuss the nature of my study and to discuss confidentiality in research. After I explained to the instructors that their participation was voluntary and that this study was part of my doctoral dissertation requirement, I emailed the recruitment presentation and consent forms to the instructors who agreed to participate in the study, along with their willing students.

Next, I had the student recruitment process completed by the willing instructors in my study who taught DCC reading classes. The student participants in my study were first informed that their participation was voluntary, next, they (student participants) were informed that they could withdraw from my study at any time with no impact on their class grades, and finally my student participants were informed that their participation was part of a doctoral student's dissertation requirement. Additionally, I had the community college professors email the recruitment presentation and consent forms to the student participants who fit the criteria for my study in their developmental reading classes. This was the first part of the recruitment process.

The second part of the recruitment process involved gaining the student participants' consent. The students who were interested in being involved in my study sent an email along with the consent form stating that they were interested in participating in my study. Additionally, a list of the student participants who agreed to partake in the study was emailed to the instructor participants who were teaching developmental reading classes. Lastly, the instructor participants emailed the student participants a link for the vocabulary survey. I verified the participants' age and gender via access to the professors' campus portal. I also collected the data from the participants who fit the criteria for this study through SurveyMonkey. The second part of the recruitment process involved gaining informed consent from the student participants through the instructor participants.

I used SurveyMonkey and SPSS (Version 27) to protect my participants' information, collect and store my data, and finally to analyze my data. First, I used SurveyMonkey to protect my participants' information. The student participants' personal information, though not identifiable, was protected through the online survey tool, SurveyMonkey. Next, I collected and stored all of my data using a password-protected computer created by SurveyMonkey. Finally, I analyzed my data on a password-protected computer using SPSS (Version 27) only after the necessary precautions were taken in my study. These precautions were taken to protect all the parties involved in my study. I took all of these precautions to make sure that my study was ethical and that personal information was protected.

Data collection began only after I gained approval for this study from the Walden University IRB and the participating college's IRB. The recruitment process and data collection occurred over a 5-week period. I conducted data collection using SurveyMonkey from March 29 to May 5, 2020. The first 2 weeks of my study (Week 1 and Week 2) were used for recruitment. I sent an email with follow up information to the potential participants inviting them to partake in this study. The qualifying participants were then sent a link by their instructor in Weeks 3, 4 and 5. The participants were then instructed to log on to SurveyMonkey after they had completed their weekly assignments. The results were received through SurveyMonkey. The survey was kept secure and confidential for the protection of the participants.

The ages and gender of the participants were also kept confidential for the protection of the participants. The participants were administered the VKS over a 3-week period to assess group differences in VR scores among DCC students who used red text, black text, and red and blue text. I stored all data on a password-protected computer using SurveyMonkey. Further, I analyzed the password-protected data using SPSS (Version 27). The precautions used in this study were taken to protect all parties involved.

This study was conducted to examine if there was a difference between red text, black text, and red and blue text in VR among DCC students. In other words, I wanted to know if there was a difference in the outcome between color effects and VR. For this reason, I chose to examine mean group differences of posttest VR scores rather than including pretest VR scores because the outcome of these two variables (color effect and VR) was what I wanted to examine. After I gained consent from the instructors, I had the

instructors distribute the survey to their class to gain consent from the student participants. I used one class for the red text survey, another class for the black text survey, and the final class for the red and blue text survey.

Next, the participants who agreed to partake in my study were sent an online questionnaire by their developmental reading course instructors. The first page of the online questionnaire was the consent form, which contained general information about the nature of this study. The procedures outlined in the consent form informed the participants of their rights as potential participants and explained that the participants could choose to discontinue this study without repercussions from the researcher or the participating college. The participants were instructed to read the consent form and click "yes" if the participants agreed to the conditions of this study. If the participants clicked "no," then the participants were not allowed to move forward and their participation was concluded. If the participants consented to the conditions of this study, then they were moved to the second page of the consent form.

The second page of the consent form was used to ensure that the participants agreed to have their data processed. If the participants consented to have their data processed, they were instructed to click "yes" in order to proceed to the survey. If the participants did not consent to have their data processed, the participants were not allowed to move forward and their participation in this study was excluded. Although 88 participants agreed to partake in this study, only 87 participants completed the survey. The 87 participants that were directed to this survey signed the consent form and agreed to have their data processed. As a result, the 87 participants who completed this survey fit

the required criteria (enrolled in DCC reading courses and ranging from the age of 18-55).

Missing Data and Out of Range Values

I addressed the missing data in my study by using Little's Missing Completely at Random Test. Initially, the missing data were found to be 11.5% (10 participants between the ages of 18-24). However, 11.5% exceeded the maximum amount that Little (1988) proposed. This percentage (11.5%) would be considered a large amount of missing data, so the missing data were replaced in this study with the series mean using SPSS (Version 27). After I replaced the missing data, the missing data were found to be not significant ($p < .001$), which indicated randomness (see Garson, 2015). Additionally, I checked for the out-of-range values and outliers. The out-of-range values were checked using the minimum and maximum frequency values for SPSS (Version 27). There were no out-of-range values or outliers in this study.

Results

Descriptive Statistics of Study Variables

I analyzed the descriptive statistics of the variables in my study. The variables in this Spring 2020 online questionnaire, VKS included the text color that was used (red text, black text, and red and blue text) and the DCC reading test scores. All participants' meeting the criteria for this study were enrolled in one of two community college developmental reading courses as shown in Table 1.

Table 1

Number of Participants and Percentages

Measure	*N*	%
Red text	29	33.3%
Black text	29	33.3%
Red and blue text	29	33.3%
Total	87	99.9%

Note. The name (*n*) represents the number of participants in each group.

The participants' age within each group are presented in Table 2. The 36.36% participants who completed the red text survey ranged between the ages of 18 and 24. Another group, which represented 24.24% of the participants, ranged between the ages of 25 and 34. The other participants in this study included 27.27% ages 35 to 44. There were 6.06% participants who were between the ages of 45 and 54, 3.03% who were 55 years old, and finally, there were 3.03% participants who were missing from this study.

Participants who took the black text survey ranged between the ages of 18 and 55. The 32.14% participants who completed the black text survey were between the ages of 18 and 24. There were 39.29% participants who ranged between the ages of 25 and 34. The other participants included 17.86% ages 35 - 44, 7.14% ages 45 - 54, and 3.57% were 55 years old (see Table 2). There were no missing participants who completed the black study.

Finally, the 18 to 24 participants who took the red and blue text survey ranged between the ages of 18 and 55. There were 41.38% participants who ranged between the ages of 18 to 24. There were also 31.03% of the participants who ranged between the

ages of 25 to 34. The other participants included 13.79% 35 to 44, 6.9% 45 to 54, 3.45% who were 55 years old, and 3.45% participants who were missing, as shown in Table 2.

Table 2

Participant Demographics: Age

Age	Red text	Black text	Red and blue text
18-24	36.36%	32.14%	41.38%
25-34	24.24%	39.29%	31.03%
35-44	27.27%	17.86%	13.79%
45-54	6.06%	7.14%	6.90%
55	3.03%	3.57%	3.45%
Missing	3.03%	0.00%	3.45%
Total	99.99%	99.99%	100.00%

Note. Due to rounding errors, percentages may not equal 100%.

As noted in Table 3, I collected the participants' gender for demographical purposes in this study. There were 55.88% participants who were female and 44.12% who were male in the red text survey, 62.07% participants who were female and 37.93% male who completed the black survey, and 63.33% participants who were female and 36.67% male in the red and blue survey. I collected the data for demographical purposes of this study.

Table 3

Participant Demographics: Gender

Gender	Red text	Black text	Red and blue text
Male	44.12%	37.93%	36.67%
Female	55.88%	62.07%	63.33%
Total	100.00%	100.00%	100.00%

Evaluate Statistical Assumptions

Once the data from these 87 participants were collected, data were screened for missing data, assumption of homogeneity of variance, and normality of dependent variables. I then analyzed the data using SPSS (Version 27). Overall, the sample is moderately representative of the population because the data were collected from only one college in the Northeastern United States.

Moreover, Figures 1, 2, and 3 show through the Q-Q plot that the assumption of normality was met because the observed values were approximately in a straight line. Furthermore, Figures 4,5,6, and 7 show that the histograms are slightly skewed to the right, thus showing that although the histograms may not exactly fit the bell curve, they fit the criteria of homogeneity of variance because the population was robust.

Figure 1

Red Text

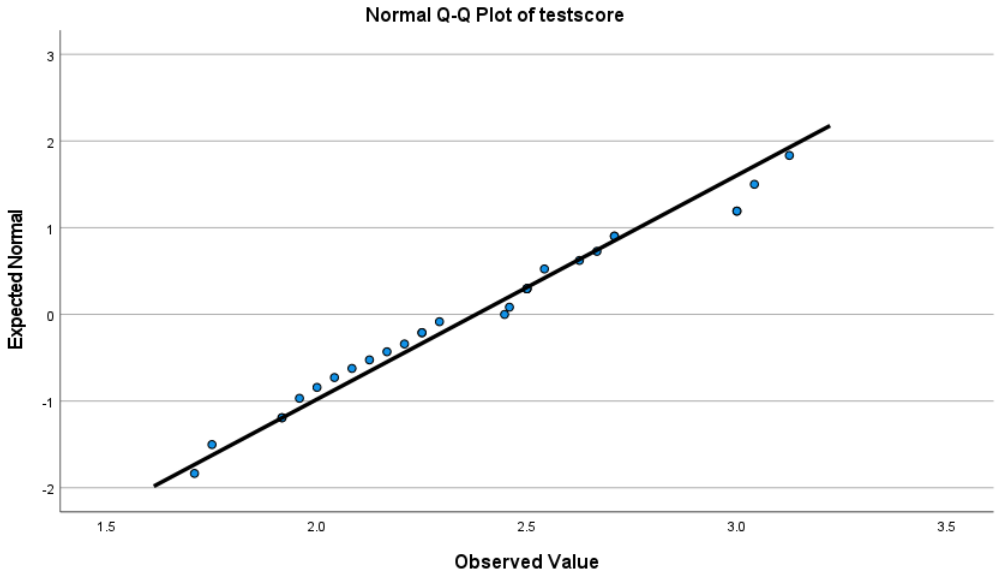


Figure 2

Black Text

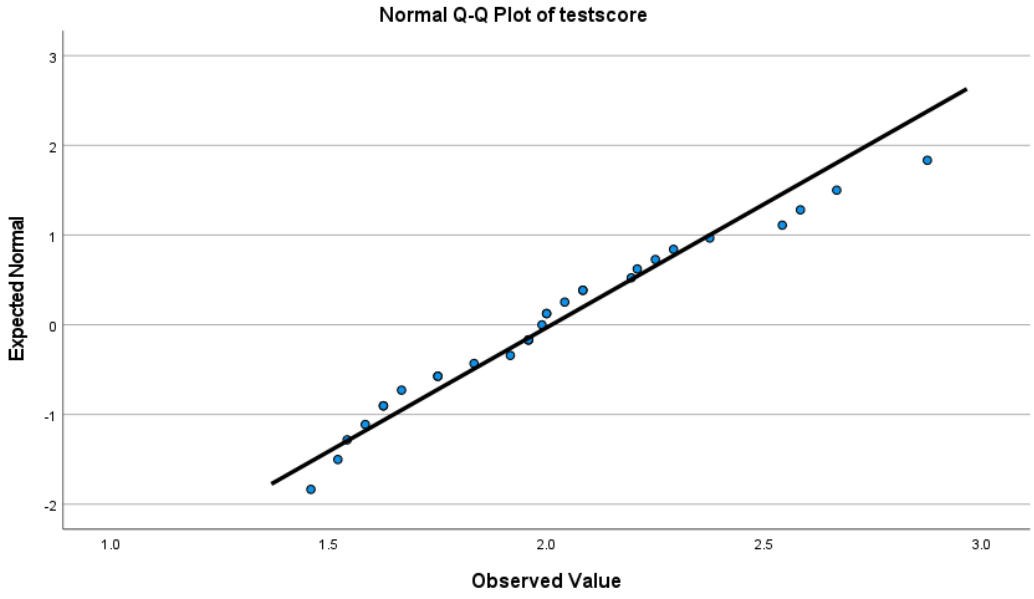
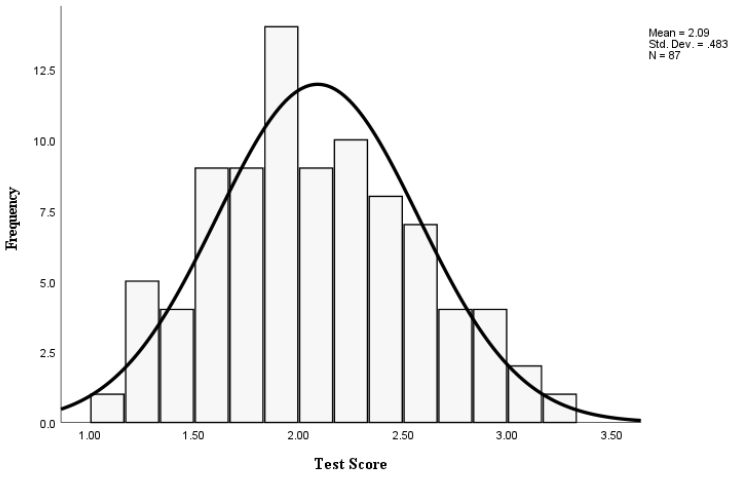


Figure 3

Red and Blue Text

Figure 4

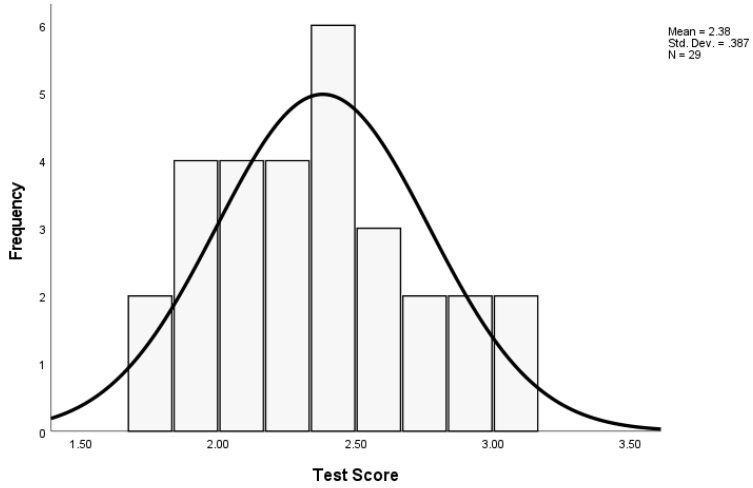
Histogram for Assumption of Normality



Note. *N* = 87.

Figure 5

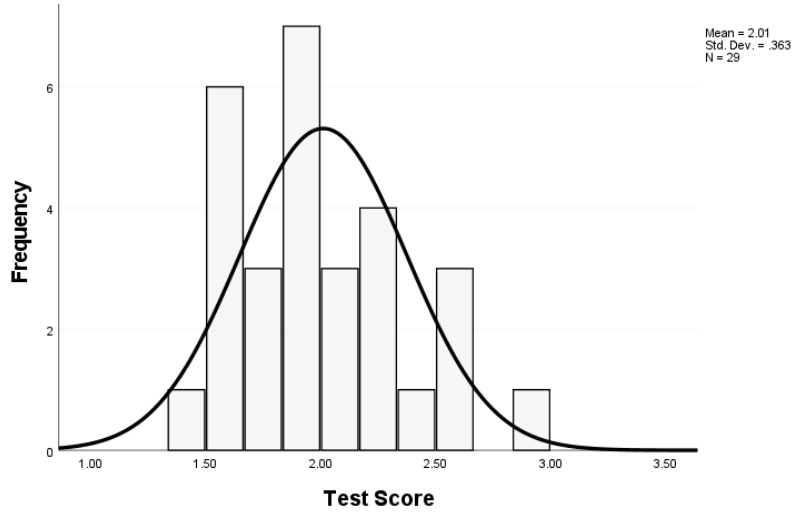
Histogram for Red Text



Note. *n* = 29.

Figure 6

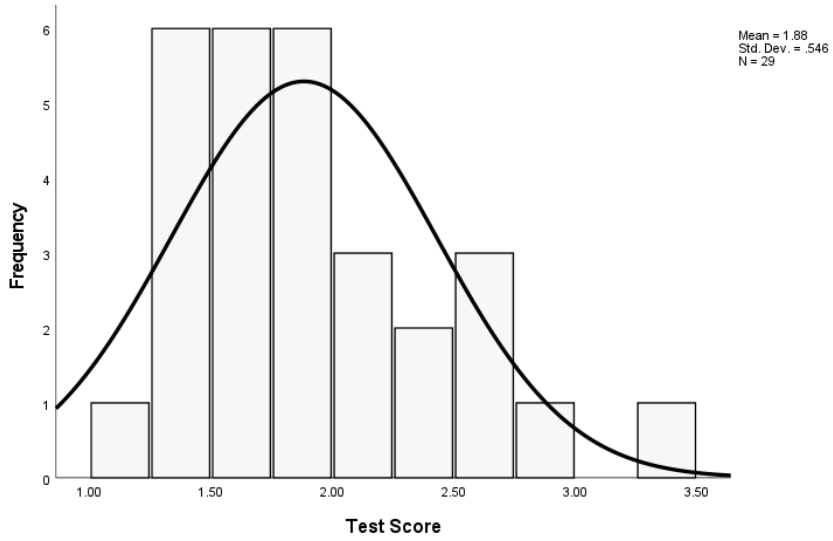
Histogram for Black Text



Note. *n* = 29.

Figure 7

Histogram for Red and Blue Text



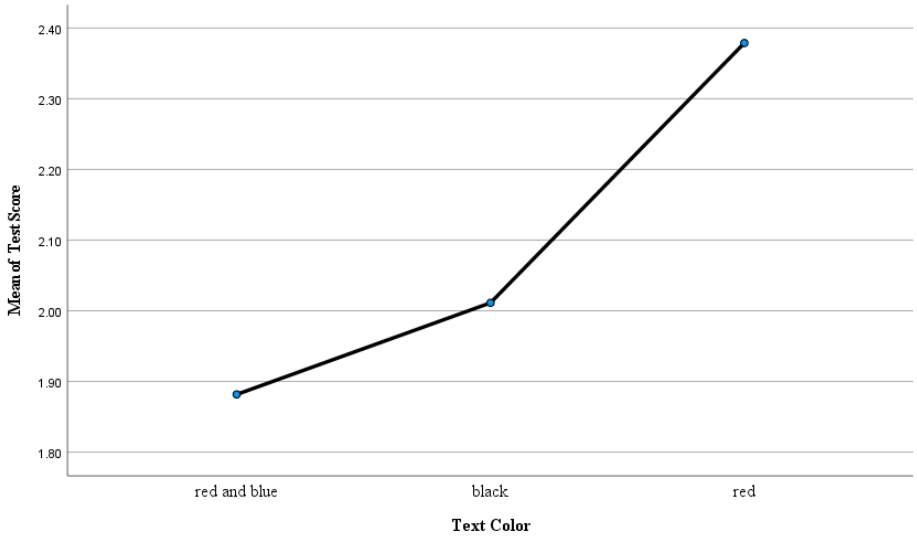
Note. $n = 29$.

One-Way ANOVA

The main variables that I used in this study were red text, black text, and red and blue text, and VR test scores. According to the graph (see Figure 8), there is a difference between red text and black text. Additionally, the graph shows a difference between red text and red and blue text. The graph also shows a difference between red and blue text and black text. Finally, the graph also shows that there is a difference between black text, and red text. Considering the results, the graph (see Figure 8) shows that there are differences between and amongst the different colors of text used.

Figure 8

Mean Text Scores



Note. $N = 87$; $n = 29$.

When the one-way ANOVA was run, I found significant differences between and among the scores, $F\ (2, 84) = 9.97$, $p = <.000$, $\eta 2 = .192$ (see Table 4). I also found that the test of homogeneity of variance was significant because it was above .05 (see Table 5).

Table 4

Descriptive Statistics and Results of One-Way ANOVA

	N	*M*	*SD*	*SE*	95% Confidence Interval for Mean		*Min.*	*Max.*	*F.*	*Sig.*
					Lower Bound	Upper Bound				
Red & blue	29	1.88	.546	.101	1.67	2.09	1.08	3.33		
Black	29	2.01	.363	.067	1.87	2.15	1.46	2.88		
Red	29	2.37	.387	.071	2.23	2.53	1.71	3.13		
Total	87	2.09	.483	.052	1.99	2.19	1.08	3.33	9.97	.000

Note. $N = 87$; $n = 29$ participants in each group.

Table 5

One-Way ANOVA and Test of Homogeneity of Variance

Groups	One-way ANOVA				Test of Homogeneity	
	F	*Sig.*	*M*	*SD*	Levene's Statistic	*Sig.*
	9.97	<.000			8.84	.092
Red			2.38	.387		
Black			2.01	.363		
Red & blue			1.88	.546		
Total			.290	.190		

Note. $N = 87$.

Post-Hoc Tukey HSC Post

The post-hoc Tukey HSD tests are a useful tool for identifying where mean group differences lie (see Eberly & Telke, 2011; Saville, 1990). I decided to use the post-hoc

Tukey HSD tests in this study considering that the post-hoc Tukey HSD tests are the most preferred post-hoc method for one-way ANOVA, makes all pairwise comparisons, and adequately controls for Type 1 error (see Kim, 2015). In my study, I used the post-hoc Tukey HSD tests after I discovered that the one-way ANOVA determined that there were statistically significant mean group differences. I used the post-hoc Tukey HSD tests to identify where the statistically significant mean group differences lie (see Eberly & Telke, 2011; Saville, 1990). The post-hoc Tukey HSD tests showed differences between the mean scores of text color and test scores, using $p < .05$ in the comparisons. The mean difference column of Table 6 shows where the significant differences lie between and amongst the three different colors or color combinations. Additionally, Table 5 shows that red text ($M = 2.38$) is significantly different from black text ($M = 2.01$), and red and blue text ($M = 1.88$), respectively, through the differences in mean scores in this study.

Table 6

Post-Hoc Tukey HSD, Groups, Mean Difference, Standard Error and Significant Difference

					95% Confidence Interval	
Text color (I)	Text color (J)	Mean difference (I-J)	*SE*	Significance	Lower Bound	Upper Bound
Red & blue	Black	-.130	.116	.503	-.405	.146
Black	Red	-.370	.116	.006	-.643	-.092

Red	Red & blue	.497	.116	<.000	.222	.773

Note. $N = 87$. The mean difference is significant at the 0.05 level.

One-Way ANOVA, Post-Hoc Tukey HSD, and Results

The goal of this study was to examine the influence of VR and color effect differences among DCC students. In order to fully investigate the research goal of this study I used a one-way ANOVA. I used the one-way ANOVA to test the following null hypothesis versus the alternative hypothesis:

$H1_0$: There is no statistically significant mean group difference for posttest VR scores.

$H1_a$: There is a statistically significant mean group difference for posttest VR scores rates.

The challenge in this study that prevented the implementation described in Chapter 3 was converting the recruitment of participants from face to face to online. I had to use online technology (phone and emails) to contact potential participants rather than conducting the study face to face. I collected the data using SurveyMonkey and I analyzed the data using SPSS (Version 27).

The results of my study help to create a clearer picture of the connection between test scores and text color. I used my Research Question to examine the differences between test scores and text color (red text, black text, and red and blue text) which was measured by the VKS. In this study, I used the participants' test scores as the dependent variable and the colored groups (red text, black text, and red and blue text) as the independent variable. The one-way ANOVA was run and found to be statistically

significant, F (2, 84) = 9.97, p = <.000, $\eta 2$ = .192. Thus, I rejected the null hypothesis of no differences between the mean groups based upon the results. Further, I found that 19.2% of the variance of test scores was accounted for by the different groups (red text, black text, and red and blue text). From the post-hoc Tukey HSD tests analysis I found that red text (n = 29, M = 2.38, SD = .387) produces significantly higher test scores than black text (n = 29, M = 2.01, SD = .363) and red and blue text combinations (n = 29, M = 1.88, SD = .546). Considering the effect size, $\eta 2$ = .192, red text had a color effect on VR among DCC students.

Summary

The problem I addressed in my study was the gap in the literature concerning VR and color effect differences among DCC students. The population that I included in my study consisted of participants who ranged between the ages of 18 and 55 who were enrolled in developmental reading courses at a community college in Northeastern USA. I used a one-way ANOVA to determine if there was a color effect difference between red text, black text, and red and blue text combinations. I also used the post-hoc Tukey HSD tests to determine where the significant differences lie. I rejected the null hypothesis based on the results of the one-way ANOVA and showed that there was a color effect difference between red text, black text, and red and blue text F (2, 84) = 9.97, p = <.000, $\eta 2$ =.192. The post-hoc Tukey HSD tests showed that there was a significant difference in red text (M = 2.38) compared to black text (M = 2.01) and red and blue text combinations (M = 1.88) based off of the mean differences between the three groups.

Chapter 5 will include the purpose and discussion of my study, an interpretation of the findings, recommendations for future research, implications and significance of the study and conclusions.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative research was to determine whether red text, black text, and red and blue text color combinations influenced VR among DCC students. In other words, I wanted to know if color had an effect on VR test scores among DCC students. This question led me to examine the nature of my study, which was to determine whether my dependent variable (VR test scores) had different effects via one-way ANOVA followed by the post-hoc Tukey tests.

I collected data using the VKS. Initially, I planned to meet with the instructors and student participants face to face. However, I met with the instructor participants via phone calls to gain their verbal consent. Then, I had the willing instructor participants sign consent forms and send out my recruitment material. After I received a list of the willing participants via email, I sent my consent forms to the willing instructor participants who then sent my consent forms to the willing student participants. I received 88 willing participants, 87 of whom (98.9%) successfully completed my form. Finally, I had the instructor participants send my survey. The results of the VKS came directly to me via SurveyMonkey. Thus, my data had been finally collected.

As previously stated, the key findings from a one-way ANOVA in my study indicated that there were statistically significant mean group differences among and between the three groups. The key findings from my study showed that red text scores significantly differed from the black text scores, and the red and blue text scores. However, there were no significant mean group differences found between the black text

scores and the red and blue text scores. In this chapter, I will interpret my findings, discuss the limitations and implications of my study, and offer recommendations for future researchers.

Interpretation of the Findings

The interpretations of my findings led me to the limitations, recommendations, and implications in my study. My first major finding was that the one-way ANOVA model was significant. These results indicated that there were significant mean group differences between color effects and VR. Next, I followed up with the post-hoc Tukey analyses. When I found the mean group differences, the analyses showed me where the significant differences lie. Finally, I analyzed my results. The analyses from these two tests (the one-way ANOVA and post-hoc Tukey analyses) indicated that my study had differences among the three groups (red text, black text, and red and blue text). I also found that red text was significantly different from black text and red and blue text, which led me to my second major finding.

My second major finding involved the Tukey post-hoc analyses results. These results indicated that the VR composite scores for red text (Group 1) showed significant mean group differences compared to black text (Group 2) and red and blue text color combinations (Group 3). Subsequently, I did not find a significant mean group difference when I compared my last two VR groups, black text (Group 2) and red and blue text color combinations (Group 3). Taken together, my results indicated that more participants tested better in VR with red text than they did with black or red and blue text color

combinations in my study. These two findings led me to further analyze my results with prior research.

The results of my study both confirmed and conflicted with previous findings of prior research on color effects and VR. For example, the findings of my study confirmed prior research (see Hall & Hanna, 2003; Kuhbandner et al., 2015; Mehta & Zhu, 2009; Ramadan, 2011; Rook, 2014) because my study showed that the color red increased VR among DCC students. In contrast, my study's results also conflicted with previous findings on color effects and VR because my findings showed that red was significantly different from black and red and blue text color combinations. These findings were at odds with those of prior research, which suggests that colors have a negative effect on academic performance (see Elliot et al., 2007; Roskes et al., 2014).

Additionally, I found differences between my results and prior research. The difference between the two results of my study and Elliot et al.'s (2007) findings may be due to the setting because academic context may have been a covariate that influenced the outcome of the results. For example, Elliot et al.'s study, which was conducted in a lab, tested 78 participants individually; however, my study, which was conducted in a classroom (computer lab), tested 29 participants at a time (87 total participants) collectively. The number of participants testing in the same room, collectively, could be viewed as a covariate that may have influenced the outcome of my results. For this reason, setting may have been a covariate for my study, thus contributing to the difference between my results and prior research (see Hall & Hanna, 2003; Kuhbandner et al., 2015; Mehta & Zhu, 2009; Ramadan, 2011; Rook, 2014)

Moreover, my results extended and supported current knowledge concerning color effects and VR. My study extended knowledge because my results showed an increase in test scores among participants exposed to red text. In contrast, Elliot et al.'s (2007) study indicated that participants in a lab "performed worse" when they were compared to the "black condition" on an anagram test (p. 158); therefore, the results of my research extended knowledge because my results suggested that participants exposed to red text may perform in a different way when the context has been changed.

My study also supported knowledge because my results confirmed prior research. Stitt and Pula (2013) found that red text increased VR. Additionally, Milne (2010) indicated that the color red increased excitement and arousal. Taken together, the results of my study supported knowledge because these results confirmed Stitt and Pula's findings that red increased VR. They also extended knowledge because my findings conflicted with Elliot et al.'s (2007) results, which showed that red decreased test scores in an academic setting. The results of these past studies (see Elliot et al., 2007; Stitt & Pula, 2013) indicate that population (DCC students) and subject matter (VR) may contribute as a covariate in this type of study. Moreover, my study's results show promise because they may provide knowledge in education that could be used to develop a new classroom teaching strategy that involves color and may also foster academic success among a greater number of DCC students.

Additionally, the findings of my study were interpreted through my theoretical framework. I interpreted these findings through the theoretical framework, FIT. This cognitive theory (FIT) is grounded in the hypothesis that color features direct attention to

relevant information during the preattentive stage (see Treisman, 2006). My study showed that red text (*M* = 2.38) was significantly different from black text (*M* =2.01) and red and blue text combinations (*M* = 1.88). Consistent with FIT, red text directed attention to the relevant information during the preattentive stage to an extent that surpassed black text and red and blue text combinations. For the reasons stated, this theoretical framework was incorporated into my study because red text was significantly different from black text, as well as red and blue text.

Limitations of the Study

The goal in this section is to address the limitations of my study. After careful examination, I found that there were limitations to generalizability and validity that arose from the execution of my study. These limitations included internal and external validity. Internal and external validity (see Ferguson, 2004; Greener, 2018) identify the connection between the results from my study and the factors that influenced the findings. Further, internal validity refers to the research design and external validity refers to the outside factor, which is associated with generalizability (see Ferguson, 2004). I found generalizability and external validity as limitations because of the sample size that I examined, as well as my collection process, and the length of my instruction.

My sample size added to my limitations because of the external validity. I only looked at students from one school in my study. Of the 225 total DCC participants who were enrolled in DCC courses, 87 (38.6%) community college students agreed to participate in my study. These students represented less than half of the DCC population. If I had included more participants in my study, closer to the total population, then I

would have strengthened my external validity or generalizability. As a result, the sample in my study was not representative of the U.S. population of DCC students, which caused external validity to be a limitation to the generalizability in my study.

Additionally, I found limitations in my study because of my data collection, which included the use of a convenience sample. A convenience sample (see Farrokhi & Mahmoudi-Hamidabadd, 2012) is a population that is collected at the convenience of the researcher, whereas a representative sample (see Omair, 2014) is a population that is collected and represents the entire population of the intended participants. I included a convenience sample rather than a representative sample so that I could save time and money for my dissertation. If I had included a representative sample rather than a convenience sample, then my results might have been different because they could have been more generalizable. For this reason, the collection process that I used (convenience sample) may have been a limitation.

Finally, the validity of my study showed another limitation, length of instruction. As stated in Chapter 1, the recruitment of participants and instructors that I used preceded data collection in my study by 2 weeks. If I had conducted a longitudinal study for more than 5 weeks, then I might have received different results. During the recruitment process, I told the instructors to conduct this study at the same time during each class; however, I did not include a longer period of instruction so that I could save time and money. Therefore, length of instruction became a limitation because of time and money which may have influenced the results.

Recommendations

The recommendations included in this section for future researchers address the results of my study, the makeup of the class, and the cost. I have also included recommendations pertaining to length of instruction, proximity, and gender-specific strategies as recommendations for future researchers. I have included these recommendations, which are grounded in future research, because they address the interaction of my variables (color effects, VR, and DCC students).

My results and the makeup of the class support recommendations for future research involves classroom specific strategies. For example, a community college instructor may use data-driven instruction (color effects and VR) based on their individual classes to incorporate the color red to increase VR. This strategy, which is based on my results and the makeup of the class, is one recommendation that I have for future researchers.

In relation to cost, color use to improve VR may be seen as an efficient way to promote academic success. This strategy can be cost-effective because community college instructors are provided with colored markers (red, black, and blue) to use on a white board. If an English instructor surveys their community college class and chooses to use the color red to teach VR rather than black or red and blue, then they may improve their students' VR in a cost-efficient way because the red dry erase marker is provided to the instructor at the beginning of the semester.

In terms of the length of time for future researchers, a longitudinal study may be beneficial to DCC students because it could be used to track the effects of color over an

extended period of time and instruction. When I conducted my study, there was no literature, to date, pertaining to VR, color effects, and DCC students. I examined color effects and VR among DCC students over a 3-week period. A longitudinal study could track the progress of individual students for more than 3 weeks as they navigate through developmental English courses and move forward into English 101 and English 102 courses. Such a study could provide insight into the effect of colors on VR over an extended period, which could be linked to improved VR performance.

Prior research has indicated that gender-specific strategies may be useful in future research (see Gnambs et al., 2010). As stated in Chapter 2, according to Gnambs et al. (2010), the color red decreased test scores of females after one exposure; however, the color red did not affect test scores of females after multiple exposures. Based on these findings, I would recommend future researchers to examine color effect differences and gender-specific strategies in VR as well as other academic areas.

Finally, I recommend that future researchers examine color effects on VR in relation to proximity. As stated in Chapter 2, Gnambs et al. (2010) suggested that a red progress bar on a web-based general knowledge test influenced test scores; however, the proximity of the color red may have had an impact on color effects and VR. Proximity may play a role in color effects and VR depending upon where a student is seated in the room. The impact of color on VR may vary depending upon whether a student is sitting in the front, middle, or back of the room. The role of color on VR may also vary depending upon the size of a room. Subsequently, future researchers might also include the influence of color effects on VR as it pertains to proximity because the use of color to

improve VR may be influenced by the proximity of the color effect and gender (Gnambs et al., 2010), as previously stated in my recommendations.

Implications

The results of my study suggested that there were methodological, theoretical, and empirical implications in education. Color effects impacted VR and the potential for a positive social change from my study can occur on an individual level, organizational level, and societal level.

The potential impact on an individual level involves the student. Red text showed significant mean differences when compared to black text, and red and blue text. As a result of my study the methodological implications are that colors may be used to improve VR through individualized learning. From a theoretical perspective, my study may have confirmed that color features guide attention to relevant information (Treisman, 2006), thus showing that colors guide attention and increase VR. For example, different colors may be used for note taking and study material among DCC students. With this knowledge, DCC students could be provided with another resource to influence success in community college level reading and writing courses.

On an organizational level, DCC and general college professors may administer another strategy to use in the community college classroom, thus presenting a different approach to teaching and learning to all students. In addition, my study results imply that there are empirical implications on a societal level. From my research, this color strategy may be explored and used with students in primary, elementary, and high school levels, thus adding to the educational practices in all classrooms.

Finally, there was a potential impact for social change on a societal level. The use of this learning strategy, color and VR, outside of the classroom, can be applied to power point presentations, corporate business meetings, workshops, and advertisements, which may impact different sectors on a societal level.

Conclusion

Further research on VR and color among DCC students may provide greater insight on its impact on student performance on district and state assessments. Use of color also shows promise for providing an additional instructional strategy for community college professors.

My study results showed an impact of color and VR on learning. DCC instructors might use color to include evidence-based instruction in their classrooms. Furthermore, instructors could then include red text in power points, teacher-created classroom material, and vocabulary tests for VR. Additionally, DCC students could use color to improve their study habits and comprehension through differentiated color-coded notes. This may provide the student another way to individualize their learning and improve VR.

Lastly, my study results added to the existing literature by building on the much-needed reading improvement of DCC students. Prior research stated that community college students tend to achieve their academic goals (see Bradburn et al., 2001); however, DCC students struggle with this achievement (see Bailey et al., 2010). Subsequently, the addition of color and VR as a strategy offers teachers and students alike, an alternative to improve instructors' teaching methods and students' learning and

study habits, ultimately increasing DCC academic success through the use of red text to potentially improve grades and the graduation rate.

Summary

Chapter 5 included a discussion of my study, the implications, and an analysis of study results. My quantitative study examined if there was a difference between color effects and VR with DCC students who used red text (Group 1), black text (Group 2), and red and blue text color combinations (Group 3). The goal of my study was to fill a gap in the literature pertaining to color effects and VR among DCC students. I wanted to examine this idea because there was a lack of research in this area. My quantitative study used a research design with the one-way ANOVA and post-hoc Tukey HSD analyses to analyze the results. My findings indicated that red text (Group 1) was significantly different from black text (Group 2) and red and blue text combinations (Group 3). Finally, I suggested to future researchers that a longitudinal study should be considered, as well as the use of gender and proximity as covariates. Together my study has indicated that color effects may have an impact on VR among DCC students.

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Appendix A: Permission to Use Survey Monkey

SurveyMonkey Inc.
www. surveymonkey.com

For questions, visit our Help Center help.survemonkey.com
Re: Permission to Conduct Research Using SurveyMonkey

To Whom It May Concern:

This letter is being produced in response to a request by a student at your institution who wishes to conduct a survey using SurveyMonkey in order to support their research. The student has indicated that they require a letter from SurveyMonkey granting them permission to do this. Please accept this letter as evidence of such permission. Students are permitted to conduct research via the SurveyMonkey platform provided that they abide by our Termshttps://www.surveymonkey.com/mp/legal/terms-of-use/of Usehttps://www.surveymonkey.com/mp/legal/terms-of-use/at https://www.surveymonkey.com/mp/legal/terms-of-use/.

SurveyMonkey is a self-serve survey platform on which our users can, by themselves, create, deploy and analyze surveys through an online interface. We have users in many different industries who use surveys for many different purposes. One of our most common use cases is students and other types of researchers using our online tools to conduct academic research.

If you have any questions about this letter, please contact us through our Help Center at help.surveymonkey.com.

Sincerely,

SurveyMonkey Inc.

Appendix B: Letter to Student Participants

Dear _____,

My name is Eric Coleman and I am currently working on my dissertation at Walden University. I recently received IRB approval from Walden University and _____to collect data. I have also contacted _____ in the Research department. My study is about the influence of colors on learning vocabulary. The colors I will use for the vocabulary words in my study are red, black, and red and blue. Over the course of three weeks, I plan to send out 8 vocabulary each week in red, black, and red and blue using SurveyMonkey Audience. The link for the survey will be provided to the professors who will email them to the willing participants. The point of the study is to determine if colors have an impact on learning so that I can find a more efficient way to teach vocabulary. I plan to study developmental students in (072 and 073) classes. As a result, I need the emails of the professors who teach (072 and 073) courses. If you have any questions, feel free to call me at (862)944-xxxx. Thank you.

Sincerely,
Eric Coleman

Appendix C: Letter to Professors Teaching Developmental English

Dear Professor,

You are cordially invited to take part in a research study about the influence of colors on learning vocabulary. The researcher, Eric Coleman, is inviting developmental community college reading students who are over the age of 18 and who are ready to learn new strategies to join this study so that the researcher, Eric Coleman, can fulfill his Walden University dissertation. A dissertation is a written document that summarizes research. The results of the study will not be used for any purposes other than research. The policy of the Walden University department of psychology is that all participation in research is voluntary and that you have the right to withdraw at any time, if you object to the nature of this research. Declining or discontinuing the study will not impact your relationship with the researcher or your access to the college's services negatively. You are encouraged to ask questions and you will receive an explanation after your participation, if you decide to participate in this study. You can contact the researcher, Eric Coleman, at ecoleman@xxxx.edu.

The purpose of this study is to examine the effects of the colors (red words, black words, and red and blue words) on learning vocabulary. This study will take place for 5 weeks. The first two weeks of the study will be used to recruit participants from your classes. Your students will be recruited from the researcher, Eric Coleman. The recruitment process involves sending an email to your students which will explain the purpose of this study, their potential involvement, and asking interested participants to sign a consent form if they are interested in participating.

The next 3 weeks of the study will be used to administer the Vocabulary Knowledge Scale (VKS). The vocabulary words for this study will be taken from the text books that you use in your 072 & 073 classes. Your role in this study will be to perform your normal academic instruction. After each class the researcher, Eric Coleman, will send an email to the willing participants to complete a 10-minute survey. The participants will have until 11:00 P.M on Saturday to complete this survey. The participants, your students, will complete this survey during weeks 3,4, and 5. After week 5, the data will be analyzed.

The purpose of this study is to examine the effects of colors on learning vocabulary (red words, black words, and red and blue words). As the instructor, your instructional methods will not be examined during this study. This study will examine how colors impact learning vocabulary. The data will be analyzed on a group and class level using red text, black text, and red and blue text. Your classes' vocabulary scores will be analyzed as a group, so your classes' individual test scores will not be identified. Your name and your student's names will be replaced with a number to protect your identity during and after the study. Your name and personal information(email), as well as your classes' name and personal information (email) will be kept in a locked closet for 7 years. This study is unproven, so the results of this study will be undetermined until after this study is complete.

This study is voluntary. You are free to accept or turn down this invitation. No one at_____ will treat you differently if you decide not to be in this study. Thank you for your time.

Sincerely,

Eric Coleman

Appendix D: Purpose of Research to Volunteer Students

Dear Student,

You are cordially invited to take part in a research study about the influence of colors on learning vocabulary. The researcher, Eric Coleman, is inviting developmental community college reading students who are over the age of 18 and who are ready to learn new strategies to join this study so that the researcher, Eric Coleman, can fulfill his Walden University dissertation. A dissertation is a written document that summarizes research. The results of this study will not be used for any purposes other than research. The policy of the Walden University department of psychology is that all participation in research is voluntary and that you have the right to withdraw at any time, if you object to the nature of this research. Declining or discontinuing this study will not impact your relationship with the researcher or your access to the college's services negatively. You are encouraged to ask questions if you decide to participate in this study. You can contact the researcher, Eric Coleman, at ecoleman@xxxx.edu.

The purpose of this study is to examine the effects of colors (red words, black words, and red and blue words) on learning vocabulary. This study will take place for 5 weeks. The first 2 weeks of this study will be used to recruit participants from your classes. You will be recruited from the researcher, Eric Coleman. The recruitment process involves sending an email to you explaining the purpose of this study, your involvement, and asking you to sign a consent form if you are interested in participating.

The next 3 weeks will be used to administer the Vocabulary Knowledge Scale (VKS). The vocabulary words will be taken from the text books that you use in your 072 & 073 classes. Your role in this study will be to perform your normal academic duties. After each class the researcher, Eric Coleman, will send an email to the willing participants to complete a 10-minute survey using SurveyMonkey. If you decide to join this study, you will have until 11:00 P.M. on Saturday to complete this survey. You will be asked to complete this survey during Weeks 3, 4, and 5 through SurveyMonkey. After week 5, the data will be analyzed.

The purpose of this study is to examine the effects of colors on learning vocabulary (red words, black words, and red and blue words). The data in this study will be analyzed on a group and class level using red text, black text, and red and blue text. Your classes' vocabulary scores will be analyzed as a group, so your individual test scores will not be identified. Your name will be replaced with a number to protect your identity during and after the study. Your name and personal information (email) will be kept in a locked closet for 7 years. This study is unproven, so the results of this study will be undetermined until after this study is complete.

This study is voluntary. You are free to accept or turn down this invitation. No one at _____will treat you differently if you decide not to be in this study. Thank you for your time.

Sincerely,

Eric Coleman

Appendix E: Debriefing Form

Prior to joining this study, you were told that this study was about learning vocabulary. At the beginning of this study, I did not specify the details of this research. This research is actually looking at the influence of colors on learning vocabulary. The purpose of this study was to examine the effects of colors (red words, black words, and red and blue words) on learning vocabulary through the Vocabulary Knowledge Scale.

This study took 5-weeks. The first 2-weeks of this study was used to recruit participants from 072 and 073 developmental English classes. The recruitment process involved sending an email to you explaining the purpose of this study, your involvement, and asking you to sign a consent form if you were interested in participating. The next 3 weeks was used to administer the Vocabulary Knowledge Scale. The Vocabulary Knowledge Scale is a survey of vocabulary words. The vocabulary words that were used in this study were taken from the text books that you used in your 072 & 073 English classes.

The data in this study was analyzed on a group and class level using red text, black text, and red and blue text. Your classes' vocabulary scores were analyzed as a group, so your individual test scores were not identified. Your name was replaced with a number to protect your identity during and after the study. Your name and personal information (email), as well as your class name and personal information (email) will be deleted at the end of this study. The data collected from this study will be kept in a locked closet for 7 years and then destroyed. The research component of this study is only limited to the 5-weeks that you have participated. The first 2-weeks of this study was used to recruit participants. The next 3 weeks was used to administer the Vocabulary Knowledge Scale. Your name and personal information will be protected.