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Impact of Design Challenges Upon the Development of Critical Thinking Skills Within an Undergraduate Image Manipulation Course: A Mixed Method Action Research Study

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Impact of Design Challenges Upon the Development of Critical Thinking Skills Within
an Undergraduate Image Manipulation Course: A Mixed Method Action Research Study

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DEDICATION

This dissertation is dedicated to my wife, Dr. Bonnie Treado. Her support and encouragement through this doctoral process never wavered. She believed in my abilities even when I had doubts and graciously sacrificed in order to allow me to accomplish this goal. We began this journey full of hope and excitement for the future. We end this process having reached our respective educational goals, expanded our family, and established our home in a new place. None of this could have been accomplished without her by my side.

The journey and process of reaching this milestone is dedicated to my daughter Annie and to my son Grant. It is my hope that you remain curious and endeavor to learn everything you can, embrace the same values your mother and I hold, work towards the betterment of this world, love and respect others, and have a greater faith than we can hope or imagine.

Bonnie, Annie, & Grant, I love you.

“Now all glory to God, who is able, through his mighty power at work within us, to accomplish infinitely more than we might ask or think. Glory to him in the church and in Christ Jesus through all generations forever and ever! Amen” (Ephesians 3:20-21, The New Living Translation).

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I am blessed to work with innovative and inspiring colleagues at Anderson University. I appreciate your encouraging words, listening ears, provision of food, and research focused minds.

ABSTRACT

The overarching purpose of this study was to improve upon critical thinking through the use of scenario-based design challenge interventions. The study was conducted within an introductory graphic arts course in higher education that focused upon Adobe Photoshop and image manipulation tools, techniques, and terminology. Twelve introductory level graphic arts students participated in the study. In addition to scenario-based design challenge interventions, a reflective practice framework that used scaffolded questioning was developed to guide students in their use of critical thinking about image manipulations.

Through a mixed-methods action research design, the study explored the concepts of design challenge interventions and reflective practice in two ways. First, how do design challenge interventions impact achievement scores within an introductory image manipulation course. Second, how do design challenge interventions impact the development of critical thinking in introductory students.

One overarching research question and four supporting questions guided this study. Each question was developed to examine how these interventions improve upon a students' transferrable knowledge and further connect and apply course objectives and goals with future careers. Qualitative and quantitative data collection techniques such as pre- and post-assessments, design challenge interventions, image manipulation projects, and semi-structured interviews were used.

The study revealed that knowledge was transferred throughout the study, yet a correlation between the design challenge interventions and image manipulation projects was not significantly detected. Analysis and evaluation of reflective statements produced during the design challenge interventions revealed that the students were applying prior knowledge and learned skills to their image manipulations. The semi-structured interviews also revealed that students were making connections between thinking critically about design and the basic image manipulation design processes.

The variability in findings and supporting themes suggest implications for a course improvement action plan, and future research and practice. To improve upon the course design, an action plan that updates the overarching course goals, inserts active learning strategies, and uses classroom assessment techniques to improve upon critical thinking and reflection is proposed. Further research supported by educators in graphic arts in the development of critical thinking and additional 21st century skill sets in graphic arts degree programs is suggested.

Keywords: Adobe Photoshop, critical thinking, design application, design challenge, graphic arts, image manipulation, reflective practice, 21st century skill sets

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CHAPTER 1

INTRODUCTION

The world communicates through graphics, symbols, and text. Aspiring graphic artists learn how to combine and structure these elements to produce meaningful messages through formal training. As students make decisions to pursue graphic arts as a career, they can move from high school into institutions of higher education and a variety of degree programs. There are many ways to teach graphic arts, but most American design education programs fall under two categories: a process school or a portfolio school. Process schools focus upon broad approaches to problem solving and graphic art. Through exposure to multiple disciplines students can participate in design programs that incorporate fine art, history, literature, and other disciplines that are commonly associated with process schools. Portfolio schools on the other hand, focus upon conceptual problem solving to generate a collective group of design artifacts and products that build up personal portfolios (Beirut, 1988; Salchow, 1981).

A variety of pedagogical approaches can be used in either category of design education. Introductory courses in portfolio based graphic art programs traditionally rely upon tutorial-based curriculums that demonstrate how to use design applications and apply specific skills. Through this method, learners are able to familiarize themselves with design applications and develop skills through design processes that scaffold. Tutorial-based learning may not necessarily enhance learners' ability to critically think

through a design process, analyze and evaluate digital designs, or creatively apply newly learned skills. For tutorial-based instruction to be effective, the learner must be able to transfer learning between assignments, projects, and future courses. Despite the widespread use of tutorial-based learning within introductory graphic arts courses, there is little research that examines their effectiveness to enhance critical thinking.

The purpose of Chapter One is to provide an overview of the mixed method action research study for this dissertation in practice. The study seeks improvement in critical thinking skills when a scenario-based design challenge intervention and reflective practices are integrated with an introductory graphic arts course in higher education. The problem of practice (PoP) in the proposed mixed method action research study was developed and based on observations within a portfolio-based design program and former classrooms of the researcher. In addition to classroom experience, anecdotal discussions with peers, a review of past research, and a review of current literature related to graphic arts and the development of critical thinking influenced the PoP.

The modern workplace changes rapidly, especially within a field as fast-paced as graphic art. Students must learn how to correctly apply 21st century skill sets, such as critical thinking and reflective writing (Hilton, 2015). The incorporation of critical thinking skills within educational curriculum is not a new idea. Many institutions of higher education understand the importance of these skill sets and make it a point to develop each student's independent thinking skills through specific critical-thinking course objectives and assigned coursework (Fahim & Masouleh, 2012; Walker & Finney, 1999). A challenging higher education environment, and eventually the workplace, can present individuals with complex problems on a recurring basis. Problems can be

presented or encountered and then solved with the widespread use of technology; however, technology and access to technology alone are not always viable solutions. When an individual enters the workplace, he or she needs more than access to technology to be successful in his or her career. Individuals will need the skill sets of creative thinking, critical thinking, problem-solving, and reflection to effectively use tools that accomplish a variety of objectives and tasks (Brown, 2012).

Preparation for the Workforce

Several experts and professional organizations have called for the development of 21st century skills and critical thinking in educational institutions, including the APA (Facione, 1990), Brown (2012), Partnership for 21st Century Learning (2006), SCANS (1991), and Wagner (2008). In 1991, the U.S. Labor Department released a report titled Secretary's Commission on Achieving Necessary Skills (SCANS), which argued for the preparation of the 21st century workforce. The report identified five competencies that form the core of needed 21st century skills in which people needed training or education. They are as follows:

- resources – identifying, organizing, planning and allocating resources;
- interpersonal – working with others;
- information – acquiring and using information;
- systems – understanding complex interrelationships; and
- technology – working with a variety of technologies.

Each competency is to be built upon basic skills, thinking skills, and interpersonal qualities (Collins & Halverson, 2009). The workforce is evolving, and furthermore, companies in an ever-competitive economy have changed the way they do business. They

will continue to change the manner in which they achieve their goals and meet their objectives in order to stay viable, relative, and competitive (Lear & Hodge, 2011).

The key element for future employees is effective development of these skill sets. *Critical Thinking: A Statement of Expert Consensus For Purposes Of Educational Assessment And Instruction*, an executive summary pertaining to a American Psychological Association (APA) Delphi Research Report defines critical thinking as a “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990, p. 3). Broken down into key components, the APA Delphi committee (Facione, 1990) came to an agreement that analysis, evaluation, inference, interpretation, explanation, and self-regulation are the core components of critical thinking and could be applied to all aspects of daily life and career disciplines.

In his book, *The Global Achievement Gap*, Wagner (2008) introduces and discusses seven survival skills individuals must possess to be successful in their careers. The skill sets discussed include: critical thinking and problem solving; collaboration across networks and leading by influence; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analyzing information; and curiosity and imagination.

Brown (2012) discusses these points further in *Cultivating the Entrepreneurial Learner in the 21st Century* and believes that the days of working within and mastering one field are fading; careers of the future will demand a constant reinvention and augmentation of multiple skill sets. Additionally, each skill set falls into one of three

domains: cognitive, intrapersonal, and interpersonal. This researcher believes the skills identified by Brown (2012), Facione (1990), and Wagner (2008) accurately describe the skill sets a graphic artist will need to be successful within an extremely competitive workforce. Through the influence of these authors and comprehensive research, the researcher should be able to create a positive learning community that can develop a student's cognitive, intrapersonal, and interpersonal abilities.

Each domain of student competence represents how humans think, learn, and transfer knowledge independently or within a learning community. The cognitive domain involves thinking, which includes the ability to reason, solve problems, and memorize information. The intrapersonal domain reflects an individual's self-efficacy, mainly their emotional state, feeling toward a topic, and the ability to self-motivate. Both the cognitive and the intrapersonal domain align well with Bloom's Taxonomy of learning objectives. The interpersonal domain of ability is used to express and apply newly gained information through interpretation and appropriate response. Abilities identified within 21st century skills fit within these domains and encourage an individual's ability to learn and transfer knowledge (National Research Council, 2012).

The Partnership for 21st Century Learning (P21) (2006) reports that U.S. companies are competing in a quickly-evolving global workplace. Employers and their respective workforce must be able to quickly and intelligently adapt to these transitions, or they risk being shut out of the marketplace by other competitors. The competitiveness needed for the future workforce will depend on higher education's ability to develop critical thinking skills and prepare highly-skilled workers. By surveying over 400 employers across the United States, P21 was able to identify the skill sets workers need to

be successful in their chosen careers. Critical thinking and creativity/innovation were listed as two of the skill sets seen by employers as being substantially important.

Businesses provide services and products that cross over many demographics. To enhance recognition in crowded marketplaces, businesses use graphic design firms or individual designers and artists to create, establish, and promote their brand(s). To achieve a successful career within artistic and creative design fields, designers must be able to think independently, be imaginative and creative, work well with others, communicate effectively, adapt to design trends, and solve problems presented by clients (Cezzar, 2015; Wagner, 2008). Therefore, the goal of this study is to assist in the preparation of students for the 21st century workforce through scenario-based design challenges that promote creativity, problem solving, and constructive critique of professionally created image manipulations. The focus of this Dissertation in Practice (DiP) will be the development and impact of an intervention that develops a student's cognitive, intrapersonal, and interpersonal abilities through critical thinking skill sets and reflective practice. This will be accomplished through an introductory design application course.

Rationale for the Study of Graphic Art

Students entering the field of graphic art must have an understanding of art and business. One cannot assume that students entering this field possess an understanding of, or offer much experience in, either art or business. Outside of personal discovery, public or private institutions of higher education that offer process or portfolio degree programs may be the first formal design organizations encountered by a student. To obtain the proper education needed for a successful career in graphic art, students should seek programs that embrace new media technology and integrate educational theory and

design practice well. How an individual combines technical skill sets and art techniques are important to graphic art. Technique, through design applications, refers to how a graphic artist combines design elements such as typography, imagery, illustration, and color (Giloi & du Toit, 2013). Tippey (2008) states “*critical thinking* is the fundamental activity of designers” (p. 1). Therefore, astute graphic artist are astute critical thinkers and the goal of the educator needs to be the development of both.

Introductory design courses are the gateway to higher-order thinking, problem solving, and creative design work. Yet, these introductory courses often have a stigma attached to them, one linked to obligation and lack of appreciation regarding the importance of this knowledge base. Most students enter college knowing they will need to complete these required courses before moving onto specific coursework related to their major or interest. Undergraduates enter higher education with varied educational backgrounds and approach assignments from multiple standpoints (Ettinger, 1988). In high school settings, students are accustomed to standardized tests where memorization techniques are beneficial (National Research Council, 2000). Critical thinking is not always encouraged or developed in these students entering higher education, leading some higher education institutions to offer critical-thinking courses to its first-year students. Memorization alone will not serve students in graphic art well (Tippey, 2008).

Within graphic art courses in higher education, critical thinking and problem-solving skills are beneficial to students applying connections between learning and producing work when assigned projects (American Institute of Graphic Arts, n.d.). Additionally, graphic art courses in higher education present students with a structured environment where design processes that require some amount of memorization must be

followed, yet educators expect a variety of design solutions and assess work through subjective techniques based on design principles and elements, which require a certain amount of critical thinking (Ellmers, Bennett, & Brown, 2014). Establishing connections between creativity and problem solving positively builds cognitive development in design students (Hargrove & Rice, 2015). Davis (2005) states, “anyone can call him- or herself a graphic designer, regardless of academic preparation for professional practice.” To give oneself a self-proclaimed title is one issue, but to be what you claim is an entirely separate issue.

Students are unaware of the skill sets future employers desire, even if design educators are promoting these skills in their course assignments (Hodge & Lear, 2011). The possession of 21st century skill sets found within graphic arts are further reinforced by P21 as they also report that business leaders are looking for creative and evaluative employees (P21, 2006). As coursework progresses through a degree program, students should be able to show more than mastery of technique; they should be able to approach problems from a creative and critical-thinking vantage point to find solutions, thereby continuing the trend of continuous enhancement of 21st century skill sets.

Statement of the Problem

This dissertation focuses specifically on graphic art students, with the intention of developing critical thinking skills set needed for future courses and their potential career. As high school graduates enter college, institutions of higher education throughout the nation report deficiencies in written communication, leadership, and work ethic (Cassner-Lotto & Barrington, 2006). In addition to institutes of higher education, employers across the nation perceive the applied skill of critical thinking as insufficient for the workforce

(Wagner, 2008). To improve upon basic knowledge skills associated with high school and academic achievement, students that enter higher education are seeking methods to build upon the application of skills associated with a variety of professions (Cassner-Lotto & Barrington, 2006; Brown, 2012; Wagner, 2008).

For most entry-level students, the basic graphic art design process includes multi-staged methods related to research, development, design, refinement, and finalization (Lawson, 2006). Each stage can be easily explained within a traditional lecture setting but can be difficult to apply to a cumulative project. Artistic students have a tendency to skip the preliminary stages of the design process and immediately jump into the creation of content (Stones & Cassidy, 2006). The application of 21st century skill sets will enhance each student's design process and critical thinking ability, thus developing a professionally prepared artist (Cassner-Lotto & Barrington, 2006).

Introductory courses at degree granting institutions must search for ways to improve academic success and increase critical thinking skills. For entry-level students in graphic arts, the beginning research phase is often conducted through a quick Internet search, with the development phase consisting of very few sketches. Through rushed research and development procedures, students formulate weak design concepts and apply basic design application techniques to create digital media. Additionally, the approval of the instructor is constantly sought when students create a design and desire to move forward with an assignment. Through constant instructor feedback, each student misses an opportunity to enhance his or her cognitive abilities with personal reflection (Bestley & Noble, 2016).

To address these concerns, it is feasible to embed critical thinking and reflective writing skill sets within an introductory level graphic art course. Under the refinement of an introductory image manipulation course and the integration of these 21st-century skill sets, this mixed methods action research study will explore critical thinking skills when scenario-based design challenge interventions are used within an introductory graphic art course. Furthermore, this action based mixed methods research study will explore the development of student achievement scores within an image manipulation course. To study how a student develops critical thinking skills by blending technical skills with artistic skills, research questions that explored connections between learning and producing work were established.

Research Questions

Through improved teaching and learning within an introductory design application course, the following research questions will explore potential effects on critical thinking:

Within an introductory design application course, how do design challenge interventions impact the development of critical thinking in first-year university students?

- *What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?*
- *What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?*
- *How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?*

- *How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?*

Through these research questions the purpose of the mixed-methods action research study is two-fold. First, how do design challenge interventions impact achievement scores within an introductory image manipulation course. Second, how do design challenge interventions impact the development of critical thinking in introductory students.

Purpose of the Study

The purpose of this action research study will be to explore achievement scores as students develop technical and critical thinking skills as it relates to the implementation of 21st-century skill sets within an introductory image manipulation course. *Applications and Foundations for Image Manipulation*, is an introductory course at a private, liberal arts, medium-sized institute of higher education in South Carolina (*Foothills University*) and offered through the graphic art department as an elective for a variety of degree programs. The course is designed to introduce Photoshop, an industry-related image manipulation software application currently used in graphic arts and other design related professions with a high learning curve. Degree-seeking students across several subject areas learn to use basic design application skill sets and technical devices commonly found within the digital production of graphic art. *Applications and Foundations for Image Manipulation* focuses upon image/photographic manipulation tools and design techniques. The course incorporates the following objectives: to learn the workspace and tools available in Adobe Photoshop, to learn the basic techniques and principles of digital imagery and design, and to apply foundational art and design principles in a digital format (Foothills University, n.d.).

This researcher taught a course similar to *Applications and Foundations for Image Manipulation* for eight years at a previous institution of higher education. The researcher partnered with a graphic arts faculty member for this study and desired to improve each student's capacity for critical thinking, problem-solving, and effective communication skills through a relevant and challenging curriculum. If introductory students are challenged with authentic scenarios and projects, they will be able to improve their transferable knowledge and further connect and apply coursework with their future careers. This mixed-methods action research study will focus upon an introductory image manipulation course that will use scenario-based design challenge interventions to develop critical thinking skills needed for the 21st century workforce (Mortensen & Moreland, 1985).

Significance of the Study

This study will focus on the integration and improvement of 21st century skill sets within an introductory image manipulation course. Through the application of scenario-based design challenge interventions found within this study, faculty members within graphic arts will be able to promote career related skill sets in introductory design students (Mandernach, 2006). The ability to think critically through the design process, solve problems related to graphic art applications, engagement with career-related internal discussions pertaining to professional designs, and the enhancement of critical thinking skills will be studied.

The significance of this research is supported by two key factors: 1) the use of scenario-based design challenge interventions within an introductory design application course, and 2) the lack of practical research to support this approach. Introductory design

application courses rely on instructional methods of topical overviews, step-by-step tutorials, and the use of design-based projects to inform and teach students skill sets. There is little evidence suggesting these processes advance skills associated with critical thinking within graphic arts (Ellmers, 2017). More often than not, confusion sets in as students are overwhelmed by these methods. Without the development of reflective and critical thinking, students will not be able to understand how design elements found within graphic arts are incorporated within design applications and techniques (Buchanan, 2002).

This study will advance understanding of how graphic art education can be improved through scenario-based design challenge interventions and reflective practice. The implementation of 21st century skill sets such as critical thinking, problem solving, evaluation, and analysis will provide introductory students with opportunities to identify design elements associated with graphic arts and image manipulation. As individuals develop these skill sets, they will be able to improve project grades and actively prepare for their careers. Furthermore, students will increase their potential income, increase job satisfaction rates, and achieve a higher sense of purpose within a chosen occupation (National Research Council, 2012).

Research Design

For this study, critical thinking is defined by the agreed-upon statement from the APA Delphi Report that critical thinking is the “purposeful, reflective judgment which manifest itself in reasoned consideration of evidence, context, methods, standards, and conceptualizations in deciding what to believe or what to do.” (Facione, 1990, p. 3). The primary research goal was to collect and analyze data pertaining to student performance

in an introductory design applications course and how that performance related to the student's critical thinking ability. The mixed-methods action research design collected a number of data values pertaining to critical thinking through pre-tests and post-tests; artifacts associated with scenario-based design challenge interventions and image manipulation projects; and through semi-structured interviews. Additionally, the researcher kept field notes, a reflective journal, samples of student work, and performance records to better determine the scope of what happened in the classroom and to deduce patterns in enhanced skill sets.

Action research. Action research is a reflective form of research that provides access to research findings and direct outcomes related to a local problem (Mertler, 2014). The researcher is placed directly into the research setting and essentially controls the design and flow of the study (Herr & Anderson, 2015). For this study, qualitative and quantitative data was collected throughout an eight-week timeframe and during the implementation of the scenario-based design challenge interventions. Measurable outcomes in the form of project scores, reflective statements, and semi-structured interviews collected data pertaining to critical thinking skills as they related to the 21st century skill sets of critical thinking and problem solving; effective written communication; and accessing and analyzing information. This data was gathered during multiple phases and is further discussed in Chapter Three.

This study focused upon the problem of practice and sought improvement to three 21st century skill sets through the use of design challenge interventions. Each intervention was designed to promote reflective thinking, increase decision-making

abilities, and actively prepare each student for future coursework and, ultimately, their career.

Research objectives. Data pertaining to critical thinking skills and student achievement was collected through the integration of the following skill sets: critical thinking and problem solving; effective written communication; and accessing and analyzing information. The first objective was to collect data pertaining to each student's knowledge of image manipulation and Photoshop, an industry-standard design application. The second objective was to integrate design challenge interventions to develop evaluative and critical thinking skill sets. The third objective was to integrate questions related to the design challenge interventions that improved analysis of information and produced written reflective communication. The fourth objective of the study was to relate all of the data to achievement scores from instructor assigned projects and identify patterns of critical thinking after the design challenge interventions. The fifth objective was to collect data pertaining to each student's development of knowledge of image manipulation and Photoshop after the design challenge interventions and assigned projects. The last objective was collect data related to the use of critical thinking skills through semi-structured interviews. These objectives will be further discussed in Chapter Three.

Participant selection and research site. The research was conducted at *Foothills University* an institute of higher education within South Carolina. This institute serves approximately 3,212 students each academic year. Through academic semesters, the institute offers degrees in the liberal arts. Degrees and programs associated with *Applications and Foundations for Image Manipulation* include: Art Education, Painting

and Drawing, Graphic Design, Interior Design, and Communication – Visual Communication and Design. Students can earn bachelor and graduate degrees within most areas of study. Placement into the course is determined by an academic advisor or department chair. All students within the visual communication and design program are required to take the course and at least one section of the course is offered in an academic year.

Each participant was required to complete a consent letter based on the policies of the institution of higher education in which the study was conducted. The age range of the participants fell between 18 and 21; therefore, no parental consent was needed. The researcher used an institution-provided learning management system to keep participants informed of the study and any changes that took place.

Assumptions

The following assumptions were used for this study:

1. The participants are deficient in critical thinking skills and academic success.
2. The participants have reduced skills sets related to academic achievement within an introductory image manipulation course.
3. The integration of scenario-based design challenges into an introductory image manipulation course will develop critical thinking skill sets and enhance project grades.
4. The techniques of mixed-method action research are a valid and reliable method of conducting research for this type of study.

Limitations

The following limitations are recognized by the researcher as being viable:

1. The participants may lack knowledge about the profession of graphic art.
2. The participants may withdraw from the course during the research process.
3. The participants may fail to complete each design challenge.
4. The participants may fail to complete each project.

Delimitations

The following delimitations are recognized by the researcher and placed upon the study:

1. This study is restricted to one institution of higher education in South Carolina.
2. This study consists of students in one section of an introductory image manipulation course.

Conclusion

The progress of innovative goods and services, revised product designs, creative marketing strategies, updated design applications, and new media art techniques will continue to develop graphic art as a worthwhile career. Institutions of higher education are challenged with properly instilling skills sets that individuals need to succeed in the future. An updated curriculum that authentically prepares students for the workforce is a vital component of creating a successful learning environment. The success of a student depends on their ability to adapt to this challenge and dynamically incorporate deeper thinking skills. Through improved teaching strategies and stronger integration of 21st century skill sets, educators will offer students the benefit of remaining relevant and successful in their chosen careers. Through a mixed-methods action research study, the researcher will develop curriculum that enhances critical thinking, problem solving, and reflective thinking for each student. The data obtained for the study will allow the researcher to update the introductory image manipulation course in a cyclical manner. Through this approach, the researcher will be providing the incoming student body with a modernized and authentic course that actively prepares them for future coursework and their intended career.

Through this introductory chapter, the researcher provides a foundation for the proposed action research study through a statement of the problem and supplementary

background information. The research question, objectives for research, assumptions, limitations, and delimitations are each stipulated. In addition, a conceptual framework for critical thinking and reflective thinking are provided. Each of these topics is further explored and supported through literature in Chapter Two –Literature Review. The research design, methodology, and participant selection is briefly described within Chapter One, with further detail in Chapter Three – the Methodology. The results and findings of the action research study are presented in Chapter Four – Research Findings. A final discussion related to outcomes found within the research study are offered in Chapter Five – Implications and Conclusions.

Key Terms

To better understand the research problem and the ensuing question, the researcher provides the following definitions to terms that will be discussed in further detail throughout the research.

- **Critical Thinking**

In relation to this study, critical thinking can be defined as the use of intellectual tools for analytical and evaluative thinking processes that are used across life and career disciplines. Critical thinking also enables inference, interpretation, explanation, and self-regulation skills, further enhancing the interconnected logic of various subject matters (Elder & Paul, 2008; Facione, 1990).

- **Graphic Art**

The American Institute of Graphic Arts (AIGA), the largest professional membership organization for design, defines graphic arts as “the art and practice of planning and

projecting ideas and experiences with visual and textual content” (American Institute of Graphic Arts, n.d.).

- **Design Application**

For the purpose of this dissertation proposal, an application is a computer program, or group of computer programs used by an individual or group of individuals to perform an activity. Within graphic arts, design applications refer to software that is used to create and design vector graphics, bitmap graphics, multiple page publications, or websites (Gordan & Gordan, 2002).

- **Image Manipulation**

For the purpose of this dissertation, an image manipulation is the transformation or alteration of a digital image. Various tools and techniques located within design application software are used to reach a final result and create a digital image (Clawson, 2015).

- **Ideation**

To obtain higher levels of formal and conceptual innovations, graphic artists use ideation techniques such as sketching, diagramming, and mapping to visually capture ideas and move past obvious solutions to a problem. Ideation techniques allow a graphic artist to transition through the design process easily (Lupton & Phillips, 2015).

CHAPTER 2

LITERATURE REVIEW

As work environments rapidly advance, employers expect to hire employees that are professionally prepared and personally capable of adapting to organizational, economic, and service-oriented fluctuations in business (P21, 2006). Within public and higher education, educators are tasked with preparing students for the workplace. Students, in turn, must be willing to enhance and efficiently apply 21st century skill sets to maintain successful coursework and eventual employment opportunities (Carnevale, 2016). Critical thinking strategies, problem solving abilities, the use of advanced verbal and written communication techniques, the capability to collaborate with others, the capacity to evaluate and analyze information, and the ability to effectively implement creative thinking strategies are necessary skill sets for the modern work environments (Wagner, 2008). The days of working within and mastering one field are disappearing (Heller, 2005). Students within higher education that have chosen to pursue a career within graphic art must be able to work with a multitude of individuals and business organizations. Therefore, the ability to constantly improve upon skill sets is of the utmost importance (Brown, 2012). Through a statement directed towards higher education and the establishment of a community of inquiry, a study by Golding (2011) influenced this dissertation proposal:

The development of critical thinkers is widely taken to be a worthwhile goal of Higher Education. Yet it is problematic how we might educate for critical

thinking, given the multifaceted nature of *being* a critical thinker. If we are serious that university graduates should be critical thinkers, then we need to provide an educative environment where they can hone their critical skills, cultivate a critical character, understand the nature of critical thinking, including the standards for judging its quality, and understand the subject matter they are thinking about. (p.357)

Research related to graphic art, critical thinking, and reflective practice, showed that deficient critical thinking skills are common among today's employees and student-learners (Burbach, Matkin, & Fritz, 2004). The traditional application and instruction of design principles and systems of art and design within higher education have given way to a more technologically driven curriculum (EDUCAUSE, 2014). The educational development and increased skill sets of art and design students encompass many areas, therefore the development of skill sets associated with critical thinking are important to coursework and potential career opportunities. Through technological development and an evolving workplace, an individual studying graphic art can now complete the work of multiple design departments upon one device (AIGA, n.d). To maintain a high standard of design and meet the needs of individual projects, designers must be able to effectively research a variety of topics, think through creative ideas, solve problems, and communicate well with others (Davis, 2012).

Purpose of the Review

In the following literature review, topics connected to scenario-based design challenge interventions, critical thinking, and reflective practice within an introductory design application course will be discussed. These topics support the development of 21st

century skill sets in higher education courses that introduce skills associated with future coursework and careers. This literature review revealed the need for further research in the development of critical thinking skills in graphic art courses, therefore the information presented here is used to address the following overarching and ancillary questions:

1. *Within an introductory design application course, how do design challenge interventions impact the development of critical thinking in first-year university students?*
 - a. *What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?*
 - b. *What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?*
 - c. *How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?*
 - d. *How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?*

This literature review was guided by the research questions, closely related studies, and examined over an extensive timeframe. A review of the literature reveals that research in the development of critical thinking within graphic art courses is an evolving area. Research that specifically focused upon curricular interventions used to develop critical thinking and reflective practice within graphic artists is also limited. To locate

information, education databases such as Academic Search Complete, Education Source, ERIC, the Chronicle of Higher Education, JSTOR, and Sage Reference Online were used to download and read peer reviewed journals and articles. In addition to these databases, a variety of books related to the workforce of the future and compilation books dedicated to graphic art and design research were used to gather information.

Theoretical Framework

Many institutions of higher education understand the importance of students developing and demonstrating higher order thinking skills. To meet this institutional goal, educators across a variety of degrees must apply pedagogical frameworks that promote the development of critical thinking in their coursework (Fahim & Masouleh, 2012; Walker & Finney, 1999). This section will discuss progressivism, constructivism, Blooms taxonomy, scaffolding, reflection, and introduce critical thinking. Each topic helps structure this mixed method action research study.

Progressivism. Progressive education models are applicable to graphic art courses. Dewey (1938) promoted progressive teaching and learning theories throughout his career. He rejected rigid pedagogical practices from the 19th and early 20th century and believed that students should learn through experience and authentic activities. Pedagogical progressivism bases instruction upon the needs and interests of students. Progressivism promotes the transmission of information through the development and application of skills; discovery and self-directed learning through active engagement; and projects that incorporate socially relevant themes (Labaree, 2005). The idea of active learning through a community of learners connected education with society and lived experiences. Pedagogical methods such as these took precedence over techniques that

used passive learning, rote memorization, and drill and practice (Ravitch, 1983). Through active learning that incorporates educational interventions, students come together to solve problems based on experiences, increase communication skills, and create routes for deeper thinking (Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt, & Wenderworth, 2014). A curriculum filled with “community-based learning, projects, diversity, learner-centered education, and many other aspects of progressive teaching and learning” (Lin & Bruce, 2013), can be used to create educational settings that connect the interests of students to life (Nowell, 1992).

There are many similarities between the educational principles of the progressive education movement of the early 20th Century and the move to student-centered constructivist educational philosophies established within the 21st Century. One could argue that Dewey, a supporter of progressive education, would embrace the latest methods, materials, and innovations of digital instruction within the 21st Century. Through digital instruction, the major components of Dewey’s educational methodologies, such as personal learning opportunities, can be established through in-depth topical research and an endless variety of learning outcomes. This allows students direct participation in a learning activity and experience in their own education (Cunningham, 2009; Little, 2013).

Foundational courses in any degree program develop basic skills for higher level course work. Through pedagogical strategies associated with authentic projects and interventions, instructors can provide structure to introductory software application courses through thought-provoking problems. These strategies allow students the opportunity to develop technological skills while also building professional skills

(Hanney & Savin-Baden, 2013). Through the active development of basic skills, students in introductory software application courses are able to apply what they have learned and construct personal connections to the material.

Constructivism. Constructivism is commonly approached as a learning theory and a process to build upon mental abilities. The learning theory of constructivism stems from the work of Piaget (Fostnot & Perry, 1996). Through constructivism, the learner creates knowledge through a series of experiences that promote reflective thinking, filtering ideas, experience with previous knowledge, and the establishment of meaning. Piaget (1952) supported learning through play, but mainly focused upon learning through lecture where construction of meaning can take place. The educational theory of constructivism differs from Piaget's theory in that learners take control of their learning and construct their own unique meanings for concepts (Von Glasersfeld, 1998).

Lecture is seen as a passive form of instruction (Tippey, 2008), but at times viewed as a necessary instructional tool to bring learners into supervised and collaborative experiences. The ability to improve critical thinking and reflection of knowledge are common goals of constructivism. To reach these goals, a variety of instructional strategies can be implemented within learning environments throughout higher education. These environments should be authentic and complex, provide social negotiation, support multiple perspectives and modes of representation, encourage ownership of learning, and use reflection to increase self-awareness of knowledge construction (Driscoll, 2005). Curriculum incorporated with constructivism and projects can increase professional relevance, inspire research, and actively engage students (de Graaff & Kolmos, 2007).

Constructivism also emphasizes contextual learning through the use of personal learning goals (Driscoll, 2005). To ensure the attainment of knowledge, educators can provide learners with experiences that encourage interaction with content, questioning, and problem solving (Kroll & Laboskey, 1996). To facilitate links between new content and prior knowledge, educators can develop and use measurable objectives within design application courses. Bloom's taxonomy of the cognitive domain can help educators align measurable objectives with authentic assignments and assessments. Through these enhancements, courses can properly prepare and train individuals for the future workforce. Higher order thinking skills, such as analysis, synthesis, and evaluation, are found within Bloom's taxonomy of educational objectives. These ordered thinking skills and objectives support the critical thinking skill sets an employer seeks (Terry, 2012). To encourage students to think professionally, instructors should align course objectives with assignments or interventions to ensure the comprehension of concepts, develop skills, and connect solutions to real world applications (de Graaff & Kolmos, 2007).

Bloom's taxonomy. Bloom (1956) proposed that learning fits into three psychological domains – cognitive, affective, and psychomotor. For the purpose of this study, the cognitive aspects of Bloom's educational objectives are discussed. Under Bloom's taxonomy, cognitive development is comprised of knowledge, comprehension, application, analysis, synthesis, and evaluation (Shaw & Holmes, 2011). Lower levels of learning such as knowledge and comprehension do not require critical thinking skills. Within these categories, facts are memorized and basic processes are studied. These skills provide a base for learning and create links to the higher levels of thinking. Higher order levels of thinking such as application, analysis, synthesis, and evaluation, require the

combination of new and old sets of information, the ability to detect relationships, and make decisions on how information is used (McDavitt, 1994). For these categories, critical thinking takes place when content knowledge and comprehension are put into practice (Bissell & Lemons, 2006).

More recently, Anderson and Krathwohl (2001) have revised Bloom's taxonomy to include verbs instead of nouns for each category and rearranged the taxonomic sequence to the following order: remembering, understanding, applying, analyzing, evaluating, and creating. Additionally, Facione's (1998) definition of critical thinking incorporates: analysis, evaluation, inference, interpretation, explanation, and self-regulation. Anderson and Krathwohl's revised version of Bloom's taxonomy align well with Facione's definition of critical thinking. Through graphic art courses, the incorporation of these critical thinking skills through constructivist strategies employed by educators has the potential to move students from lower order thinking skills such as memorization, understanding, and application skills to higher order thinking such as analyzation, evaluation, and creation skills. These are skills the 21st century workforce demands (Bybee & Fuchs, 2006). Educators can use scaffolded instruction to help students effectively build knowledge, develop creativity, and learn how to apply skills in settings beyond the classroom.

Scaffolding. Within the classroom, lower order thinking skills are often interwoven with higher order thinking skills. To accomplish this, educators can use scaffolding, or support structures in their curriculum. Scaffolded learning supports the development of new understandings, new concepts, or new abilities. Through this structure, educators can help learners acquire skills appropriate to their discipline and

gradually withdraw support as learners grasp new tasks and understand concepts (Mercer, 1994; Wood, Bruner, & Ross, 1976).

Scaffolded instruction stems from Vygotsky's sociocultural theory and concept of the zone of proximal development. Vygotsky (1980) believed that adults foster a child's learning and development through social interactions or contextual situations. Students continuously develop their cognitive and metacognitive skill sets by: interacting with people, developing inner speech, and establishing a zone of proximal development. Through social interactions, learning takes place when students participate in experiences that are meaningful. Students develop intellect through the internalization of concepts and interpretations of an activity. During social interactions, inner speech is also taking place and directing personal cognitive activities. Inner speech is developed through reflection upon personal thoughts and later directs decisions (National Research Council, 2000).

Scaffolding also includes Vygotsky's concept of a zone of proximal development (ZPD). This zone incorporates information learned during a social interaction, a contextual situation, or through assistance from an educator. As educators' present new concepts, students may enter the zone or situation with a basic understanding. Through guided support, learning is increased through supervised problem solving and collaborative activities (Whiteside, 2015). The learner develops new understanding by expanding upon prior knowledge.

Educators can support and facilitate this development through building upon previously taught content, assisting in the internalization of new information, and helping students get to the next level of knowledge. As learners increase their knowledge and use of skills, the educator can slowly withdraw and allow the learner to complete a task or

master a concept on their own (Chang, Sung, & Chen, 2002). When educators use instructional strategies that scaffold, students can become independent, self-regulated learners, and problem solvers (Brown & Palincsar, 1989). Independent and self-regulated learners use a variety of skills to retain and apply knowledge. Scaffolding helps learners know how to think and apply new skills in a variety of new contexts (Hammond & Gibbons, 2005). This ability also involves the learner to reflect upon prior knowledge.

Reflection. Reflective practice can enhance learning and allow for additional forms of engagement with course content. Dewey (1933) is commonly associated with the concept of reflection in education during the twentieth century. To Dewey, reflection was a special form of thinking that lead to problem solving and establishing links between previously learned knowledge, ideas, and skills. Through the connection of knowledge and beliefs, reflection is an active and deliberate cognitive process.

Boud, Keogh, & Walker (1985) define reflection as “a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciation” (p.3). Through this definition, reflection through intellectual and affective activities would include inference, recollection, generalization, discrimination, evaluation, analysis, judgement, and problem solving.

Schon (1987) developed a constructivist framework for reflective practitioners, or those engaging in professional activity. His research focused upon educators but can be applied to practitioners that engage in any kind of professional activity. Schon describes that two kinds of reflection can take place in professional settings; reflection-in-action and reflection-on-action. Reflection-in-action is implied when a professional has reached

a stage of competence and is able to think consciously about what is taking place around them and has the ability to modify action immediately. Reflection-on-action takes place when practitioners review past actions and learn from previous experiences (Hatton & Smith, 1995).

Through progressive educational models that promote higher order thinking skills, students can build upon their mental abilities and construct knowledge. Through constructivist learning techniques, educators within the field of graphic art can create educational environments that promote authentic experiences, encourage interaction among students, increase the ability to solve problems, and promote reflective thought process. Scaffolded learning and reflective practices support progressive and constructive educational environments. Through scaffolded learning, educators can improve upon skill sets and develop knowledge. In addition to scaffolded learning, educators can use reflective practice within educational settings to connect prior knowledge and skills to newly acquired information. To understand how educators implement these techniques, one must understand why the development of critical thinking within higher education is desired.

How Educators Develop Critical Thinking Skills in Higher Education

The nature and practice of becoming a critical thinker takes time. Educators have been incorporating pedagogical strategies with coursework to help learners improve upon this multifaceted skill (Bray, Green, & Kay, 2010). To better understand why critical thinking is frequently incorporated with course objectives in higher education and used as a focus in this mixed method action research study, this section will briefly describe the history of critical thinking, critical thinking in higher education, discuss the enhancement

of critical thinking skills through scaffolding, and explore how the use of Bloom's taxonomy can assess critical thinking.

History of critical thinking. Critical thinking is an important part of everyday thinking and often labeled with a variety of terms such as – higher order thinking, problem solving, rational thought, or reasoning. Each of these terms can be confusing to individuals, but ultimately help them properly assess situations and make decisions related to a variety of contexts and disciplines (Lewis & Smith, 1993). Traditionally, critical thinking is studied from two positions, philosophy and psychology. It can be difficult to merge these two positions, but critical thinking shapes how we develop as ethical human beings and provides a purpose for us to continue seeking knowledge (Renaud & Murray, 2008).

The practice of thinking critically can be traced back to the classical Greek philosophers; Socrates, Plato, and Aristotle. All of these philosophers employed what is called the Socratic Method to study religion, law, politics, and society (criticalthinking.org, 2013). The Socratic method is based on inquiry and discussion between individuals; dialogue is the key to knowledge through this learning process. Socratic questioning involves the use of questions between individuals that stimulate deeper, analytical, or *critical* thinking. Individuals implementing the Socratic method seek evidence, examine expressed reasons and assumptions, analyze concepts, and research implications of what is stated and completed (Golding, 2011; Lombard, 2008). Further development of critical thinking came through several influential philosophers across the centuries. From the early 18th century to modern times, the definitions of

critical thinking have been adjusted to include creative thinking, problem-solving, and metacognition.

Critical thinking in higher education. W.G. Sumner (1906) recognized the need for critical thinking and reflective thought in education in the early 20th century. Additionally, Dewey (1933) integrated the idea of increased self-thought and reflection into his educational reform theories. The term *critical thinking* was created by B. Othanel Smith (1953) and focused upon how thinking skills were taught within a classroom (Brandt, 1987). More recently, the research of Scriven & Paul (1987), Facione (1990), Brookfield (1995), Halpern (1998), and Elder & Paul (2008) has further advanced the development and use of critical thinking skills in educational settings.

Critical thinking definitions and frameworks are wide ranging, often times overlapping, and diversely applied within educational settings. Scriven & Paul (1987) define critical thinking as a disciplined process that incorporates conceptualization, application, analysis, synthesis, evaluation, experience, reflection, reasoning, communication, and belief. Facione and the Delphi Group's (1990) dispositions toward critical thinking encompass inquisitiveness, desires to be well-informed and use critical thinking, open and fair mindedness, flexibility and willingness to considering alternatives, and understanding other opinions. Brookfield (1995) focuses on learner assumptions and interpretations. Halpern's (1998) dispositions focus upon willingness, persistence, planning, follow through, open mindedness, flexibility, and self-correction. Paul & Elder (2008) focus upon self-directed, self-disciplined, self-monitored, and self-corrective thinking. Each framework or definition work together to form a significant

concept of critical thinking. Through this variety of dispositions, educators can convey information and prepare learners for the active application of knowledge.

For this study, critical thinking corresponds with an APA Delphi Report where Facione's (1990) understanding and definition of critical thinking is stated as the "purposeful, reflective judgment which manifest itself in reasoned consideration of evidence, context, methods, standards, and conceptualizations in deciding what to believe or what to do." (pg. 3). To meet these criteria, educators can provide situational questions, scaffolded assignments, and activities that require information stored in a learner's memory to interact with new information. Higher order thinking takes place when this information is used to achieve a purpose and find solutions (Lewis & Smith, 1993). This can take place in higher education within a single course or throughout a degree program.

Within higher education, critical thinking is supported and promoted by faculty as part of their curriculum. Educators that simply follow predetermined curriculum guidelines do not foster the development of critical thinking and struggle to improve the cognitive abilities of students (Pithers & Soden, 2010). A transition to student-centered teaching promotes active learning, active inquiry, research, and links within knowledge and content (Langer, 2016).

This transition is not always smooth. Halx and Reybold (2006) state, "When students first begin to think critically, they often experience discomfort because critical thinking calls for students to reflect; set aside their established assumptions; and consider other, sometimes counter, perspectives" (p. 296). When students move from the

classroom to the workforce, critical thinking skills remain an integral part of everyday interactions.

When solving problems, evaluating ideas, and making decisions, the internal motivations of a person constitute a disposition of critical thinking. A person's attitude, values and inclinations relate to their personality and how they approach problem solving and reasoning (Giancarlo, Blohm & Urdan, 2004). Through projects and challenges, students can develop confidence in their abilities to perform well in a variety of domains. When educators use curricular methods based on authentic projects, students show enhanced critical thinking abilities, communication skills, increased investigative techniques, and improved reflective writing skills (Tamim & Grant, 2013).

In classrooms that use authentic projects, undergraduate students learn directly from their teacher and peers (Korfhage Smith, 2010). Within curriculum based on projects and interventions, common problems associated with introductory graphic art courses allow educators the opportunity to work with relevant examples of image manipulation and scenarios. Students are able to work independently or collaboratively on assignments, solve problems, and develop critical thinking skills. In turn, these skills allow individuals an opportunity to learn how to manage their time, develop technical design skills, make informed decisions, communicate effectively, and become accustomed to a work environment. The use of scaffolded learning promotes these skills.

Enhancement of critical thinking through scaffolding. Scaffolding allows educators an opportunity to explain content from multiple perspectives, link information, and support learners through curricular tasks and assessments (Langer, 2016). As the students become more active in their learning, they increase in competence, ask

questions, and personally seek information related to problems (Pithers & Soden, 2000). The role of the educator becomes supportive and when appropriate, becomes involved with the learning process again through an intervention (Wood, 1999).

Through scaffolding, learning occurs between a novice and an expert during interpersonal interactions in the classroom. Through these interactions, the expert can model how to perform tasks and continue to offer high levels of support and guidance while the student completes the necessary practice (Larkin, 2002). As students reach acceptable levels of competence, the support from the educator begins to fade away and allows the student to feel confident in their decision making and acquisition of new information (Sharma & Hannafin, 2007).

Within introductory technology- and skill-based environments, scaffolding can support a novice's learning. In learning environments where technology-based instruction and face-to-face instruction take place, scaffolding can be used to promote interaction among peers and increase the use of technological tools (Sharma & Hannafin, 2007). Scaffolded learning can be used to support technologically enhanced learning environments usually found within introductory design application courses. These courses use design application overviews, routine design tasks, and step-by-step tutorials to direct students in the application of skills and techniques associated with graphic art.

Routine tasks and step-by-step tutorials are scaffolded templates that precisely connect and focus the attention of students upon specific design processes used within graphic art (Hadwin & Winnie, 2001). Through the directed approach of tutorials, educators can prevent learners from engaging in unnecessary tasks and provide students' a reference point and support during creative assignments. Students are able to access

multiple viewpoints from experts and tutorials, thus improving upon strategies selected for problem-solving and design processes. As students become independent, they can begin to use creative design processes, apply skills, and focus their thinking on complex designs (Cho & Jonasses, 2002). Throughout this process, the educator provides enough scaffolding to keep the students on task, but otherwise allows them to take on the responsibility of making good design decisions and take control of their learning (Wass, Harland, & Mercer, 2011).

Use of Bloom's taxonomy to assess critical thinking. Institutions of higher education often support critical thinking as a major educational goal with the ability to self-assess and knowingly implement high order thinking as a primary objective (Kurfiss, 1988). Faculty also believe that critical thinking should generally be taught and infused with coursework and expanded throughout degree programs (Ennis, 1989). They knowingly implement these skills throughout curriculum and use a variety of instructional strategies that focus on critical thinking. Despite these beliefs, faculty rarely develop summative or formative assessments to measure high order thinking in their courses (Bissell & Lemons, 2006; Tsui, 2002). Bloom's taxonomy can aid faculty in the formation of assessments and be used as a learning process.

Through use of the taxonomy, educators in higher education have a guided process for stating objectives and planning instruction. Clearly defined assessments that meet course objectives and instructional strategies can be easily created (Airasian & Miranda, 2002). Scholarly assignments that require greater analytical abilities, actively integrate multiple perspectives, organize themes, and highlight differences among ideas,

fall into high order thinking found in Bloom's Taxonomy of the Cognitive Domain (Shim & Walczak, 2012).

First year students enter higher education with undeveloped critical thinking skill sets as most educators use lower level orders of cognition in their instruction (Eber & Parker, 2007). Simply recalling facts and description techniques do not allow for positive cognitive development (Murphy, 2007). As a learning process, faculty can use the taxonomy to direct learners to high order thinking skills. Before a concept is understood, the learner must be able to remember it. Before a concept can be applied, the learner must be able to understand it. Before a concept can be analyzed, the learner must be able to apply it. Before a concept can be evaluated, the learner must be able to analyze it. And lastly, before a learner can create, he or she must be able to remember, understand, apply, analyze, and evaluate the concept (Anderson & Krathwohl, 2001). To positively impact critical thinking skills, faculty can use each level of the taxonomy to create authentic assignments. As Christopher, Thomas, and Tallent-Runnels (2004), state, "Real learning happens when individuals can see connections and make changes in their own environment" (p. 170).

When educators do attempt to measure critical thinking, it usually takes place through multiple choice tests and questionnaire responses (Tsui, 2002), where students dutifully answer questions without applying knowledge and problem solving (Kearney, 1986). Specific instructional techniques do not always enhance the ability of a student to think critically, therefore, when searching for instructional strategies that incorporate critical thinking, educators must consider how specific levels of thinking will be assessed (King, 1995). Smith (1977, 1981) and Terezini, Theophilides, & Lorang (1984) found

positive gains in critical thinking when instructors increased student involvement; used encouragement, praise, or student ideas within their courses; and interacted with students. Renaud & Murry (2008) found that students show an improvement in critical thinking ability when educators incorporate relevant content that is directly related to the student's degree program. To determine these factors, educators can create rubrics based on Bloom's Taxonomy of Educational Objectives and focus upon specific disciplines (Eber & Parker, 2007).

Bloom believed that the taxonomy could be used to align course objectives, activities, and assessments (Krathwohl, 2002). To maintain alignment between curriculum, specifically designed rubrics related to critical thinking skill sets and terminology can help educators ascertain a student's ability to think through projects and problems (Daniels, 2010). Rubrics related to course content and real world context can be used to accurately measure if activities and assignments truly improve critical thinking skill sets (Noblitt, Vance, & Smith, 2010).

A variety of terms can be associated with critical thinking skills and used within rubrics; therefore, Bloom's taxonomy remains relevant to higher education. Learners cannot move through Bloom's taxonomy without enhancing learning. Knowledge is a lower order skill, but comprehension is one level higher on the taxonomy. To comprehend, a learner must understand, organize, compare, and interpret information (Anderson & Krathwohl, 2001). Once a learner is able to comprehend, he or she can apply facts, techniques, skills, and knowledge to solve problems. If further comprehension is needed, the learner can analyze or break down information into parts, look for relationships, and understand structure and purpose of the problem. Synthesis,

uses the previous levels of the taxonomy to look for different patterns in information, develop alternative solutions, and derive new information. Finally, the highest order of thinking within the taxonomy is evaluation. Through this level learners are defending viewpoints and supporting judgments through valid sources (Anderson & Krathwohl, 2001). Nominal values can be assigned to course objectives that incorporate terms associated with each level of Bloom's taxonomy. As students respond to specifically worded prompts, values can be calculated and compiled to show an increase or percentage of use in higher order thinking skills. Reflective writing, application of knowledge, and analytical enhancement skills combine to increase higher order thinking techniques (Eccarius, 2011).

Educators seeking an improvement in critical thinking skill sets must remember that the ability to think critically is different than the disposition to think critically. If a person performs well on a critical thinking assessment, that does not mean they will always choose to think critically or creatively (van Gelder, 2001). Giancarlo et al. (2004) state, "Educators at all levels agree that there are students in their classroom who are able to think well but simply choose not to utilize those skills on a regular basis." (p.361).

Educators must take the time to develop measurements that showcase critical thinking abilities in relation to course content (Frisby & Traffanstedt, 2003). The use of a commercially available critical thinking test is unlikely to imply that a student has a reflective approach to their education and would not apply to specific course disciplines and the application of critical thinking skill sets. Publications tend to describe what critical thinking is (Brookfield, 1995; Elder & Paul, 2008; Facione, 1990, Halpern, 1998; Smith, 1953), and strategies used to teach critical thinking (Halpern, 1999; Meyers, 1986;

van Gelder, 2005). The measurement of critical thinking differs across disciplines, therefore studies related to Bloom's taxonomy and the use of rubrics to determine critical thinking are focused upon for this mixed methods actions research study.

Instructors at Duke University, Bissell and Lemons (2006) collaborated on a way to help faculty assess and develop critical thinking skills for students enrolled in an introductory biology course. Through Bloom's taxonomy, the researchers developed a scoring rubric that separately assessed course content and critical thinking skills. Through this rubric, discipline specific questions can be analyzed and measured. Using a detailed process and evidence-based research, Bissell and Lemons developed their methodology for designing, testing, and scoring discipline specific assessment in several stages. Their process begins with developing a series of questions related to biology and critical thinking skills. Second, they documented course content and paired it with specific levels of Bloom's taxonomy. A scoring rubric was then created. Third, the discipline specific questions were validated by experts in biology and biological education. Fourth, the researchers scored student assessments based on the rubric.

Bissell and Lemons (2006) reported that use of this methodology positively affected the introductory biology students and helped them understand how to use critical thinking. The researchers state:

For example, thinking in advance about what we want questions to accomplish in terms of both content and critical thinking has enabled us to be explicit with students about the skills they need to develop in order to succeed in the course. We have reviewed questions and grading rubrics in our lectures and made examples of them available to students outside of class. As a result of this

exposure, students were more aware of the quality of responses we expected for questions and could easily cross-reference their own responses with our explicit guidelines. These efforts helped students reflect on and improve their thinking (and writing) abilities—concept referred to as metacognition (p. 70).

Bissell and Lemons (2006) found that the rubric did benefit students in introductory biology courses and suggest their methodology can be used across different disciplines. “Since one characteristic of critical thinking is the awareness that a given question may have more than one correct answer, this methodology allows alternative answers to be considered and possibly built into the scoring rubric” (p. 71). In conclusion, the researchers offered three advantages for student learning. “First, these types of assessments demand content knowledge, so there are no “wasted” questions. Second, the assessments are flexible, in that they can be easily amended to accommodate unforeseen answers and can be weighted to favor either the critical-thinking component or the content component. Third, the assessments can be more rapidly and reliably scored than other “open-ended” questions because of the highly refined format of the scoring rubrics” (p.71). To further examine the transferability of skills and introduce this methodology into interdisciplinary studies, the researchers planned to collaborate with other departments and disciplines at Duke University. Through this effort to collaborate with peers, Bissell and Lemons can help faculty recognize the value of assessing critical thinking and introduce a method that measure course goals and content appropriately.

For this mixed method action research study, reflective statements are assessed through the Holistic Critical Thinking Scoring Rubric produced by Facione and Facione (1994). Landis, Swain, Friehe, & Coufal (2007), present an action research study on how

online discussions are used to promote critical thinking skills in an high school AP American Government course. To maintain validity and reliability in the study, the researchers chose two commonly accepted assessment methods for critical thinking, the Newman Method and the Facione Rubric. Throughout the study, these two methods were used to compare in-class and on-line discussions.

The Newman Method refers to the Content Analysis Method to Measure Critical Thinking and Computer Supported Group Learning. This method was developed by Newman, Webb, and Cochrane and is used to analyze face-to-face and asynchronous online discussions. The framework for this method is based on Garrison's (1992) description of critical thinking, where the "construction of meaning through internal reflection by the individual and the sharing of personal constructs, thereby establishing a "cognitive presence" in the discourse" (p. 136). Using the Garrison description of critical thinking, the researchers developed a technique to categorize and assess the range of critical thinking iterations repeated during discussions. The researchers matched the statements with positive or negative codes and used an equation to arrive at a critical thinking ratio for each discussion.

As an alternate approach to measuring critical thinking, the Holistic Critical Thinking Scoring Rubric created by Peter and Noreen Facione (1994) was used in the study. To measure critical thinking, the Facione rubric uses broader criteria than the Newman method. Facione and Facione believe that six behaviors are involved when critical thinking takes place. They are: analysis, interpretation, evaluation, inference, explanation, and metacognition. A four-level performance-based rubric was designed by the Faciones to analyze critical thinking behaviors. Level 1 indicates low levels of critical

thinking, while Level 4 indicates higher levels. When using this rubric to assess critical thinking, the Faciones suggest using two-raters that later reconcile differences through conversation, using a third independent rater, or averaging initial scores.

The researchers adhered to the guidelines of each method and began data collection within the AP American Government course. During discussion, four questions were presented to the students during topics in the course and assigned first through an in-class discussion and followed by an online discussion. Two questions sets were created and alternated during the study. Due to the course schedule, the students had one week to discuss questions online. In-class discussions were held in groups, recorded and transcribed. Online discussions were archived and printed. A three or four-person team of educators analyzed the discussions using each method. The researchers then compared the results. To further establish a reliable method for measuring critical thinking, the researchers dispersed a questionnaire to the three to four-person educator teams seeking responses on ease of use, expansion of understanding of critical thinking, accuracy of measurements, comprehensiveness of the tools, and commentary.

Both methods of assessment for critical thinking took different approaches to identify critical thinking behaviors. The Newman method was determined too cumbersome, produced inconsistent results from the raters, contained hard to follow methods for rating discussions, and was time-consuming. The Facione rubric was generalized, produced changes throughout the sample, produced variance between ratings, but also produced greater agreement from the raters, and provided time for the raters to discuss ratings. Each of the raters questioned the reliability of the tools and had problems justifying which tool produced the most significant results.

The researchers found the Facione rubric best at producing higher levels of reliability and ease of use when applying to large samples but could not recommend one tool over the other. “Given the attention that higher level thinking has been given in educational theory and practice throughout the years, it is surprising that more reliable tools are not available for assessing this highly desired outcome of learning” (Landis, Swain, Friehe, & Coufal, 2007, p.142.).

Structured Learning Environments That Impact Critical Thinking

“The purpose of an educational experience, whether it is online, face-to-face, or a blending of both, is to structure the educational experience to achieve defined learning outcomes” (Garrison & Cleveland-Innes, 2005, p. 134). Within higher education, an introductory design application course would be placed within a variety of pre-professional degree programs. The learning environment and curriculum for an introductory course should guide students to contextual knowledge, facilitate problem solving, encourage reflective thinking, and support critical thinking (Demetriadis, et al, 2007). This section will discuss how scenario-based assignments, scaffolded questioning, and reflective practice impact students enrolled in pre-professional degree programs or introductory graphic art courses.

Scenario-based design challenges. For graphic art, an introductory image manipulation course that focuses upon the digital workspace, tools, and techniques of Photoshop would familiarize students with the work of design professionals and assist students in judging their ability to study design or image related coursework (Davis, 2004). The use of scenario-based assignments that incorporate scaffolded questioning and written reflective statements supports the skill sets needed for successful completion of

courses in higher education and the eventual achievement of earning a professional degree (Coulson & Harvey, 2013).

Occupations in the 21st century are often described as collaborative, creative, and focused upon problem solving. A learning environment that promotes active learning techniques may enhance a student's critical and creative thinking skill sets (Hagel, Brown, Mathew, Wooll, & Tsu, 2014). Instructional techniques such as lecture, overview, and self-paced tutorials promote a passive learning environment (Pellegrino & Hiton, 2012). To help students learn in their own way, scenario-based assignments have been used as effective teaching strategies in education for a number of years. A scenario-based assignment establishes a professional mindset, presents a problem to the learner, and requires them to respond by interacting with the information given and reflect upon solutions (Heitzman, 2008). For the purposes of this research study, these scenario-based assignments are referred to as *design challenges*.

Kolodner (2002), uses the term “design challenge” within middle school science-based courses. Her definition of a design challenge focuses upon the educator providing a reason to learn new content and engages students in skillful practice and application of their knowledge. Curriculum units organized around the design challenge can provide students with opportunities to access prior knowledge, apply what is being learned through practice, receive feedback, and improve upon cognitive skills. Through the use of scenarios, educators provide students with an opportunity to reflect upon and apply their skills during a task.

For an introductory undergraduate graphic art course, condensed scenario-based design challenges can be used to present realistic, complex, and contextually appropriate

materials to students. According to McNergney, Herbert, & Ford (1994), scenario-based design challenges should be no more than one page in length and built upon topical overviews, classroom discussions, tutorials, and assignments taking place within the course. Through design challenge assignments, educators can use structured statements that lead learners through analytical research techniques that promote problem solving and decision-making skills (McDade, 1995). To align with Bloom's Taxonomy, scenario-based design challenges can use scaffolded questioning and reflective statements to promote high order thinking skills such as analysis, evaluation, and synthesis (Demetriadis, et al, 2007; Kunselman and Johnson, 2004).

Scaffolded questioning. Introductory design application courses focus upon specific skill sets, design processes, and the application of knowledge to new context. Through the use of scaffolded questioning and scenario-based design challenges, educators can encourage the learning and application of skills (Brown & Palincsar, 1989). Educators also support the development of contextual knowledge when new skills are applied to new problems (Hammond & Gibbons, 2005). Research shows that scaffolded questioning can improve a student's ability to solve problems, apply skill sets, and increase understanding.

Demetriadis, Papadopoulous, Stamelos, and Fischer (2007) investigated the efficiency of scaffolded learning during case study in technology enhanced environments. The premise of the study was that scaffolded questioning during case studies activated cognitive processes within students and promoted learning of contextual information. During the study, the researchers employed the strategy of using specific and scaffolded question prompts to guide students' attention to important aspects of case-based material.

This strategy seemed to improve the conceptual knowledge of students and enhanced problem-solving skills.

The researchers conducted a thorough literature review and found that “adding “why...” questions to textual information resulted in greater factual and inference learning” (p.940) for students involved with technology-enhanced learning environments. The authors found that “why...” questions directed students toward course goals, focused attention, modeled additional student questioning, and helped visualize thinking and reflection.

Demetriadis et al. (2007) found that when educators use case-based learning as an instructional method, they can encounter challenges. First, if the case study is too simple, educators can create misunderstandings of domain specific knowledge. Therefore, students need to work through several cases to develop specific knowledge. Second, educators should support the transfer of knowledge through original problem-solving situations. This increases the ability of students to recall and reflect upon larger amounts of information and actively construct solutions.

The researchers used information obtained from the literature review to develop eCASE, a web-based environment that supports case-based learning with scaffolding through question prompts. The researchers conducted the study within a challenging project management course. The four-phase study included a pre-test, a simple case to familiarize participants with the researcher created eCASE, a case-study phase, and a post-test. A control group and an experimental group were established for the study.

Outcomes from the study indicated that scaffolding questions can activate context-generating cognitive processes and have positive effects on learning. This was

reinforced by higher performance of the experimental group over the control group. The experimental group exhibited deeper domain knowledge and understanding, which held potential for knowledge transfer in future situations.

When students are able to process information, and articulate their understanding in answers to question prompts, relevant information can be easily recalled. Through question prompts, students can connect information between cases, articulate their conclusions, and develop deeper understanding of domain knowledge and principles. Demetriadis et al., used questioning schemes that can be further manipulated and formatted to fit within a variety of traditional instructional environments or technology enhanced learning environments.

For educators, the tasks of creating scaffolded curriculum and developing formative and summative assessments that incorporate appropriate levels of critical thinking can be a challenge. Through use of Bloom's taxonomy, educators can better align course objectives with forms of assessment and measure improvements in critical thinking.

Through quasi-experimental research that gathered quantitative and qualitative data, Ge and Land (2003) studied the effects of questioning and peer interactions in scaffolded problem solving in undergraduate students. Previous research has focused upon deficiencies in problem solving and failures to apply knowledge, therefore the researchers were interested in scaffolding strategies that can be adapted to support cognitive and metacognitive skills during attempts at problem solving. Specifically, the researchers were focused upon question prompts and peer interactions when ill-structured tasks were assigned.

The use of ill-structured problems requires students to use domain specific knowledge, as well as structural knowledge to formulate a solution. Question prompts can be used to focus student attention and monitor their learning through responsive statements. Peer interaction can support reflective social conversations. This helps students hear and consider a variety of viewpoints, in which they are able to make decisions based on evidence. The question prompts used within the study were “domain specific and meta-cognitive like” (Ge & Land, 2003, p. 24) and prompted students to analyze specific details during different phases of the study. The question prompts also assisted students in their planning, monitoring, and evaluation when looking for solutions. Peer interaction took place during collaborative group sessions that involved three to four students. Through collaboration, students were expected to solve problems and interact with each other to determine meanings, share knowledge, and develop solutions.

The study used ill-structured problem-solving tasks based on authentic problems related to information science and technology.

Students across all the four conditions were instructed to analyze the problem, propose information technology solutions, support their solutions with evidence, and evaluate their solutions. The output of the task was a two- to three-page solution report, accompanied with a diagram of their proposed system. (Ge & Land, 2003, p.26)

The tasks were measured through an individual versus group context. The participants answered ten questions created by the course instructors who were considered information science and technology experts. The question and sub-question

prompts were organized into four categories: problem representation; solution prompts; justification prompts; and monitoring and evaluation prompts. An analytical rubric based upon theoretical frameworks for ill-structured problems was developed and used to evaluate the problem-solving reports.

Through quantitative and qualitative data analysis, Ge and Land (2003) concluded that question prompts can support both well-structured and ill-structured problem-solving tasks. Structured guidance, where the questions act as cues to direct student attention can enhance knowledge representation and direct students to neglected information. Prompts that seek justification can direct students to understand when, why, and how they can apply understandings. Question prompts that monitor and evaluate progress can help students think through alternative solutions and ensure they are viable. Furthermore, the researchers found that problem-solving through peer interactions can be effective when scaffolding strategies are used in certain conditions. Within this study, problem-solving through peer interaction allowed students to build upon the ideas of others. This also produced responses, explanations, shared perspectives, and gaining advantages from other's knowledge.

The study produced a large amount of data which can be used to guide further studies related to scaffolded questioning prompts. Research in this area can be expanded through replication of the study through additional methods of scaffolding questions and focus upon individuals.

Reflective practice. Face to face discussions frequently bring out expressions of knowledge through points of view, references to instructor handouts, statements of fact, and general agreement. When students engage in reflective practice they think back to

educational experiences and former knowledge. Reflection allows a student to form new understandings and appreciation for topics as they are taught (Dewey, 1933; Boud, Keogh, & Walker, 2013). Prompts that encourage written reflective or descriptive statements further promote justification of facts and statements through evidence (Ge & Land, 2003), thus leading to higher order thinking and attainment of knowledge (Guiller et al., 2008). An effectively worded prompt can create and maintain high-order thinking skills throughout reflective writing. Prompts help students develop learning concepts and construct a deep understanding of course topics (Chen, 2010). The use of reflective writing within scenario-based design challenges that use scaffolded questioning promote transfer of knowledge and can help students “define, question, and interact with content, concepts, ideas, values, beliefs, and feelings” (Hubbs & Brand, 2005, p. 65).

Even at basic levels, reflective practice through writing can advance habit of mind, provide for flexibility in thought processes, and develop analytical and logical reasoning skills sets (Lunney, M., Fredererick, K., Spark, A. & McDuffie, 2012). Through these practices, students are using metacognition, a form of reflective practice. (National Research Council, 2000). Metacognition is the process used by people to plan, monitor, and assess personal learning (Flavell, 1979). Metacognition or reflection is an important step in the design process. Through reflective practice, learners can begin to control their personal thinking skills and later enhance their understanding of how personal knowledge is constructed (Al-Samarraie et al., 2013; Schon 1983).

Through a blend of prompts related to subject matter, instructors can promote in-depth thinking skills and help students learn how to clarify arguments, promote reflection, and organize their thoughts (Guiller et al., 2008; Lim, Cheung, & Hew, 2011).

Reflective writing, allows students an opportunity to move past surface level thinking and further develop their cognitive abilities, increase skill sets related to research, identification, assumption, evaluation, assessment, and articulation (Stover & Pollock, 2014). To increase the effectiveness of scenario-based design challenges, educators should give students sufficient time to reflect upon their research and better develop understanding of a problem before moving forward with additional assignments (Kong, 2014). “Reflection lies somewhere around the notion of learning and thinking. We reflect in order to learn something, or we learn as a result of reflecting” (Moon, 2013, p.80).

de la Cruz and Mejia (2017) report upon student outcomes when semiotic theory is placed into studio courses found within a graphic design program. Semiotics is considered to be an important theory within the practice and education of graphic art, however it is rarely taught. Semiotic theory is important to understanding and producing visual signs, yet, students are not motivated to read through theory without a relation to their future practice or career.

Through a literature review, de la Cruz and Mejia (2017) determined that semiotic theory could improve the design process for up-and-coming graphic designers. The researchers examined how a didactic strategy that uses semiotic theoretical reflections could stimulate learning and combine theory with practice. The researcher’s reflective instructional strategy included three core elements: learning based on authentic problems presented as design challenges; use of graphic/communicative prototyping in iterations; and tested meaning through communication with peers. This strategy was implemented through three phases; construction, confrontation, and feedback. During the construction phase, students read about semiotic theory, worked in small groups, and created

functional prototypes. During the confrontation phase, students participated in a class-wide critique. For the third phase, the up-and-coming graphic designers collected feedback from other students in the class and took time to individually analyze data. This strategy allowed students took control of their own learning through collaboration and peer-to-peer feedback.

de la Cruz and Mejia (2017) used qualitative data collection techniques such as interviews and observations. Undergraduate graphic design students with prior knowledge of semiotic theory and in their second semester of college participated in the study. A case-study from a previous graphic art course was the basis of the design project and allowed the researchers to provide an authentic assignment.

Through interviews and direct observations, de la Cruz and Mejia (2017) found that students entered the course with limited knowledge of semiotic theory and used simple, surface level internet searches to learn about their assigned topic. The researchers also noted that the students also relied upon the course instructor to guide them through the design process. As the study progressed, the researchers witnessed changes in student participation, argumentation, and documented learning through peer-to-peer feedback.

The first design challenge was based upon reading, therefore student participation in the assignment was low. During the second design challenge, when construction of a design took place, the researchers observed a high level of student participation. Students participated in professional design studio tasks, such as sketching, observation of other design processes, and simple forms of argumentation. During the third design challenge a high student participation level was maintained, continued outside of class, and enhanced communication between team members and others critiquing designs. Throughout this

process, the researchers observed student comprehension and reflection through the use of semiotic terminology during feedback and how groups relayed information to an audience.

After the reflective didactic strategy created by the researchers was implemented, a second set of interviews took place at the end of the course. The researchers stated, "...students reported recognizing the benefits of the didactic strategy, although they still felt that semiotics is a difficult and complex theory" (de la Cruz & Mejia, 2017, p. 92). The final interviews revealed that students gained a greater appreciation for communicating among and with their peers, especially when design problems were beyond their understanding and skill set. The researchers concluded that the confrontation stage of the study improved upon each student's reflective design process and challenged the students to test their comprehension of semiotics and use terminology during collaborative work time.

While some students did not respond well to the design challenges, feedback sessions, or working with a team, the authors witnessed positive effects on comprehension and use of semiotic theory in a studio-based course in graphic design. For this reflective didactic strategy, the researchers recommend further study on the confrontation phase as it "generated rich reflection in the students individually and in conversations within the studio" (de la Cruz & Mejia, 2017, p. 95).

Conclusion

As students make decisions to pursue careers in the field of graphic art, design educators in higher education must be willing to improve upon course development techniques and incorporate new instructional strategies. The integration of 21st century

skills sets within a course can actively prepare future artists for a variety of work environments. This literature review supports the need for development of critical thinking skills within entry-level graphic art courses. Design educators can develop these skills through a constructivist model of education that incorporates higher order thinking skills, scaffolds information and assignments, and has students learn within structured reflective environments. Scenario-based design challenges that use scaffolded questioning and reflective writing could increase creativity, enhance collaboration among peers, and improve upon problem solving skill sets. To further investigate these claims, chapter three will describe the research design, methodology, and tools used in this mixed-methods action research study.

CHAPTER 3

METHODOLOGY

The purpose of this chapter is to describe a mixed-methods action research strategy that includes qualitative and quantitative data collection used to address the following research question:

Within an introductory design application course, how do design challenge interventions impact the development of critical thinking in first-year university students?

Statement of the Problem

The researcher-observer of the present mixed-methods action research study identified that students entering portfolio-based graphic art programs in higher education have deficiencies in critical thinking (Cassner-Lotto & Barrington, 2006; Reid & Moore, 2008; van Gelder, 2001). This problem was identified through the observation of undergraduate students enrolled in an introductory graphic arts course and witnessed throughout several academic terms. Previous research showed that critical thinking skills could be developed in introductory design application courses through the use of scenario-based design challenges focused upon design applications and questions that promote reflective writing (Ellmers, 2015; Golding, 2011).

At its essence, *Applications and Foundations for Image Manipulation* is an introductory course related to Photoshop, a design application used within the graphic arts field. The goal of the course is to prepare students for sequential graphic design

courses and gain a basic understanding of the tools and techniques used within the design application. In addition to basic understanding of the digital tools, the course examined image manipulation techniques that can be used during an artistic design process. To develop critical thinking skill sets, the researcher-observer explored the refinement of an introductory graphic arts course and searched for methods to increase critical thinking and enhance reflective writing. The intervention of a series of scenario-based design challenges was proposed, with the assumption that an improvement upon critical thinking, reflection, and project grades will take place.

This mixed-methods action research study addressed the implementation of scenario-based design challenges that promoted critical thinking skill sets. For the study, critical thinking was defined by the agreed upon statement from the APA Delphi Report that critical thinking is the “purposeful, reflective judgment which manifest itself in reasoned consideration of evidence, context, methods, standards, and conceptualizations in deciding what to believe or what to do.” (Facione, 1990, pg. 3). Through scenario-based design challenges and reflective writing, the researcher-observer assessed critical thinking through student-written reflective statements prompted by a scenario. The application of a design process and critical thinking was assessed through scores collected from a collective series of image manipulation projects. By using this type of research study design, both quantitative and qualitative data was collected, analyzed, merged, and compared.

Approach to Research

Action research is a reflective process that can be used within educational settings when teachers need to study personal educational environments, search for ways to

improve upon their instructional techniques, and increase the effectiveness of their assignments and assessments (Mertler, 2014). Action research places the researcher within settings that tend to progress through the design and methodology of the research. The researcher essentially controls the research (Herr and Anderson, 2015).

To properly study an educational environment, both quantitative and qualitative data should be gathered during an action-based research study and later merged to compare results. Creswell (2015) described this merger of data as mixed methods research. Yin (2006) further described mixed method research as being focused upon a single study, thus producing convergent and compelling data sets. Farquhar, Ewing, & Booth (2011), further described mixed method research as taking place over multiple phases within a single study. This allows educators the ability to identify important elements of the study, look past limitations related to one form of research, and methodically establish credibility and validity to small populations (Green, 2008).

For this study, qualitative and quantitative data was gathered throughout the implementation of the scenario-based design challenge interventions. Measurable outcomes in the form of reflective statements, project scores, and semi-structured interviews collected data pertaining to critical thinking skills as they relate to the 21st century skill sets. The identification of resources, acquiring and using information, understanding relationships, and working with a variety of technologies were dispersed throughout the study. This data was gathered during multiple phases and during a single study timeframe of eight weeks.

Within the eight-week timeframe for the research study, an explanatory sequential design for sampling was used. Explanatory sequential designs operate in two phases, the

first sequence is to collect quantitative data, and the second sequence collects qualitative data. To gain a thorough understanding of the research problem, this form of sampling allowed the researcher an opportunity to analyze data and refine and explain results in a detailed format (Ivankova, Creswell, & Stick, 2006). For mixed-method sampling, data from the quantitative findings helped explain the qualitative findings (Creswell, 2015; Merriam & Tisdale, 2015).

Role of the Researcher

Within mixed method action research, educational practitioners design studies where goals are set and problems are intended to be resolved. This form of research is solely intended to solve the problem at hand and improve upon practice (Creswell, 2015). The study is not providing generalizations to larger populations. The researcher-observer positioned himself within the study and established the role of an observer as participant. Within this foundational course, the researcher-observer partnered in the instructional design of the image manipulation course and interacted with student-participants on a weekly basis. As an observer and participant, the researcher had a natural understanding of the problem and actively explored logical solutions to each question (Ary, Jacobs, Sorenson, & Walker, 2014). Through this role, student-participants knew they were being observed, having data collected, and could interact with the researcher (Merriam & Tisdale, 2015).

The researcher-observer partnered with the course instructor and helped establish a caring, accessible, dependable, capable, and authentic classroom for the study to be successful and show positive improvement rates related to critical thinking and reflection. To create a trustworthy environment and establish presence for personal interactions, the

researcher-observer openly communicated details related to the study and aligned each instructional strategy to course objectives, future coursework, and career advancement. The instructional design of each scenario-based design challenge directly aligned with course assignments and provided refinement of critical thinking skills.

Ethical Considerations

To establish and maintain trust throughout the research study, the researcher informed the student-participants about the purpose of the study, the process for collecting data, and the role of the observer as participant. If a potential student-participant was unable to attend the informational meeting, the researcher-observer also provided an additional meeting option through a video conferencing platform. As directed by Foothills University's institutional review board, participant consent forms (Appendix A) were distributed in person and through the institute provided LMS. If a student decided to join the study and later change their mind, they were able to stop their participation without consequence to their final course grades or average. The details of the study were repeated during the first day of the course, where collection of the participant consent forms took place and final questions related to the study were asked to the researcher-observer.

The confidentiality of each participant was an important aspect of this study; therefore, each student participating was assigned a non-identifying set of initials. Data collected from the participants was recorded within the institute provided LMS and through observational field notes. Audio from the semi-structured interviews was recorded digitally and preserved in a secure location. The researcher-observer downloaded all files associated with the scenario-based design challenges and scores

associated with collective projects assigned throughout the academic session. This data was preserved in a physical and digital format.

Selection of Student-Participants

Participants in the study were students enrolled in *Applications and Foundations for Image Manipulation* during an academic semester. The method for requesting participants included an introduction to the research study, an overview of the data collected, a participant information letter, and assent form. An institutional course enrollment policy and limited number of computers within the lab, allowed twelve students to participate in the study. During the data collection phase of eight-weeks, no students withdrew from the course. As a researcher-observer limited by time to gather data, the decision was made to conduct research in one section of the course. This convenience sample was non-experimental due to the absence of a comparison group. The demographics of the participants were collected with a questionnaire (Appendix B) at the beginning of the study.

The student-participant demographic for this study was comprised of students averaging 19 years of age, within their sophomore year of college, and working towards degrees in Art Education (2), Fine Art (Painting and Drawing) (1), and Interior Design (9). The student-participants identified their gender as: Female (83.33%), Male (8.33%), and Gender Variant/Non-Conforming (8.33%). The student-participants identified themselves as: White (91.67%) and African American/Black (8.33%).

An institute provided LMS was used to keep the student-participants informed of the study and any changes that took place. This smaller sample size may have produced

results that are skewed and reduced the ability to infer the findings to other courses within the study site.

Research Setting

The research was conducted at a private, liberal arts, medium-sized institute of higher education within South Carolina. Through academic semesters, the institute offers degrees in the liberal arts. Degrees and programs associated with *Applications and Foundations for Image Manipulation* include: Art Education, Painting and Drawing, Graphic Design, Interior Design, and Communication – Digital Media. Students can earn bachelor and graduate degrees within most areas of study. According to the National Center for Education Statistics (n.d.), the 2015-16 academic year showed that the research setting was populated by 62% females and 38% males.

The student population is approximately 3% Race/Ethnicity Unknown, 83% White, 8% Black or African American, 3% Hispanic, 2% Two or more races, and 1% Non-resident alien.

The class was scheduled for a two-hour evening time slot, once a week, and held within a computer lab that held fourteen computers. Each computer had access to the Internet and design applications needed for the course.

The Intervention

In this study, the area of focus was determined when the researcher-observer identified that students entering portfolio based graphic arts programs in higher education have deficiencies in critical thinking (Reid & Moore, 2008). Identification of this deficiency took place over several academic terms and focused upon undergraduate students enrolled within an introductory graphic arts course. As a researcher-observer,

who was also an instructor in similar courses, the research provides an opportunity to improve upon the instructional techniques of other educators, increase the effectiveness of assignments and assessments related to image manipulation, and possibly increase project grades for students.

Throughout the course, authentic projects were assigned by the instructor for *Applications and Foundations of Image Manipulation*. Three consecutively assigned projects aligned with course and unit learning objectives scaffolded upon each other. Prior to each project, a scenario-based design challenge was assigned.

- a) Project one focused upon photo manipulation. The student-participant produced a personal profile.
- b) Project two focused upon digital drawing and painting. The student-participant produced and manipulated an interior space.
- c) Project three focused upon digital painting. The student-participant produced and manipulated digital images.
- d) Between each project, a scenario-based design challenge was assigned to the student-participants. Each student-participant was prompted to produce reflective statements focused upon course objectives.

Throughout the eight-week timeframe for research, the scenario-based design challenges placed the student-participants into a scenario of working for a design firm as a junior level visual communication designer and assigned between the above described projects. During time inside and outside of class, the participants learned about image manipulation skills and design techniques. This took place through video based step-by-step tutorials and in-class overviews. Through scaffolded assignments, the participants

performed small design tasks, researched image manipulation techniques, collaborated with others, and held constructive critiques. These instructional techniques were conducted by the instructor and ultimately produced unique, yet tangible designs appropriate for a junior level graphic artist. As the course progressed, three image manipulation projects were assigned. Each project aligned with the course objectives and built upon each other to produce a final project. In total, there are six instructor assigned projects. Due to the timeframe of the study, achievement upon three of the six projects were measured.

The intervention of an image manipulation scenario-based design challenge was spread throughout the academic term and assigned prior to each project. Each scenario-based design challenge presented the participants with a digitally enhanced or created image that aligned with previously covered course objectives. Through attained knowledge of Photoshop tools and image composite techniques, the participants were asked to evaluate the image and record everything noticed. To further encourage critical thinking through research, evaluation, and analysis, the participants were prompted to write reflective statements that described and identified design elements of the digital images. The use of image manipulation terminology and suggestions for improvement were encouraged. As the course progressed and course objectives were met, each image manipulation scenario-based design challenge increased in complexity.

Each image manipulation scenario-based design challenge was assigned through an LMS. Through this system each participant was able to access the design challenge, a copy of the digital image to be evaluated, and reflective prompts. As the scenario-based design challenges were completed, the participants digitally submitted their reflective

statements which were used to measure the development of critical thinking skills, image manipulation knowledge, and design skill sets within the participants. A baseline for reflective writing was determined within the first scenario-based design challenge and measured through Facione and Facione's (1994) Holistic Critical Thinking Scoring rubric. Through this rubric, the measurement of critical thinking skills aligns with the description of critical thinking within the APA Delphi Report.

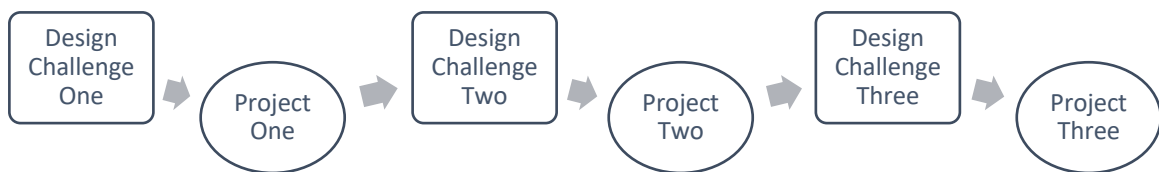


Figure -3.1 Research Design Process

Data Collection Methods

To enhance the internal validity and credibility of data collection, a methodical approach to data triangulation and peer review was used (Creswell, 2015; Merriam & Tisdale, 2015). The data sources for the study included qualitative and quantitative collection methods (Table 3.1). This mixed-method approach incorporated questionnaires, image manipulation scenario-based design challenges, reflective statements, cumulative projects, semi-structured interviews, and researcher observations found within the classroom and LMS.

Table 3.1

Alignment of Data Collection Instrumentation to Research Questions

Research Questions	Data Collection Instrument(s)
What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?	Pre-test – 20 close-ended questions
	Post-test – 20 close-ended questions
	Paired <i>t</i> -test
What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?	Design Challenges 1 – 3
	Holistic Critical Thinking Scoring Rubric by Facione and Facione
How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?	Image Manipulation Projects 1 – 3
	Project-grading Rubric based upon Anderson and Krathwohl's revision of Bloom's Taxonomy
	Pearson Correlation Coefficient
How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?	Semi- Structured Interviews

Data Analysis

Quantitative and qualitative process. The mixed method action research design used in the study was comprised of three distinct phases. In the first phase, pre-assessment data identified students' knowledge of design application and image manipulation skills (Appendix C). The second phase included the collection of artifacts produced in the scenario-based design challenges (Appendix D) and reflective statements

produced at the conclusion of each design challenge. During this phase, the researcher-observer kept field notes, a reflective journal, samples of student work, and performance records to better determine the scope of what happened in the classroom to deduce patterns related to observed skill sets (Atherton, 2014; Olson, 2014). In the third phase, the researcher-observer administered a post-assessment that identified the development of design application and image manipulation skills. During phase three, the researcher-observer also conducted semi-structured interviews with the student-participants. Each phase is described below.

Pre-assessment pilot test. Prior to Phase One, a pre-assessment pilot test was administered. The pilot test was used to increase the validity of the observer created data collection tool. To pilot the researcher-observer created pre-assessment and post-assessment, an alternate section of *Applications and Foundations of Image Manipulation* was used. The alternate section allowed the researcher-observer access to a similar sample of student-participants. The data collected from the pilot test of the Photoshop Knowledge pre-test highlighted confusing questions and provided feedback on what to expect from the study.

Phase one. Phase one of this study was administered on the first day of research and gathered qualitative data pertaining to a student-participant demographic survey.

- 1) Quantitative data was obtained through a researcher-observer created questionnaire (Appendix B) that collected demographic information and established nominal and ordinal measurements. This 10-question survey determined the age, gender, race, collegiate classification, and intended major of each student-participant. The survey

was conducted through Qualtrics, an online data and analysis tool. A survey link was placed into the institute provided LMS and was open for one week.

- 2) The student-participant's prior knowledge of Photoshop terminology, tools, and techniques was determined through a 20-question pre-assessment created by the researcher-observer. Quantitative data was obtained through the questionnaire (Appendix C). The prior knowledge survey collected information that was used to measure the study participant's prior knowledge of image manipulation tools, terminology, and techniques. Data from the questions established a baseline for the study through central tendency mean scores. The pre-assessment was administered through Qualtrics, made available within the institute provided LMS, and open for one week.

Together, these surveys provided general information related to the background and demographics of the study participants.

Phase two. Phase two of this study took place throughout the eight-week timeframe for research. The course instructor assigned six projects throughout the academic semester. For this study, three projects and three scenario-based design challenges produced quantitative data based upon technical skills associated with Photoshop.

- 3) A project grading rubric (Appendix E) based on Anderson and Krathwohl's Revised Bloom's Taxonomy produced descriptive statistics. Quantitative data based upon technical skills associated with Photoshop, and the artistic design process was derived from the rubric. A mean score was determined and used to compare student averages between scenario-based design challenges and projects. The Pearson correlation

coefficient was used to determine if a relationship between technical skills and knowledge implemented during the design challenge interventions and artistic skills used during the image manipulation projects took place.

4) Between the first three projects, three scenario-based design challenges were used as interventions to develop critical thinking and reflection during the creative design process (Appendix F). Each scenario-based design challenge aligned with the assigned projects and course and unit learning objects. The scenario-based design challenges increased in complexity and prompted the student-participant to visually deconstruct an image and produce reflective statements related to the design application tools and techniques discussed in class. To describe the degree of relationship between the scenario-based design challenges and the projects, a correlation was determined.

a) A three-step process brought student-participants into a reflective state. When presented with the design challenge, step one directed the student-participant to use recently acquired image manipulation skills and techniques during the challenge. Step two placed the student-participant into a semi-professional scenario as a junior-level visual communication designer when a digital image is presented for analysis and evaluation purposes. Step three provided prompts that lead to reflective statements about design application tools and techniques.

The intervention of scenario-based design challenges also provided quantitative data. The assessment of each reflective statement was evaluated using the Holistic Critical Thinking Scoring Rubric (Appendix F) developed by Facione and Facione (Insight Assessment, 2016). Through use of a holistic rubric, the evaluation of critical

thinking, content knowledge, and technical skills was obtained. The mean scores obtained from the rubric were quantitative. The Pearson correlation coefficient was used to determine if a relationship between reflective statements and critical thinking skills took place. Qualitative data derived from reflective statements helped identify patterns over time in each student-participant's understanding of the artistic design process, use of design application techniques, and use of critical thinking skills.

Phase Three. Quantitative data was obtained through a researcher-observer created questionnaire (Appendix C). The Photoshop knowledge survey collected information that was used to measure the student-participant's knowledge of image manipulation tools, terminology, and techniques at the conclusion of the research study timeframe. Data from 20 questions was compared to the Photoshop Knowledge survey administered in Phase One. Together, the pre-assessment and post-assessment provided numerical data that compared and identified a development in image manipulation terminology, tools, and techniques. To look for statistical differences and compare the pre-test and post-test, a t-test was used.

1) Upon the conclusion of the data collection phase, semi-structured interviews were conducted with purposefully sampled participants. For the academic term, twelve student-participants were enrolled in *Applications and Foundations of Image Manipulation*. Four student-participants were purposefully sampled and interviewed to establish an understanding of how the student-participants responded to the intervention (Appendix G). Four student-participant interviews were used to represent a quarter of the participants and selected upon academic performance. Students with high-, mid-, and low-proficiency in Photoshop skills were interviewed. Through four

interviews, the researcher-observer was able to obtain insight related to a quarter of the student-participants and develop an understanding of their experience with the scenario-based design challenges and use of critical thinking.

Through engagement with the student-participants, the researcher-observer held conversations that were semi-structured and allowed for flexibility in exploring related issues that emerged during the interview (Merriam & Tisdale, 2015). The interviews were recorded, used pseudonyms, and transcribed. Interviews within qualitative studies produce data that can support instructional interventions and allows researchers to compare project outcomes and experiences.

An organized flow chart of the research study and table (Table 3.1) provide a graphical view of the research study.

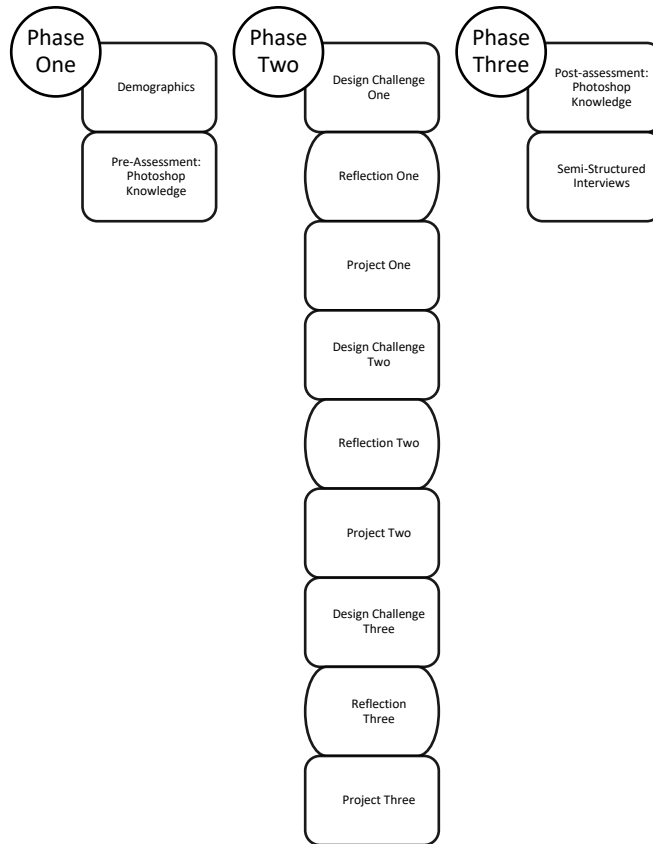


Figure 3.2 Phases of Data Collection

Qualitative Analysis. To gain a clear understanding of the effect of the design challenge interventions, the collection of qualitative data in the form of field notes and responses to the design challenge interventions took place over a time period of eight weeks. At the conclusion of the eight-week data collection phase, semi-structured interviews were held with four student-participants. A description of the coding process is presented below.

Over the eight-week timeframe, the researcher observed the instructor during time with the student-participants. The researcher-observer recorded field notes throughout each session of class. These notes were used to gauge student comprehension and peer-to-peer conversations during class time. To align with weekly objectives and assignments, the instructor provided the class with a detailed overview of Photoshop and image manipulation techniques. Throughout the class, the instructor defined image manipulation terminology, described how a variety of techniques could be used to achieve similar styles. In addition to the weekly overview, the instructor provided the student-participants with multiple opportunities and time in class to practice their image manipulation skills.

To capture significant information about the design challenge interventions, a qualitative analysis software titled NVivo was used to look for patterns and themes within the student-participant responses to the reflective prompts. The use of NVivo allowed the researcher-observer an opportunity to work with multiple data, run queries, code significant data, and create illustrations found within the reflective statements.

NVivo was used to evaluate and analyze each design challenge intervention where the labeling of information took place within containers called nodes. For this

In addition to the word count feature, a word tree command was used. The word tree feature in NVivo shows words and phrases used before and after the searched word. Through this feature, the coder can better understand the context in which the word is used. In total, the initial cycle produced 23 codes.

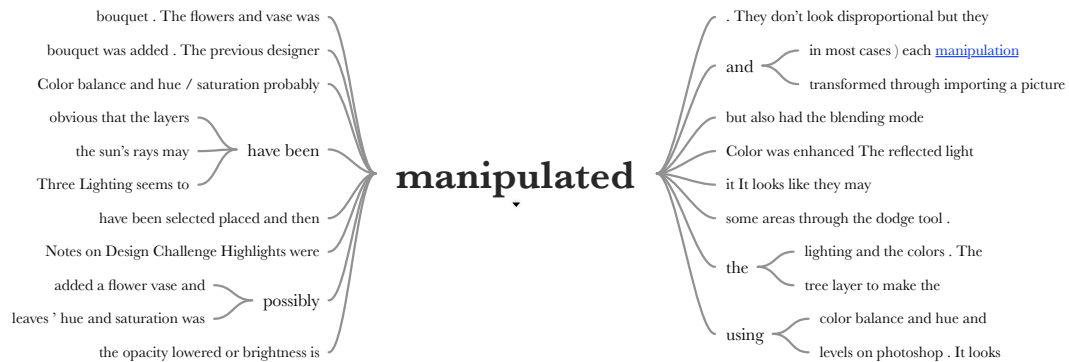


Figure 3.4 Image Manipulation word tree

The second cycle of coding was used to see the relationships between codes and analyze the underlying idea of each theme. Through an analysis of patterns in the initial codes, a second coding cycle helped summarize and reduce these codes to search for frequency and commonality. As categories emerged within the data, relationships were recognized, refined, and recoded. From the categories, themes were extracted to provide context to the analysis (Saldana, 2016). For this study, the researcher-observer was involved with the course and interacted with student-participants, therefore a coding method that maintained consistency and filtered responses through the research questions was utilized.

SOURCES		Name	Sources	Referen...
▼ Internals		▼ Design Challenge Interventions	72	294
DC 1.1		Analytical Thought	38	63
DC 1.2		Comparison	1	1
DC 2.1		Creative Thinking	7	9
DC 2.2		Critical Thinking Process	2	3
DC 3.1		Critical Thinking PS	19	25
DC 3.2		Evaluative Thought	15	31
Interview - DCI		Manipulation	36	60
Interview - FGCS		Photoshop Techniques	44	88
Externals		PS Identification	9	14
Memos				

Figure 3.5 Themes categorized with Nvivo 11 for Mac

A third coding cycle further filtered and highlighted categories found throughout the design challenge interventions. The final codes established for the design challenge interventions were: development of image manipulation skills, constructive critical thinking, and enhanced creative thinking.

Observations. Throughout the eight-week timeframe, the student-participants were observed during class time. The researcher was an observer and contributed to the design of course assignments such as the design challenge interventions and image manipulation projects. The purpose of the observations was to produce descriptive information that supplements and complements the data collected during the study and interviews.

Student activities such as student-teacher interactions, student-student interactions, student-computer interactions, information seeking, discussions, and practice of image manipulation tools and techniques were observed. Field notes were

kept to document the image manipulation overviews, techniques presented by the instructor, and student reactions to Photoshop.

Conclusion

Over three phases, the study produced a generous amount of information that was coded for critical thinking and reflection skills. Quantitative data obtained from rubrics was analyzed and produced scores related to project grades. The semi-structured interviews were recorded by audio, transcribed, and coded. Patterns and themes were identified. The intervention of scenario-based design challenges within an introductory image manipulation course were documented through reflective statements, scored through project grades, and recorded through semi-structured interviews.

As a researcher-observer, the information obtained in this study will be shared with interested faculty members and academic departments at Foothills University. As higher-level graphic arts courses are offered, faculty members will be able to use these strategies to improve instructional methods, course content, and various forms of assessment.

In conclusion, this study not only has the potential to positively affect each individual student-participant, but it also has the potential to improve the overall course, the department, the institution, and, ultimately, the graphic art workforce. Through research studies of sample populations, data was created in many forms. Descriptive statistics were used to help organize, categorize, analyze, summarize, and describe observations (Ary, et al., 2014). Researchers use inferential statistics and acquired data to generalize outcomes related to the population being studied (Mertler, 2014). The project scores should increase as student-participants improve their critical thinking and

reflection skills. This effect should be reflected in future coursework or within a chosen degree or career field. Therefore, this information will be important to other instructors, particularly those in the field of graphic art and within the study site. As a matter of best practice, other instructors would be able to use the findings and improve their courses as well. In turn, as the student-participants' skill sets grow in quantity and also quality, one could expect the value of the degree to increase as the student-participants' skill sets will be self-evident to employers within their chosen field. In summary, making small changes within one course as it relates to critical thinking, project grades, and reflection might have the ability to improve an individual, a family, an institution, a business, and a community. The findings from the mixed methods action research study are presented and analyzed in Chapter 4.

CHAPTER 4

FINDINGS

The analysis of data from this mixed method action research study includes quantitative and qualitative data collected from twelve participants. The chapter is presented in three parts. Part one provides outcomes for each of the research questions. Part two provides data analyses related to knowledge of image manipulation, design challenge interventions, and image manipulation projects. Part three provides data collected focused upon the qualitative results and responses from the semi-structured interviews that have been analyzed. The aims and relevance to the study, the results, and discussion of these results are included.

The goal of this study was to assist in the preparation of students for the 21st century workforce through scenario-based design challenges that promoted creativity, problem solving, and constructive evaluation of professionally created image manipulations. The study modified a pedagogical strategy suggested by Golding (2011), in which learners were brought into a critical thinking environment through discipline specific thinking and thought-encouraging questioning. The study was conducted within an introductory visual communication and design course that focused upon image manipulation via Photoshop. The role of the researcher was as an observer.

As discussed in Chapter 3, the concurrent mixed-method action research study took place over eight weeks and was conducted in three phases. The first phase of the eight-week study was to gather demographic data and determine the learners' prior

knowledge of Photoshop. The second phase of the study was to assign and gather data from three scenario-based design challenges and three image manipulation projects. The third phase of the study consisted of two parts: one to determine the learners' knowledge of Photoshop at the conclusion of the study timeframe through a posttest and two to conduct four semi-structured interviews focused upon the scenario-based design challenges. The interviews were used to determine the student-participants perception and experience with the design challenges and their use of critical thinking throughout the data collection timeframe.

The overarching research question for this study was: *Within an introductory design application course, how do design challenge interventions impact the development of critical thinking in first-year university students?*

Through four supporting questions, the researcher-observer was able to gather data for analysis to help answer the overarching research question.

Supporting Question One: *What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?*

Supporting Question Two: *What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?*

Supporting Question Three: *How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?*

Supporting Question Four: *How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?*

This chapter will present findings related to each research question. Quantitative data was gathered from a close-ended 20 question pretest, three scenario-based design challenges scored through Facione and Facione's (1994) critical thinking holistic scoring rubric, three image manipulation projects scored through a project grading rubric based upon Anderson and Krathwohl's (2001) Bloom's Taxonomy, and a duplicate copy of the pretest in the form of a close-ended 20 question posttest. Qualitative data was gathered from reflective statements prompted in the three scenario-based design challenges, and four student-participants interviews to provide their perception of the scenario-based design challenges.

Data Analysis for Supporting Research Question One: *What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?*

A close-ended pre-test was first used to determine prior knowledge of image manipulation, tools, techniques, and terminology. The pretest consisted of multiple choice, true/false, and fill in the blank questions. The same test was used for the post-test to measure and identify the student-participants development in knowledge of image manipulation tools, techniques, and terminology throughout the study.

Pre-test Results. Descriptive statistics, including minimum, maximum, median, mean, and standard deviation were used to analyze the quantitative data generated from the Photoshop knowledge pretest. The pretest was 20 questions in length, with each question possessing a score of 1 point. As shown in Table 4.1, scores for the pre-test ranged from 12 to 16 out of 20. The participants obtained a mean score of 14.08, the

median was 14.00, and Photoshop knowledge pretest had a standard deviation score of 1.51, which means all scores were close to the mean.

Applications and Foundations for Image Manipulation is an introductory design application course. The pretest was used to determine the domain knowledge of each student as it related to basic terminology, skills, and techniques used in image manipulation. The mean score of 14.08 out of 20 points, translates to an average of 70.40 out of 100 percent. Students registered for this course may have been exposed to image manipulation software prior to their enrollment in higher education. With an average score of 70 percent, an opportunity to progress knowledge through the scenario-based design challenges and image manipulation projects existed.

Posttest Results. Descriptive statistics, including minimum, maximum, median, mean, and standard deviation were used to analyze the quantitative data generated from the Photoshop knowledge posttest. To obtain meaningful results that measure progress, the posttest was 20 questions in length and identical to the pretest. As shown in Table 4.1, scores ranged from 13 to 19 points out of 20. The participants obtained a mean score of 15.83, the median was 15.5, The Photoshop knowledge posttest had a standard deviation score of 1.53, which displays that scores were close to the mean.

The posttest was used to determine if an increase in domain knowledge of image manipulation for each student was obtained. The mean score of 15.83 out of 20 points, translates to an average of 79.15 out of 100 percent. Between the pretest and posttest, the mean score increased by 8.75 points or 12.43%. This increase suggests that domain knowledge of image manipulation terminology, skills, and techniques did improve throughout the data collection timeframe.

Table 4.1

Photoshop Knowledge Pre-Test and Post-Test Scores

Student	Pre-Test Score	Post-Test Scores
BK	15	15
BQ	14	16
CC	12	16
DK	12	15
FP	13	15
IT	16	19
KE	16	15
KH	13	17
LO	16	17
NX	15	15
TW	14	17
TN	13	13
M(SD)	14.08(1.51)	15.83(1.53)

Paired t-test results. A paired t-test was conducted to compare knowledge of image manipulation, tools, techniques, and terminology between the pretest and posttest. The paired t-test suggests a significant difference from pretest to posttest scores. The 12 study participants had a mean score of 14.08 ($SD = 1.51$) for the pretest, and mean score of 15.83 ($SD = 1.53$) for the posttest, indicating a statistically significant increase in knowledge occurred between both assessments, $t(11)=3.5405$, $p=.005$ (two-tailed). The results of the pre-test and post-test are displayed in Table 4.2. Between the pretest and posttest student-participant scores increased by 1.75 points or 12.43%.

Throughout the data collection timeframe, an increase in scores from pretest to posttest indicated that each student-participant significantly increased their knowledge of image manipulation, tools, techniques, and terminology.

Table 4.2

Paired t-test results for Photoshop Knowledge Pre-Test and Post-Test

Outcome	Group			Group			95% CI for Mean Difference	t	df
	Pre-Test		n	Post-Test		n			
	M	SD			M		SD		
Pair	14.08	1.51	12	15.83	1.53	12	-0.66 2.84	3.54	11

Data Analysis for Supporting Research Question Two: *What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?*

Three scenario-based design challenges were assigned to the student-participants. Each design challenge was assigned one week prior to the image manipulation project and aligned with course objectives. The student-participants were assigned to analyze and evaluate three professionally created image manipulations, take notes, and respond to question prompts through reflective writing. Quantitative and qualitative measures collected data related to the scenario-based design challenges. Quantitative data was collected through Facione and Facione's (1994) Holistic Critical Thinking Scoring Rubric. Qualitative data was collected through reflective statements written by the student-participants and will be discussed later in the chapter.

Design Challenge Results. Facione and Facione's Holistic Critical Thinking Scoring Rubric produced numerical scores. This rubric allowed descriptive statistics such as mean and standard deviation to be evaluated for each design challenge. Results for each design challenge are shown in Table 4.3.

Table 4.3

Participant Scores for Design Challenge Interventions (n=12)

Student	Design Challenge One	Design Challenge Two	Design Challenge Three
BK	100	100	100
BQ	100	100	100
CC	100	90	100
DK	88	92	88
FP	84	92	92
IT	100	90	100
KE	96	100	100
KH	92	92	92
LO	92	90	100
NX	88	94	100
TW	86	92	100
TN	92	84	82
M(SD)	93.17(5.94)	93.00(4.86)	96.17(6.18)

Each design challenge was evaluated with Facione and Facione's Holistic Critical Thinking Scoring Rubric (see Appendix F). The results for Design Challenge One are shown in Table 4.3. The participants obtained a mean score of 93.17, range: 16. The standard deviation score was 5.94, which means scores were close to the mean. The results for Design Challenge Two revealed that the participants obtained a mean score of 93.00. The standard deviation score was 4.86, range: 16. The results for Design Challenge Three revealed that the participants obtained a mean score of 96.17. The standard deviation score was 6.18, range: 18.

The student-participants produced similar scores for each scenario-based design challenge. Scores between Design Challenge One and Design Challenge Two dropped slightly by -0.17 percent. Scores increased between Design Challenge Two and Design Challenge Three increased by 3.4 percent. In the reflective statements for each design challenge, the student-participants consistently and accurately interpreted the graphics

with thoughtful evaluative statements and provided justification for their reasoning. A comprehensive analysis of the student produced reflective statements provided additional qualitative measures. This data is presented and discussed later in the chapter.

Data Analysis for Supporting Question Three: *How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?*

Three image manipulation projects were assigned to the student-participants. Each project was assigned one week after the scenario-based design challenge, aligned with course objectives, and focused upon the development of a personal portfolio in the form of a digital magazine.

Image manipulation project results. Descriptive statistics were produced by a project-grading rubric based upon technical skills associated with Photoshop and Anderson and Krathwohl's (2001) revision of Bloom's Taxonomy (see Appendix E). The highest possible score for the image manipulation project was 20 points. Each score was translated into a 100-point scale for students. These statistics were used to analyze the quantitative data associated within the image manipulation projects.

Project One focused upon the creation of a two-page magazine style spread that showcased student portraits and personal work. The project aligned with course objectives that focused upon photo retouching tools and techniques. Image manipulation took place through the use of balancing light levels, adjustment of color, and the use of image editing tools such as the smooth tool, dodge tool, burn tool, paint brush, and healing brush. The magazine spread included three portraits and two forms of personal artwork. The participants obtained a mean score of 91.67. The standard deviation score

was 3.89, which means scores were close to the mean. Figure 4.1 provides an example of Project One. To maintain privacy of a student-participant, personal portraits have been masked in gray.



Figure 4.1 – Example of Project 1

Project Two continued work on the personal portfolio. The creation of a two-page magazine style spread that showcased personal artwork. The project aligned with course objectives that focused upon photo retouching tools and techniques. The students scanned personal artwork at high resolutions, retouched sketches or simple line drawings, retouched full value drawings, and made final color adjustments. The magazine spread included three drawing and one full color image of personal artwork. The participants obtained a mean score of 95.42. The standard deviation score was 3.34, which means scores were close to the mean. Figure 4.2 provides an example of Project Two.



Figure 4.2 – Example of Project 2

Project Three continued work on the personal portfolio and focused upon combining digital drawing techniques with images. The creation of two illustrated objects aligned with course objectives that focused upon photo retouching and digital drawing tools. The instructor provided the class with a number of images depicting people in everyday situations. The student-participants selected one image from the group and added an illustrated object, animal, or person. The digital drawings began as simple line drawings. To add value to the overall image, color, shadows, midtones, highlights, and blended paints were added by the student-participants. The participants obtained a mean score of 92.08. The standard deviation score was 5.82, which means scores were close to the mean. Figure 4.3 provides an example of Project Three.



Figure 4.3 – Example of Project 3

Table 4.4 reports that the student-participants produced a similar range of scores for each image manipulation project. Between assignments, the project-scoring rubric revealed that students focused upon the application of skills and techniques, and the final presentation of each project over original ideas and use of a design process. Scores between Project One, a personal profile magazine spread and Project Two, a personal artwork magazine spread increased by 3.75 percentage points. Scores between Project Two and Project Three, a digital illustration assignment decreased by 3.34 percentage points.

Table 4.4

Image Manipulation Project Scores (n=12)

Student	Project One	Project Two	Project Three
BK	85	95	90
BQ	95	100	100
CC	90	90	100
DK	90	95	90
FP	90	95	90
IT	95	90	85
KE	95	100	95
KH	95	95	95
LO	95	100	100
NX	95	95	90
TW	85	95	85
TN	90	95	85
M(SD)	91.67(3.89)	95.42(3.34)	92.08(5.82)

To determine if the scenario-based design challenges influenced the projects, a Pearson Correlation Coefficient was used to look for associations between the measures.

Correlation of design challenge and image manipulation project results. To assess the relationship between each design challenge and image manipulation project, a Pearson correlation coefficient was computed between each assignment grouping.

The correlation of design challenge one ($M = 93.17$, $SD = 5.94$, $N = 12$) and project one ($M = 91.67$, $SD = 3.89$, $N = 12$) did not produce a significant relationship, $r = 0.183$, $p = 0.219$. The correlation of design challenge two ($M = 93$, $SD = 4.86$, $N = 12$) and project two ($M = 95.42$, $SD = 3.34$, $N = 12$) produced a moderate and significant positive correlation, $r = 0.475$, $p = 0.041$. The correlation of design challenge three ($M = 96.17$, $SD = 6.18$, $N = 12$) and project three ($M = 92.08$, $SD = 5.82$, $N = 12$) produced a moderate and significant positive correlation, $r = 0.368$, $p = 0.020$.

The relationships between the scenario-based design challenges and the image manipulation projects fluctuated between each assignment. Through the Pearson correlation coefficient, the researcher-observer explored how students combine technical skills with artistic skills and develop connections between learning and producing work. The mean scores for each scenario-based design challenge and project were similar throughout the data collection timeframe, but a significant relationship between each assignment was difficult to establish. For Design Challenge One and Project One, the student-participants produced scores that showed an insignificant correlation. For Design Challenge Two and Project Two, the student-participants produced scores that showed a moderate correlation. For Design Challenge Three and Project Three, the student-participants also produced scores that showed a moderate correlation.

Applications and Foundations for Image Manipulation is an introductory course, filled with novice Photoshop users. A lack of domain knowledge related to image manipulation may be a factor in producing inconsistent relationships between the scenario-based design challenges and the projects. To gain a better understanding of this inconsistency, the scenario-based design challenges will now be discussed through qualitative data collected during the mixed methods action research study.

Data Analysis for Supporting Question Four: *How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?*

Through the instructor, the researcher-observer was able to assign three scenario-based design challenges. Each design challenge was assigned one week prior to the assignment of the image manipulation project, aligned with course objectives, and used a

fictional workplace scenario to provide a relevant situation to the assignment. A comprehensive qualitative analysis of the reflective statements produced during the design challenges revealed three overall themes: development of image manipulation skills, constructive critical thinking, and enhanced creative thinking. Each theme aligns with 21st century skill sets and scaffolds the skills needed to meet the course objectives.

The first design challenge had the student-participants compare two images and reflect upon what image manipulation tools and techniques may have been used. They were also prompted to describe how an addition to the image would be added and transformed. Both questions set the framework for the sequential scenario-based design challenges and allowed the student-participants to reflect upon their current knowledge of image manipulation.

The second design challenge increased in complexity and asked the students to evaluate and analyze a detailed image composite. Each student took time to break down the image into segments and describe image manipulation tools and techniques. The reflective statements produced by the student-participants for this design challenge incorporated prior knowledge of image manipulation with learned content. In their limited knowledge of Photoshop, the students communicated how image manipulation techniques were applied, what tools were used, and personal observations about a professional design.

The third design challenge increased in complexity and again asked the students to evaluate and analyze a digital image. The reflective statements associated with this design challenge continued to show an increase in knowledge of image manipulation

skills. The student-participants began to hypothetically apply image manipulation tools and techniques to improve upon designs.

In the following section, the scenario-based design challenges are further explained through student-participant responses and three overall themes that emerged from the qualitative analysis and coding process (Saldana, 2016) described in Chapter 3: development of image manipulation skills, constructive critical thinking, and enhanced creative thinking.

Development of image manipulation skills. Students within *Applications and Foundations for Image Manipulation* developed their use of Photoshop and image manipulation terminology throughout the scenario-based design challenges. Through the combination of course observations, course objectives, and use of terminology in the reflective statements, the theme of *development of image manipulation skills* emerged in the coding cycles. The written reflections produced by each student built upon responses and strengthened the use of terminology and tools specific to Photoshop. Course observations and field notes revealed that terms and tools such as background, layer, selection, lasso tool, magic wand tool, transform, dodge and burn, and healing brush were discussed in class and aligned with course objectives. The instructor presented, defined, and discussed each term and technique. Techniques specific to image manipulation such as: blending, lighting, perspective, saturation, and shadowing also aligned with course and weekly objectives. A variety of processes used to create digital images were presented. Through use of terminology and design tools associated with image manipulation, a written description of the techniques provided the students with examples

of how to use their knowledge of Photoshop to deconstruct a digital image and reflect upon their own understanding of graphic art.

The student-participants were asked to compare two images and take note of the image adjustments in the first design challenge. After comparing the images, BQ originally thought the designer simply added images to enhance the graphic, but later decided that shadows in the after image would not exist, therefore “a mixture of layers and blending options” were applied. KE compared the provided images and suggested that the “saturation levels were raised to sharpen the colors and make the shadows on the wall more dramatic.” Additionally, KE also suggested that the “blending modes” were applied to the image to provide a “much more dramatic effect”. LO suggested that “the designer probably added a layer to the photo” and “found a photo of an image and added it into the photo using different design transform tools such as skew and rotate”.

The student-participants continued to evaluate digital imagery and take note of the image additions and adjustments in the second design challenge. After analyzing and evaluating the image, the student participants identified the Photoshop tools used to enhance the image. DK provided a list of tools that “may have been used to create the promotional image.” CC referred to “different blend modes in order to apply certain effects.” NX suggested “the designers adjusted the hue/saturation in order to make the image more vivid.” KH specifically mentioned adjustment tools such as color balance to “adjust the intensity”, the dodge tool to “lighten and darken areas” and the healing brush to “blend” graphics “into the scene to make it look more natural.”

The first and second design challenge produced surface level responses that aligned with course and project objectives. The reflective statements produced for the

third design challenge exhibited a greater understanding of the skills needed for image manipulation. LO was able to identify the individual images and layers, “If each individual plant is its own graphic I would say there is at least 20-30 different pictures or images going into this piece.” CC assumed “that each graphic has one layer” and accounted for additional enhancements and “other changes” to reach a conclusion of “45 layers” being used in the provide image. NX recognized multiple image transformations and suggested the spot healing brush was used “on the man’s face, neck, and hands, as they are free from any skin defects or dirt.” DK focused upon selection methods and suggested that the “quick selection tool may have been used to select larger areas of the image” for image adjustments. IT suggested that transformation tools, such as the scale tool, were used to “conform the plant shirt to the body of the figure.” FP assumed that multiple tools were used to adjust the perspective “to make the image look more accurate and 3D.”

Each design challenge produced reflective statements that used image manipulation terminology, tools, and techniques. The student-participants responded with suggestions and assumptions focused upon the correct use of a tool or how a technique may have enhanced the images provided in the assignment. The reflective statements consistently displayed an understanding of skills associated with image manipulation. If students are able to correctly analyze and evaluate image manipulation techniques, then they should be able to use these methods in personal artwork. By combining these skill sets with image manipulation skills, critical thinking should be applied in the production of artwork for future course assignments or clients (Samah, Hussin, & Putih, 2016).

Constructive critical thinking. Through course observations, peer to peer interactions, student-teacher interactions, and the coding cycle, the second theme of *constructive critical thinking* emerged. This theme documented how students interacted with the course instructor, and each other, as questions were asked and opinions sought. The instructor described and simplified image manipulation tools and techniques throughout the course. Furthermore, the instructor provided students with authentic applications of these tools and provided examples of how he uses techniques to manipulate digital images for clients. Field notes from the researcher-observer documented when and how often students interacted with each other. In-class conversations, usually held right after an overview, focused upon the image manipulation tools, techniques and terminology. As the students discussed the course content, they built upon their knowledge of image manipulation and exemplified constructive critical thinking in their reflective statements. As the design challenges progressed, the students moved beyond basic explanations of image manipulation terminology, tools, and techniques.

When comparing two images in design challenge one, some of the students began to incorporate their thoughts with specific Photoshop terminology. CC focused upon subtle adjustments and enhancements in the image through “the removal of the light switch and outlet which clean up the image nicely”. KE noticed that a vase “was transformed, blended, and warped to fit the perspective of the room.”. BQ noticed how “the designer seemed to make the room feel brighter and have a warmer welcoming mood” that was created by adjustments to lighting and shadows.

The student-participants displayed aspects of critical thinking by talking through a potential design process and provided further suggestions to improve upon the image adjustments. CC analyzed the image and noticed that the designer could “transform the image into a layer and copy it to the new image, then go about resizing it match the proportions of the room.” CC also suggested that, “there may need to be some minor adjustments to the hue and saturation, but otherwise an image was placed correctly”. IT did not agree with the adjustments to the lighting and shadowing of the image and stated that the “vase of flowers has several things wrong with it...nor does it follow the lighting in the room.”

As the students continued to evaluate the provided images, reflective statements produced during the second design challenge continued to display aspects of analytical, evaluative, and critical thinking. BK was able to “identify ten or eleven layers” within an image which matched “the number of graphics because the graphics were all placed on the image at one time, over top of each other”. FP thought about different elements of the image and counted eleven layers, “if you count the text on the banner as it was most likely typed into the composition.” NX evaluated the image and produced a higher number of images than other students and provided justification for the statement, “I am identifying anywhere from 20-30 layers; this number does not match the number of graphics because it is obvious that the layers have been manipulated and (in most cases) each manipulation adds another layer.”

The student-participants further displayed aspects of critical thinking by moving beyond basic explanations and began to associate specific tools with image manipulation techniques. FP analyzed the given image and determined that “they most likely used

level, hue/saturation, and color balance to make the colors of the different images match so the image as a whole would flow well...so that the composition would look more natural.” KE analyzed the image thoroughly and grouped techniques and tools together, for example:

A texture was applied to the edges to get the worn look around the edges. It looks like the dodge tool may have been used to get the lighting of the sun beams where the clouds overlap. The saturation of the beams changes towards the edges of the image. Maybe even a glow was used near the back.

As the student-participants evaluated the provided image in the third and final design challenge, they produced statements that incorporated and connected specific Photoshop terminology, tools, and image manipulation techniques. In addition to these enhanced statements, the students also began to associate the digital images with real-world settings. CC described the detail the original design placed into the graphic, “I can tell that the designers were very intricate when creating their selections and applying the blend modes as the image appears as one and it is almost believable that the image is real.” BQ deconstructed and critiqued the image, for example:

The green sweater seems to be more of a copy and paste then blend the excess sweater so it doesn't look too big. The greenery on the pants seem to have been selected placed and then manipulated. They don't look disproportional but they do look like they wrap around the model more than greenery would do naturally so the image may have been transformed using wrap.

Critical thinking was further exemplified by BQ through the following statement,

Two enhancements can be seen on the shovel blade and the background. The color of the shovel seems to be an unrealistic blue, and though the light is in the same direction on the shovel as the model, the shovel is better lit which doesn't make sense. The shovel end seems to be enhanced in order to improve the look of the overall image, because no normal shovel would also be that clean, it's used to pick up dirt.

Through the reflective statements produced during the design challenges, the student-participants demonstrated constructive critical thinking. The student-participants responded with statements that combined image manipulation terminology, tools, and techniques with relevant and personal thoughts. As students' progress through degree programs, they will need to improve upon their ability to think creatively about the work of others.

Enhanced creative thinking. As the student-participants analyzed and evaluated the provided image, they began to describe how selection techniques and image adjustment techniques were used in each design challenge. The theme of *enhanced creative thinking* emerged from course observations and field notes that recorded students discussing the benefits of certain image manipulation tools and techniques over others. Conversations took place individually and during overviews. The ability to create a digital image through multiple techniques was discussed by the instructor. Conversations between the instructor and students usually took place after an overview. The instructor encouraged students to think about a design process and apply it to their projects. Through these conversations and processes, the instructor was able to encourage the use of image manipulation tools and techniques to produce unique digital designs. As the course progressed, students began to seek peer opinions and ask each other about specific tasks to achieve an artistic aesthetic. The reflective statements produced by the student-participants provided descriptions for areas of improvement and further suggested what adjustments could be made to the published image. Through these statements, they explained how image manipulation tools and techniques would be used to enhance the image. In the first design challenge, FP wrote:

If I were to add another vase to the after image I would start by using the other night stand. After moving the vase, I would add shadow by selecting small sections of the vase and making them darker or lighter in order to create a more realistic image. Next, I would try and find a way to add shadow on the dresser for the vase. I would select a paint that matches a darker color of the night stand, use paint brush to color in the shadow, gradient to smooth it out, and transform: skew and distort, to make the shadow look like the right proportion.

IT provided an alternate solution to improving upon the image,

If I had been editing this image, I would have gotten a tighter crop on the flowers and left out the black spot. I also would have flipped the vase horizontally so the light source matched up with the light in the room. To add a shadow, I would have used the burn tool but taken the shadow towards the wall to fit with the light from the window.

For the second design challenge BQ focused upon the illustrative and typographic aspects of the image, “The text should not be separated from the scroll or else the scroll doesn’t make sense, and the scroll shouldn’t be floating in the air, but be held by the bird, and pairing them on the same layer would make this easier to do.” KE provided an extensive list of observations and areas for improvement, “The elk had light used on it, possibly the dodge tool, to make the sun look like its hitting the animal” or “The way the bird, that is holding the scroll, is flying appears correct in being added to the layers but the scroll seems to be off in perspective”

The final design challenge produced creative thoughts and solutions from improvement from each student-participant. IT considered how the plants were used in the image, “The designers could have chosen one type of plant and used that same plant all across the man’s body, but they chose to use a variety of different types of plants to add interest to the image and help capture the viewer’s eye.

BK focused upon the use of color in the provided image,

Obviously the plants needed to be green, but besides that, they chose to make his undershirt brown, along with blue jeans and a blue shovel. Brown, green, and blue

are all colors that appear outdoors on a regular basis, therefore they coincide perfectly with the earthy theme that the restaurant was aiming for.

The formatting of text or use of typography, was also focused upon in the reflective statements. TW imagined that text “could be made to look like plants.” KH made suggestions about the placement of the text and stated, “[it] should not cross in front of the image as it would cause too much activity over the figure” KE provided a detailed overview of what could be done to improve the image and provide information to a perspective audience. She states:

Effectively I feel that Typography could be placed in three places. At the top of the image, at the bottom of the image, or at the top and bottom. the reason for the placement of these words is in order to make the add a strong caption. Having the words at in upward angle going across the top like a superhero title saying something along the lines of “Going Green for a Better Tomorrow.” Or having the words at the bottom at an angle down saying, Going Green Never Felt so Good!” or warping the words in an upward and downward facing are arches with the caption “Green today, Still Alive Tomorrow!” ... Then in the bottom right corner I would add a price, something like “\$39.99.... That is how I would place the words. And I would curve them and change them using warp, wrap, and scale in transformation.

Through reflective statements produced during the design challenges, the student-participants demonstrated the ability to think creatively about complex professional designs. The student-participants responded with statements that combined image manipulation terminology, tools, and techniques with ways to improve or further modify the provided images. As students begin developing graphic art, a design process should be followed. The ability to think creatively about designs will be an important component of that process. By analyzing, evaluating, and critiquing the work of other designers, students can improve upon their capacity to develop and design unique artwork (Tsui, 2002).

As the design challenges increased in complexity, the student-participants displayed an increase in domain knowledge and began using terminology associated with Photoshop. This was evident from the written reflective statements produced during the scenario-based design challenges. The instructor incorporated design terminology and image manipulation skills during personal discussions with students and throughout the weekly overviews.

To scaffold learning, the instructor assigned step-by-step tutorials from an online resource. A graphic artist walked students through a variety of design processes and provided example images and Photoshop files to follow along with. During class time, the researcher-observer witnessed interactive and collaborative discussions among the students. If a particular tool or technique was not working correctly, students adjacent to one another would help each other. During their interactions, image manipulation terminology, tools, and techniques were directly used.

To gain a deeper understanding of these findings semi-structured interviews were conducted with four student-participants.

Semi-Structured Interviews

Through a convenience sample, the researcher-observer conducted semi-structured interviews with four student-participants. Based upon course observations, student-instructor interactions, and course grades, the interviewees were purposefully selected to include a combination of high-level, mid-level, and low-level proficiency in image manipulation skills. Through the semi-structured interviews, a better developed understanding of the student-participant's experience with the scenario-based design

challenges and use of critical thinking throughout the data collection timeframe was gathered.

Since the student-participants experienced the scenario-based design challenges and image manipulation projects, they provided perceptive statements related to the scenario-based design challenges and development of critical thinking within an introductory visual communication and design course. The interview process was used to help the student-participants reflect upon image manipulation tools and techniques and consider how the design challenges impacted their thought processes.

Table 4.5 indicates the pseudonyms of the students who participated in the semi-structured interviews.

Table 4.5 – *Participant Pseudonyms*

Pseudonym of Student Participants	Proficiency of Image Manipulation Observed During Data Collection	Degree Program
Suzanna	High	Interior Design
Kate	High	Interior Design
Leigh	Mid	Fine Art (Painting & Drawing)
Elizabeth	Low	Interior Design

Three student-participants expressed no prior knowledge of image manipulation terminology, Photoshop tools, or techniques. Leigh indicated that she was “an amateur” and “brand new” to Photoshop. Elizabeth stated, “Never used Photoshop before”.

Suzanna expressed:

I literally just started blank when I came into class for the first time. I had no idea what I was doing. I definitely did not get any previous experience with it to know what to do or different techniques.

Due to the lack of experience with image manipulation tools and techniques, the following analysis reveals that undergraduate students in introductory courses can learn to use and think through a design process, apply reflective practice to current assignments, and modify thought processes for future coursework or careers. The first theme focuses upon the impact the design challenges had upon the image manipulation projects. The second theme focuses upon the student-participants enhancement of critical or reflective thinking during design development for the image manipulation projects. The third theme focuses upon the improvement of understanding in image manipulation tools and techniques after the scenario-based design challenge was completed. The fourth theme focuses upon personal descriptions for critical and reflective thinking. The fifth theme focuses upon the student-participants perception of using reflective practice in their coursework and future careers.

Impact of design challenge interventions on a design process. The fundamental findings for this theme revealed that the scenario-based design challenges encouraged personal realizations, thought processes, and improved understanding of how image manipulation tools and techniques are used within graphic art.

Kate expressed that she “didn’t realize” what process professional designers took to create digital designs. In reference to Photoshop techniques, Kate used phrases such as “it’s not just as simple as putting something in someone’s hand.” and “it helped me really think about how other people are going to be viewing this”. Her thought process shifted from simply completing a task to “thinking outside of the box and maybe not doing what every other designer has done, but just really sitting there and thinking about how I can do it differently than the next designer but still keeping the functionality”.

Leigh approached the task of evaluating and analyzing digital imagery as a way to avoid using image manipulation tools and techniques incorrectly. She expressed, “It helped more on knowing what not to do”. Through this awareness, she was able to notice how image manipulation tools are used to create a unique digital design. She states, “Oh, they probably did this and this,” and now it’s “They probably did this with this”.

As a novice user of Photoshop and manipulating digital imagery, Elizabeth did not express any adjustments in her thought process, understanding, or realization of image manipulation tools and techniques. In response to the scenario-based design challenges influence upon decisions for projects, she stated, “I guess they did...I guess a better understanding of how layers work in a grand scheme of pictures I guess.”

From these responses, the student-participants acknowledged that the scenario-based design challenges did influence their thought process. Three of the four responses focused upon using the assignments as a way to improve upon their thought process and understanding of how image manipulation tools and techniques could be used in projects. The ability to think critically and reflect during this process is discussed in the following section.

Enhancement of critical thinking through reflection. The fundamental findings for this theme revealed that cognitive abilities were altered by the design challenges. The findings also revealed that the student-participants were influenced by the scenario-based design challenges during the design process.

As the image manipulation projects increased in complexity, the students were able to increase their creativity and move past guidelines set by tutorials and the instructor. Suzanna felt that she was thinking “more critically” and moving past “what the

project says to do, and the step-by-steps”. Kate stated, “I would say the design challenge also helped me really think about how other people are going to be viewing this”.

Leigh expressed an adjustment to her thinking and design process:

In the beginning, it was I don't know what I'm doing, so if it just goes in there, then fine, we're good. Towards the end, it was more of this is kind of challenging, like I know what level is expected, so it's no longer just trying to figure out, it's trying to do it well and get it to a standard that's good enough to fool the amateur eye of, I didn't just copy and paste.

Prior to the course and working through design challenges, the interviewees did not follow an image manipulation design process and seemed to work from personal preference or step-by-step processes assigned through instructors. Through the following statement, Kate explains the design process as it related to her personal preference:

Before these design challenges, these helped change it a little bit, but before the design challenges, it was more of what my preference was, not thinking about gearing it towards other people and the general public. I was more thinking, oh, I like it this way, so I'm going to put it this way.

As a Fine Art major, Leigh indicated that she did not follow a design process for creative work. “I just kind of went for it and hoped it worked out in the end”. She revealed more through, “I hadn’t had any training in high school, and so my process was just figure out an idea and try to do it.”.

Elizabeth reverted to her lack of exposure to Photoshop and was unaware of using a design process. She stated, “I never used Photoshop before, so I don’t know if I had a specific one”. When asked about using a design process in her major coursework, she again stated, “I don’t know if it was any different”.

From these responses, the student-participants acknowledged that the scenario-based design challenges slightly influenced their critical thinking and reflective thought process. Three of the four responses focused upon using the assignments as a way to

move past a personal thought process and how image manipulation tools and techniques could be used in projects to produce appropriate work for future assignments and clients. The following statements focused upon reflective writing show that scenario-based design challenges can further influence critical and reflective thinking.

Improvement of understanding through reflective thinking. The fundamental findings for this theme revealed an effect on reflective thought and how image manipulation tools and techniques can be used in digital design.

Elizabeth conveyed that the reflective statements “made us think about it more” and “try to answer each question while looking at the image at the same time, and try to see how they...I guess, not influence each other, but combine together with each other”.

The scenario-based design challenges seemed to quickly place Suzanna into a reflective mindset. She states, “I would start talking about it before I even realized it, like I was starting to talk about what could have been added and how it was added”. She indicated that she “was really looking at it and trying to figure out what was originally there, what was added, how it could be added”. Kate expressed how the combination of reflective writing and use of image manipulation tools can produce effective design. She states:

Well, it definitely expanded my knowledge on the individual tools and what they can all do. I mean, even just the class, along with the design challenges, like I said, little subtle differences that I'm like, oh the Dodge tool does this. The design challenge really helped just nail in my brain what tool does what and like oh, this was changed about the photo, so then they probably used this tool and it helped me to really gain knowledge and, like I said, really nail in my head what tool did what and how the changes were made in Photoshop.

Leigh made a similar statement:

Yes. Because it's pretty easy to be like, okay, just like I'm following along with doing ... Use this, do this, do this, do that, but then trying to look at an image and

evaluate what they did. It helps you gain a better understanding, and it helps to figure out how to do this rather than just following along without really paying attention. Like it really gets you to think about the process and remember it better.

From these responses, the student-participants acknowledged that scenario-based design challenges and reflective methods could improve upon how basic tools and techniques are used in image manipulation projects. As the design challenges increased in complexity, the student-participants seemed to be influenced by the evaluative and analytical tasks. The student-participants found themselves making decisions based upon critical thinking and reflective writing. To explore this further, an interview question sought a personal definition of critical and reflective thinking.

Personal descriptions of critical thinking and reflection. The following theme produced relevant descriptions of a term often associated with complex frameworks and multiple classifications.

Suzanna described critical thinking as:

I don't know ... I hate critical thinking. I really don't even know. You hear it all the time, but you never really think ... what are they actually telling you to do. I would say just using what you know and not surface thinking, but actually really looking at it, studying it, thinking about it, and then using the knowledge that you have to come up with an example or a solution to whatever you're looking at, or an explanation for what you're looking at. I don't know if that answers that at all.

Kate described critical thinking as:

Well, I think definitely part of it would be taking out my thoughts and opinions and thinking of what other people would want. Yeah, that would be part of it, but there's more. I guess really slowing down and taking the time to thinking about each individual part of the image and not just rushing through it and really just taking time to think, like I said, not just what I would want but what other people would want and how it can impact the world around me.

Leigh described critical thinking as:

Oh crap. I don't know. I feel like a good bit of us already have a definition of critical thinking, but going off of that, it's evaluating from nothing. Just like getting an image and working your way through it in a logical order and trying to arrive at the correct ...not answer, but process, or the correct steps that they did.

Elizabeth described critical thinking as, “I guess the ability to, I don't want to use think, but to reason outside of easy means I guess. Not just stereotypical means of thinking”

A description of reflective thinking produced similar relevant and simple responses from the student-participants.

At length, Suzanna spoke of reflective thinking and briefly described a process she used to review assignments:

I was actually reading through old rubrics and stuff of how to do it to make sure I was using the right techniques and stuff. So, I guess I was reflecting on things that I had done previously to keep going through the other projects. If it was supposed to be base knowledge that I was already supposed to know and I might have forgotten some, I had to go back and re-learn it some or read through it again just to remind myself.

Kate, personalized her response, “[I] guess I would define reflection as my personal thoughts and opinions on a certain topic after taking time to think about it and really dig deep and use critical thinking in it”. Leigh responded in a similar fashion, “Well, me as a person who did the design, just to sit back and look at it and be like, I did this and this well. I did this wrong, so it's just kind of like taking a step back and evaluating it and seeing how you did or how it turned out”. Elizabeth stated, “I guess thinking about bringing it back towards yourself, or another image, or object”.

Each response revealed how an undergraduate student may use critical and reflective thinking within educational settings. After obtaining personal definitions for critical and reflective thinking, the students were asked to think about future coursework and career opportunities and envision using evaluative, analytical, and reflective skills on a daily basis.

Reflective practice in future coursework or careers. The fundamental findings for this theme revealed degree and career focused thinking among the interviewees.

Suzanna and Leigh focused their response upon coursework and projects. Suzanna stated, "I feel like I really have to with interior design, because I kind of have to look back on what I've did. I don't want to copy what I've did before.... I don't want to repeat design".

Leigh stated:

Well, me as a person who did the design, just to sit back and look at it and be like, "I did this and this well. I did this wrong," so it's just kind of like taking a step back and evaluating it and seeing how you did or how it turned out.

Through Kate and Elizabeth's response, a focus upon future career opportunities in interior design are revealed. Elizabeth stated, "I guess more thinking about how to create things that ... I guess in terms of the future job, to reflect the needs of the client, or what they want".

Kate stated:

Oh absolutely. Yeah. Even just incorporating, like I said earlier, really thinking about what the client would want rather than just what I think would work as well as especially bringing in critical thinking. People are going to come to me with designs that they have issues. It's not just going to be a simple oh, I want my living room to look like this. They're going to come and say, "Okay. I need this and this and this, and there's this issue with the building. I need you to fix it." Just really thinking outside of the box and maybe not doing what every other designer

has done, but just really sitting there and thinking about how I can do it differently than the next designer but still keeping the functionality and still making it so that it functions and works and that the client's happy.

Although brief remarks were made, the interviewees showed that when critical and reflective thinking are applied to future assignments, they will be enhancing their own work and better focus upon what clients are asking of them.

Through the demonstration of high-level, mid-level, and low-level proficiency four student-participants were purposefully sampled and interviewed for this study. Throughout the semi-structured interviews, the students discussed their experience with the scenario-based design challenges and projects. They provided personal definitions for critical thinking and reflective thinking, two topics of interest for this study. Throughout the interviews, a focus upon personal reflection was present, along with a career focused mindset. For students with limited experience in image manipulation, they expressed interest in using critical thinking, reflective thinking, and a design process in future educational and professional settings.

Triangulation of Findings

To understand the full picture of this study, data was triangulated to enhance descriptions and provide a better understanding of the data. Through triangulation, the data is validated across comprehensive and consistent findings during the study (Johnson, Onwuegbuzie, & Turner, 2007). Each method provided useful and meaningful answers to the research questions.

In this study, triangulation was accomplished through different data gathering methods. Each method was carefully chosen to collect data related to the interventions' impact upon achievement scores and development of critical thinking in introductory students. The pre-test established the amount of Photoshop knowledge each student held

prior to the study. The design challenge interventions allowed students to reflect upon knowledge gained during the course. The intervention also allowed students to apply critical thinking skills and evaluate digital imagery. The qualitative analysis of the design challenge interventions revealed how students thought critically and creatively about images created by professional designers. The image manipulation projects allowed students to use a design process and apply their knowledge of Photoshop skills to the creation of a unique digital image. The post-test revealed how image manipulation skills were impacted throughout the study. To complete the study, the semi-structured interviews provided a detailed description of how students perceived critical and reflective thinking. This methodology combines strengths from quantitative and qualitative data collection methodology and supports findings from the study.

Tutorial-based assignments and in-class overviews outside of the study may have influenced how each student-participant increased their knowledge of Photoshop by 12.43% and built critical thinking skills. Scores produced by the Holistic Critical Thinking Scoring rubric (Facione & Facione, 1994) and the Project Scoring rubric fluctuated between assignments. Since no correlation was detected between the interventions and image manipulation projects, a disconnect between thinking about and applying design techniques may have taken place. Classroom observations revealed that the student-participants focused upon the tutorials or simply followed directions from the instructor. Results from the project scoring rubric also confirm that the student-participants used skills and techniques acquired from online tutorials or the instructor. Results from the Holistic Critical Thinking Scoring rubric revealed that most student-participants were consistently analyzing and evaluating the graphics given to them.

The development of image manipulation skills and the impact the design challenges had upon the knowledge of Photoshop were further explored through qualitative data. The student-participants responded to scaffolded questions within each design challenge and produced a series of written reflective statements. As the student-participants progressed through the course, this reflective practice established a connection between online tutorials, in-class overviews, and course projects. Three overall themes emerged during qualitative analysis and described how image manipulation skills, techniques, and terminology were used in the assessment of digital designs.

To further validate the study, semi-structured interviews were conducted to better understand how the student-participants understood critical thinking, reflective practice, and the basic graphic arts design process. Each skill is needed for the creation of unique pieces of digital art. The design challenge interventions and image manipulation projects allowed the student-participants a chance to think through a design process, apply reflective design practices to image manipulation projects, and modify thought and design processes that could be used in future courses or their career.

Conclusion

The purpose of this concurrent mixed-method research study was to answer how design challenge interventions impacted the development of critical thinking in first-year university students. The research sought to gain an understanding of how image manipulation skills were improved and applied within an introductory image manipulation course. The impact of three design challenge interventions and the use of reflective practices during the data collection timeframe were measured. In addition to

statistical measurements, themes associated with critical and creative thinking emerged from the analysis and evaluation of reflective statements produced by the student-participants. From four semi-structured interviews, five themes emerged during the analysis and evaluation of interview transcripts. These themes included: impact of design challenge interventions on a design process, enhancement of critical thinking through reflection, improvement of understanding through reflective thinking, personal descriptions of critical thinking and reflection, and reflective practice in future coursework or careers. The research questions and implications of this data will be further explored in Chapter 5.

CHAPTER 5

IMPLICATIONS AND RECOMMENDATIONS

This chapter presents the outcomes of a mixed-methods action research study. This is accomplished through an overview of the problem of practice and the purpose of the study. The research questions frame subsequent findings. An action plan for the implementation of new educational practice is proposed. Recommendations for future practice and research are considered. Limitations of the study are described. The chapter concludes with a brief summary.

The modern workplace changes rapidly, therefore graphic artists must be able to blend artistic techniques and technical skills with 21st century skill sets (Brown, 2012). Degree programs in higher education can thoughtfully incorporate critical thinking learning models with graphic arts practices to offer students an experience with new media technology in structured yet rigorous learning environments (Hilton, 2005). Introductory graphic arts courses should be the gateway for degree programs to incorporate of 21st century skill sets, yet they often have negative connotations attached to them. Most students enter degree programs knowing they will need to complete a series of required courses before moving onto courses that offer creative freedom (Ettinger, 1988). Many of these courses focus upon tutorial-based learning and design application techniques. To reach creative freedom in their designs, students must

demonstrate the ability to think critically and solve problems when required (Tippey, 2008).

This study sought to improve upon critical thinking within an introductory graphic arts course in higher education through the use of scenario-based design challenge interventions. As a former graphic arts instructor in higher education, this problem of practice was established and based upon observations and classroom experiences within a portfolio-based graphic arts degree program. In addition to scenario-based design challenges, a reflective practice framework was developed to guide learners in their use of image manipulation tools, techniques, and terminology. Through a mixed-method action research strategy that included qualitative and quantitative data collection techniques, the eight-week study supports further research in the development of 21st century skill sets in graphic arts degree programs.

Applications and Foundations for Image Manipulation is a course designed to introduce Photoshop, an industry-related image manipulation software application. This design application is widely used in graphic arts and other design related professions. The purpose of the mixed-methods action research study was two-fold. First, how do design challenge interventions impact achievement scores within an introductory image manipulation course. Second, how do design challenge interventions impact the development of critical thinking in introductory students.

One main research question and four supporting questions were developed to study how the scenario-based design challenge interventions may improve upon a students' transferrable knowledge and further connect and apply course objectives and goals with future careers. The main research question asks:

Within an introductory design application course, how do design challenge interventions impact the development of critical thinking in first-year university students?

Four supporting questions were developed to help answer the main research question and explore the potential effects of critical thinking in an introductory design application course:

- *What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?*
- *What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students?*
- *How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?*
- *How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges?*

Discussion of Research Questions

The findings from each research question are summarized below.

Supporting question one: What is the impact of the design challenge interventions on the knowledge of image manipulation skills and techniques to first-year university students?

To determine if knowledge improved during the timeframe of the study, a close-ended pretest and posttest consisting of 20 questions was assigned to the student-participants. The pretest produced an average score of 70.40 out of 100 percent. The pre-

test average aligned with responses obtained during the semi-structured interviews, that student-participants enrolled in *Applications and Foundations for Image Manipulation* barely possessed a basic understanding of image manipulation tools, techniques, and terminology upon entering the course. Three of the four student-participants interviewed for the research study had no experience with image manipulation applications prior to their enrollment in the course.

The post-test produced an average score 79.15 out of 100 percent. A two-tailed t-test showed an increase in scores between the pretest and posttest. This test indicated a significant increase in knowledge for the student-participants involved with the research study, $t(11)=3.5405$, $p=.005$ (two-tailed). As the course progressed, the post-test scores suggested that the student-participants became more knowledgeable of Photoshop terminology, tools, and techniques. Eight student-participants demonstrated individual gains in image manipulation knowledge between the pre-test and post-test. Three students retained their original scores. One student experienced a minor reduction in their score. The difference between beginning and ending scores measuring knowledge of image manipulation was significant, however the sample size is too low for generalization to other introductory courses in graphic arts degree programs in higher education.

Serving as a point of reference for reflective practice, the student's ability to identify and analyze changes within professional designs enhance their transfer of image manipulation knowledge. The design challenge interventions allowed students to apply their knowledge of image manipulation in a variety of thoughtful and creative formats. In this study, reflective thinking occurred during the evaluation and analysis of a professional design. The student-participants reflected critically upon designs and

ultimately challenged their thinking about image manipulation. By asking students to reflect upon professional designs, the interventions could guide and allow individuals to improve upon their understanding and application of digital tools and techniques. To further explore an improvement in knowledge and critical thinking, the research study explored the impact the design challenge interventions had upon three assigned image manipulation projects.

Supporting question two: What is the impact of the design challenge interventions on the application of skills used in image manipulation assignments to first-year university students? Through analytical and evaluative thought processes, the student-participants critiqued digital imagery. Each scenario-based intervention was designed to assess whether course objectives were met. Each design challenge was scaffolded and asked the student-participants to deconstruct an image, take personal notes, and produce reflective statements that described image manipulation tools, techniques, and terminology. Qualitative data was collected through reflective statements written by the student-participants and examined by the researcher-observer. As mentioned previously, this data was collected and analyzed through Facione and Facione's (1994) Holistic Critical Thinking Scoring Rubric.

The Holistic Critical Thinking Scoring Rubric, revealed that most of the student-participants were thinking critically about image manipulation tools, techniques, and terminology. Across each design challenge, the majority of scores on the Holistic Critical Thinking Scoring Rubric were marked in the upper levels of critical thinking. After deconstructing and critiquing the given image, the student-participants produced reflective statements that accurately interpreted the graphic, thoughtfully analyzed and

evaluated alternative points of view, drew warranted conclusions, and justified their results and explanations with reasoning. Individual notes produced by the student-participants revealed that very few misinterpreted how image manipulation tools and techniques were used in the design challenge images.

Three image manipulation projects allowed the student-participants to transfer knowledge from the critique of an image to the creation of a digital image manipulation. Each image manipulation project was assigned one week after the scenario-based design challenge. The assignment aligned with course objectives, course content, and in-class instruction. Each project focused upon building a personal portfolio in the form of a digital magazine. The projects were measured by a project-grading rubric based upon technical skills associated with Photoshop and Anderson and Krathwohl's (2001) revision of Bloom's Taxonomy.

The project-grading rubric produced scores for project one of 91.67, project two of 95.42, and project three of 92.08. The similarity between scores for each project revealed that students focused upon two categories; skills and techniques and the final presentation. These results aligned with the overall purpose of *Applications and Foundations for Image Manipulation*, which was to introduce students to the procedures, tools, and techniques used in the creation and manipulation of digital imagery. The instructor designed projects were primarily focused upon the application of image manipulation tools and techniques. Skills were learned through tutorials and in-class overviews, therefore, the instructor placed higher values on image manipulation skills than the applying an overall design process to create an image manipulation. The documentation of each student-participants' design process was not required for

submission, therefore the procedures used to reach a final design may not have been valued by the student-participants.

Ellmers (2017) found that students can make connections between their reflections and projects when a structured and critical approach to reflective assessments are practiced within a course. To test for a relationship between each design challenge and image manipulation project, a Pearson correlation coefficient was computed between each assignment grouping. A connection between thinking critically about digital imagery would have positively impacted the design process used in the image manipulation project. For this study a positive correlation was not detected. A positive connection between the intervention and project may have been affected by the student's ability to relate what they learned with the ability to identify and link their approach to a design process. To determine why a connection between the assignments was not present, a closer look at the qualitative data collected during the design challenges was important.

Supporting question three: How do design challenge interventions impact first-year university students' ability to reflect on the image manipulation process?

To encourage and support critical thinking, each scenario-based design challenge incorporated scaffolded questioning that led to written reflective statements. To develop these skills, three scenario-based design challenge interventions, one page in length (McNergney, Herbert, & Ford, 1994), were assigned to the student-participants during the research study timeframe. Each design challenge was assigned one week prior to an image manipulation project. Through the design challenges, the student-participants were asked to analyze, evaluate, and produce reflective statements focused upon three professionally created image manipulations (Demetriadis, et al, 2007; Kunselman and

Johnson, 2004). As the student-participants critiqued three digital images across the research study timeframe, they were provided an opportunity to access prior knowledge and construct and apply new knowledge of image manipulation skills.

To produce each reflective statement and obtain a numerical score for the assignment, each student had to access prior knowledge, apply what was learned, and interpret recently obtained knowledge of Photoshop tools and techniques (Kolodner, 2002; McDade, 1995). A numerical score was produced by Facione and Facione's Holistic Critical Thinking Scoring Rubric (1994), which is designed to measure critical thinking through four distinct levels of performance. Design Challenge One established a baseline score of 93.17. Design Challenge Two produced a score of 93.00, while Design Challenge Three produced a score of 96.17. These scores produced evidence that students were successfully analyzing and evaluating digital image composition. Furthermore, the students were applying knowledge obtained during tutorial-based lessons, instruction and interactions during class, and collaboration among peers.

The qualitative data collected during the research study revealed that the student-participants dwelled within areas associated with 21st century skill sets and were able to interact with course content, question their knowledge, and solve problems (Kroll & Laboskey, 1996). The students participated in design scenarios that enhanced personal creativity, developed image manipulation skills, and used critical thinking skills to contemplate the work of other designers. Each area aligns with skills that employers are seeking and connect real-world applications to educational settings (de Graaff & Kolmos, 2007; Terry, 2012).

The prompts used in the scenario-based design challenges incorporated verbs associated with Bloom's Taxonomy (1956) and higher order thinking skills (McDavitt, 1994). The student-participants appeared to enhance their analytical and evaluative thought process through answering these questions. The development of image manipulation skills was identified through written descriptions of Photoshop design techniques, proper use of terminology, and suggestions for improvement.

To further explore an improvement in knowledge and critical thinking, the research study sought the opinions of four purposefully sampled student-participants. Each interviewee discussed the impact of the design challenge interventions upon image manipulation projects.

Supporting question four: How do first-year university students perceive the design process for an image manipulation project when assigned designed challenges? Lawson (2006) describes the basic graphic arts design process as a multi-staged method. First, designers must research the problem. The research stage begins the use of analytical and evaluative thought processes. Second, designers must develop multiple solutions to the problem. The development of multiple solutions incorporates memory, understanding, application of knowledge, analytical thought, and evaluation skills. Third, designers begin to use information obtained during research and development to create graphic arts. Fourth, designers refine their work through an internal process or collaboration with peers. The fifth and final stage of the basic graphic arts design process is the finalization of the design. A finished product has been created and will be distributed across various mediums.

Multiple intentions were attached to the image manipulation projects. The semi-structured interviews further strengthened the argument that an improvement in knowledge took place during the research study. Student-participants had to recall learned material, break apart research, develop multiple designs, and understand how to apply Photoshop techniques in the creation of an original piece of graphic arts. Therefore, throughout *Applications and Foundations for Image Manipulation*, the student-participants used the basic graphic arts design process. The purpose of multiple design challenge interventions was to improve upon a final design for the image manipulation projects. If a student was able to use recall information obtained from course discussions, step-by-step tutorials, and in-class assignments, then the development and creation of a new solution would improve the final product.

The semi-structured interviews provided additional details related to the impact of the design challenges upon each student's design process. As novice Photoshop users, the student-participants did not have an established design process for image manipulation or graphic arts. Each interviewee mentioned using a design or creative process obtained from another degree program or career focused area. If they were not incorporating skills from other areas of interests or courses, the student-participants were finding and using personal resources. The ability to blend and reflect upon processes from multiple areas of knowledge and personal solutions demonstrates that the student-participants were applying prior knowledge and learned skills through appropriate techniques.

Each design challenge encouraged the student-participants to critically think through a design process and create unique image manipulations. Graphic arts is applied in a variety of professional settings, therefore a designer must be able to evaluate artistic

sources, identify design application tools, apply design-based techniques, and discuss their work using applicable terminology (de la Cruz & Mejia, 2017). Each design challenge used in the study placed the student-participants into a designer's mindset and prompted them to think as a professional. Three of the four interviewees used the design challenges to improve upon their thought processes and work towards an understanding of how image manipulation skills could be used in the future.

After participating in the scenario-based design challenges and image manipulation projects, the students were asked to provide personal definitions for critical thinking and reflection. The students interviewed were cautious to provide definitions or had not fully considered the benefits of using critical thinking and reflection in their design processes. Although introductory level responses were obtained, connections between a critical thinking process to the basic graphic arts design process were perceived by the students.

To further explore the impact of the design challenge interventions, the interviewees were asked to imagine how reflective practices would be used in future coursework or within their chosen career. Each interviewee acknowledged the importance of reflective practice to maintain relevancy within their chosen career and to not overuse ideas in assigned coursework. Through these acknowledgements, critical and reflective thinking can be connected to the beneficial use of a design process to create original forms of graphic arts.

The findings from this mixed-methods study suggests implications for practice for introductory students taking courses in graphic arts programs. The findings also suggest

implication for further research that could improve courses found in graphic arts degree programs.

Action Plan for Improvement to the Course Design

Through classroom observations, open communication with students, and analysis of data collected during the mixed-methods action research study, the researcher-observer offers three suggestions to improve upon the effectiveness of *Applications and Foundations for Image Manipulation*. First, the course objectives must be updated to reflect higher order thinking and 21st century skillsets. Second, the course should be updated to improve upon critical thinking and reflective practices. This can be accomplished through use of active learning strategies that keep students engaged and motivated during class. Third, increase the use of formative assessments during time in class. This can be accomplished through use of classrooms assessment techniques. Each suggestion focuses upon the learner's ability to improve upon their capacity to think critically about image manipulation and establish meaning to the course content.

1. Courses are built upon overarching goals and lesson objectives. To establish a course that effectively meets the needs of students, educators should thoughtfully design and develop courses that align. Alignment must take place between course goals, content, activities, and assessments (Fink, 2013). As an introductory course, *Applications and Foundations for Image Manipulation*, the goals are stated as follows:
 - a) Learn the workspace and tools available in Adobe Photoshop.
 - b) Learn the basic techniques and principles of digital imagery and design.
 - c) Apply foundational art and design principles in a digital format.

To support students in their development of critical thinking, the current set of goals could be extended to incorporate lower order thinking with higher order thinking skills. Measurable objectives associated with the six categories of Anderson and Krathwohl's Revised Bloom's Taxonomy (2001) can be used. Those categories are: remembering, understanding, applying, analyzing, evaluating, and creating. Through this mindset, the course goals could be restated as follows:

- a) Through assigned tutorials and design application overviews, the learner will be able to identify tools within the Photoshop workspace.
- b) Through assigned projects, the learner will be able to apply Photoshop tools and techniques to an image composite.

The learner will:

- i. change an image size.
 - ii. adjust image resolution.
 - iii. make image selections.
 - iv. transform images.
 - v. arrange images.
 - vi. change the color mode on an image.
 - vii. apply photo editing techniques.
 - viii. adjust object and layer properties.
 - ix. apply blending modes to an image.
 - x. apply textures to an image.
 - xi. insert text upon an image.
- c) The learner will be able to apply the five-step graphic design process to the creation of a digital image composite.

The graphic arts design process includes:

- i. research.
- ii. development.
- iii. design.
- iv. refinement.
- v. Finalize

Through the updated course goals and objectives, the instructor could refine individual lessons, update the design challenge interventions, and

significantly improve upon the image manipulation projects by using a basic graphic design process. Assessment of the course goals and objectives, and the student's ability to develop critical thinking could be developed similarly to Bissell and Lemon's study (2006).

2. The traditional method of instruction for a design application course involves passive learning through online or textbook based tutorials. To improve upon this instructional strategy, and better incorporate critical thinking and reflective practice, the course design could adopt the use of active learning strategies (Chickering & Gamson, 1987). The course instructor for *Applications and Foundations for Image Manipulation* used tutorial-based instruction and generalized overviews of Photoshop throughout the semester. To reinforce and apply skills discussed in class or through the online tutorials, an image manipulation project was assigned. Within the study, the purpose of the design challenge interventions was to help students improve upon their ability to think critically about image manipulations and reflect upon design techniques associated with Photoshop. Progressivism promotes learning through active engagement with other learners, experiences, and authentic activities (Dewey, 1938; Labaree, 2005). Active learning strategies can take on many forms within an introductory design application course but educational activities based upon progressivism such as the application of skills through reflection, writing, and problem solving would be beneficial (Freeman, et al, 2014). Activities that encourage critical thinking skills would align with the design challenge interventions. As students become comfortable

with reflecting upon and writing about graphic arts, knowledge can be transferred from one activity to another.

3. To better understanding how students are retaining information and transferring knowledge during course activities, formative assessment methods can be applied (Green & Johnson, 2010). These methods fall into the category of classroom assessment techniques and align with aspects of constructivism that promote critical thinking and reflection (Driscoll, 2005; de Graaff & Kolmos, 2007). Within *Applications and Foundations for Image Manipulation*, the instructor can use classroom assessments to find out what students know; discover if students can apply or integrate knowledge; learn if students are able to engage with and share what they know among their peers; and see if students are able to integrate and apply knowledge in group settings. Classroom assessment techniques are simple, non-graded, in-class activities. They produce useful feedback on the teaching and learning process as it happens. If the course instructor needs to make adjustments, they can take place quickly. Assessments such as minute papers or one-sentence summaries help students reflect upon confusing portions of class or quickly synthesize information. Directed paraphrasing activities can help students transfer knowledge from a digital setting to an authentic setting (Angelo & Cross, 1993). This type of activity would allow students to talk about and express their knowledge of image manipulation in authentic situations.

By applying the suggested changes, *Applications and Foundations for Image Manipulation*, would be significantly altered. The delivery of course content and newly

created learning environment would fit well within the educational aspects of constructivism. Through constructivism, students use reflective practice to take ownership of their learning and increase the creation of personal and professional knowledge.

This individualized action plan addresses questions and concerns the researcher had throughout the timeframe of the study. If these adjustments were made, the researcher holds the impression that the study would better answer the overarching research question. The suggested improvements could strengthen and validate conclusions found within the study. To generalize the results to the field of graphic arts, implications for future practice and research are discussed.

Implications for Future Practice and Research

The implications for future practice are framed through project-based learning, improvement to the scenario-based design challenges, and streamlined use of assessment tools. Implications for future research are framed through adjustments to the structure of study. This includes the use of a comparative study to compare and contrast data between a treatment and control group. To impact the development of critical thinking in graphic artists, the use of a Visual Thinking Strategies curriculum is discussed.

Implications for future practice. This study has significant implications for educational research in graphic arts. Design based educational programs in the higher education can be categorized as a process school or a portfolio school. Despite the widespread availability of graphic arts programs in the United States, there are few firsthand studies that examine their ability to produce critically reflective graphic artists. Graphic arts programs in process schools incorporate multiple disciplines and focus upon

problem solving and artistic techniques. Portfolio based programs focus upon general artistic concepts and support a student's ability to generate numerous design artifacts and products. At *Foothills University*, a portfolio-based process is used throughout the graphic arts program. To build a student's portfolio, curriculum that incorporates project-based learning (PjBL) techniques is used by faculty members.

Within introductory graphic arts courses, educators should introduce industry standard design applications and specific design techniques. The use of a design process should also be included within their curriculum, as these courses are a gateway to comprehensive and highly creative processes. Time within courses at portfolio-based schools can be limited, therefore, PjBL provides students with the ability learn throughout the process of creating and generating a tangible product. Projects that are connected throughout a course allow students the opportunity to engage in an active learning environment that promotes research, analysis, evaluation, collaboration, creativity, and reflection (Lawson, 2006). When reflective strategies are used during PjBL, students can document their decisions and learning processes (Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989).

There is little evidence to suggest that project-based learning (PjBL) techniques are able to enhance critical thinking within introductory design application courses. Therefore, there are limitations to using PjBL within design application courses. PjBL has a tendency to focus upon the final product and students learn little from the design process. They can become overwhelmed with the scope of a project and obtain a distorted view of what has been learned. When students focus too much on the project, or become overwhelmed by the assignments, cognitive links are diminished. Students become

unclear about what is learned and are unable to identify and link critical thinking to their creativity and design skills (Dorst & Reyman, 2004; Kvan, 2001; Lawson, 2006).

In addition to the student perspective, designing a learning environment based upon PjBL and scaffolding can be a difficult task for instructors. Learning environments that incorporate PjBL rely heavily upon tools, resources, and scaffolded learning (Grant, 2011). Instructors should be prepared to design assignments and assessments that represent learning processes and learning products (Grant & Branch, 2005). Research focused upon improving critical thinking through PjBL that scaffolds learning and promotes documented reflection techniques would further enhance courses in degree programs and prepare students for future careers in graphic arts.

The interviews with the student-participants indicated that scenario-based reflective practice can support introductory students when making connections between their learning, assignments, and future career. This has important implications for educators that lead courses focused upon specific tools, techniques, and terminology associated with graphic arts. When scenarios are given to introductory level graphic arts students, scaffolded and critically reflective practice may improve upon the importance of implementing a design process and the ability to think critically about personal or professional designs.

If PjBL does not fit feasibly within the course timeframe, graphic arts educators could introduce a basic design process and require that each student document and submit proof of their process. Through reflective statements and documentation of a process, graphic arts educators can analyze the reflective statements produced during the design challenges. Through analysis of the detailed reflective statements, educators could better

evaluate the methods students are using to create unique designs. This would allow the graphic arts educator to improve upon instructional techniques that benefit introductory students and verify that objectives of the course are being met at appropriate levels.

The scenario-based design challenges used in the study were created specifically for *Applications and Foundations for Image Manipulation*. Graphic arts educators could modify scenarios to better promote reflective practice during and after an activity (Schon, 1987) or throughout introductory design application courses. This should also enhance the reliability of scenario-based interventions. To measure critical thinking produced by reflective statements, the use of Facione and Facione's Critical Thinking Scoring Rubric (1994) was time consuming and cumbersome. This result aligned with the action research study of Landis, Swain, Friehe, & Coufal (2007).

To produce creative designs in mass, portfolio-based design programs can move through content and courses quickly. Alternative assessment tools used to measure critical thinking could be advantageous for graphic arts educators. Redesigned assessment tools influenced by Facione and Facione's rubric (1994) and Anderson and Krathwohl revised Bloom's taxonomy (2001) could allow educators the ability to measure each student's capability to reflect and apply design specific techniques found in graphic arts. Further research is required to validate these claims and to understand the impact upon reflections produced by student-participants.

In this study, student-participants completed three reflective assessment tasks. Each scenario-based design challenge offered an opportunity to reflect upon recently learned knowledge of image manipulation. Through this method of reflective writing, the student-participants typically produced simple one sentence statements that aligned with

the course objectives. The evaluation and analysis of one sentence statements proved to be difficult. To better assess critical thinking and improve upon creativity in the design process, the prompts used in the design challenges could be redeveloped to produce lengthy statements. To achieve this, the scaffolded questioning used to produce reflective statements could be revised from simple explanatory “how” questions to thought producing descriptive “why” questions. The reflective statements produced through “why” questions would allow students to use lower order thinking skills and higher order thinking skills within one assignment.

Inspired by Bloom’s taxonomy, Pappas (2010) developed a taxonomy that uses questioning to reflect upon learning experiences. A taxonomy of lower to higher order reflection parallels Bloom’s taxonomy and has students: 1) Reflect upon what they did; 2) Reflect upon what was important about their assignment; 3) Reflect upon their prior knowledge of topic and where it could be applied again; 4) Reflect upon patterns and relationships; 5) Reflect upon their decisions and look for areas of improvement; and 6) Reflect upon a combination of elements and decide what can be accomplished next. This process allows students to move past the repetition of information to supporting mastery of a topic. If students are able to reflect upon their experiences they can think abstractedly about patterns, connections, and progress. Through critical and reflective thinking, students could improve upon their ability to reflect, think critically about graphic arts, and produce unique designs. Further research on reflective practice in graphic arts is required to validate this claim.

Implications for future research. This study contributes to graphic arts education research through an organized and evidence-based investigation of an

introductory image manipulation course. This is achieved through the design and application of a mixed method approach to critical thinking and reflective practice. The nature of the research means this study has the potential to inform the broader field of design education and other fields of research that specifically examine critical thinking, reflection, or scaffolded learning. Each implication for future practice could be enhanced through the use of treatment and control groups. Straightforward analytic techniques could be used to better estimate the impact of the design challenge interventions has upon knowledge, application of skills, the ability to reflect, and application of a design process (Kisida, Bowen, & Greene, 2016).

To support learning and develop aesthetic understanding of fine art, Housen (2001) developed curriculum that engages with learners to focus and reflect upon works of art. The Visual Thinking Strategies (VTS) curriculum was originally designed to develop critical thinking and enable the ability to transfer knowledge of fine art to children. This curriculum could be adapted for use in higher education and promote the development of critical thinking throughout multiple contexts. Through VTS, students are assigned carefully selected images of art. Group collaborations are held where discussions between students allow for the development of critical thinking through analysis, evaluation, and reflection upon the meaning of the assigned art work. To measure critical thinking in VTS, educators can use a variety of assessment tools. Reflective writing through student journals were found to be effective. Other instruments based upon aesthetic development interviews or material object interviews allow educators to ask students simple questions such as ‘what is going on here?’ ‘what makes you think this?’ and ‘what more can you find?’. These questions help focus learners, but

also require them to be active in thought and general conversation. In addition to this, learners are able to reflect upon prior knowledge and transfer information to new contexts and content.

Housen (2001) developed VTS over a number of years and conducted the study through a treatment and control study, with significant increases in critical thinking observed in the treatment group (DeSantis & Housen, 2007). Degree programs in graphic arts that develop assignments and assessments around VTS could witness graphic arts students develop skills in observation, interpretation, evaluation, association, problem-solving, and comparison. Each skill is identified as a characteristic of critical thinking (Adams, Foutz, Luke, & Stein, 2006) and aligns with commonly sought skills in future careers (Brown, 2012; P21, 2006; Wagner, 2008).

Graphic artists are hired to produce creative and memorable designs. To achieve distinction within crowded markets, graphic artists must use critical thinking and reflective practice throughout the design process. To accurately prepare graphic artists for future careers, research focused upon the development of critical thinking skills during phases of the design process could benefit design educators. Knowing that introductory courses primarily use tutorial-based instruction to develop basic skills in design applications, research could be performed within mid- and upper-level courses where designs are multifaceted and may involve an actual client or organization. In tutorial-based instruction, transfer of learning and development of skills usually occurs through repetition, therefore an improvement in project scores should be expected. Research focused upon critical thinking and problem solving during the design process could reveal educational strategies that construct flexible knowledge bases, develop effective

problem-solving skills, improve ideation, and enhance collaborative critiques (Hmel & Ferrari, 1997).

For this study, three adjustments could be made to the design challenge interventions and enhance the use of image manipulation skills during an assigned project. First, the scenarios used in the design challenge interventions could be easily adjusted to match the degree programs or future careers of student participants. This information would be obtained at the start of the study and collected with participant demographics. A connection to authentic, career focused settings may enhance transfer of knowledge between the interventions and projects. Second, the scaffolded questioning used to produce reflective statements could be revised from simple explanatory “how” questions to thought producing descriptive “why” questions. The reflective statements produced through “why” questions would allow students to use lower order thinking skills and higher order thinking skills within one assignment. Third, to measure lower- and higher order thinking skills, an analytical rubric designed by a graphic arts educator could capture data connected to image manipulation techniques, design process skills, creativity, and critical thinking.

To improve upon this mixed-methods study, graphic art educators could use these suggestions to gather data and connect critical thinking skill sets to course assignments and assessments. Through these enhancements, students may be able to transfer and reinforce their knowledge of image manipulation and the use of a design process. When students are able to think through design techniques they can apply image manipulation skills and create unique art.

Limitations of the Study

The primary limitation of the research study relates to the timeframe the study was conducted within and the number of students that participated. Twelve students were enrolled in *Applications and Foundations for Image Manipulation* and each participated in the eight-week timeframe of the study. The study was conducted under a mixed-methods approach that triangulated data from multiple sources to minimize potential criticisms of the timeframe and number of participants (Creswell, 2015). Through a mixed method approach, multiple research questions that produced quantitative and qualitative data supported a broader analysis of the design challenge interventions. Despite the use of these methods, the small number of participants in the study does not allow the study to be generalized to upper-level graphic arts courses but may be useful for similar introductory design application courses. The findings from this study may only be unique to the participants in the study and cannot be generalized to every course in a graphic arts program.

A further limitation of this study relates to the subjectivity of the researcher-observer. For this study, the researcher-observer positioned himself within the study and established the role of observer as participant. In this role, he first partnered with the instructor of the course to establish the course schedule, develop the design challenge interventions, and provide input on the projects assigned to the students-participants. As a former instructor of graphic arts, the researcher-observer was familiar with stigmas attached to introductory courses in graphic arts. The researcher-observer understood the importance of developing critical thinking skills through the problem of practice and

sought to move past stigmas and help develop an engaging learning environment for *Applications and Foundations for Image Manipulation*.

Furthermore, to reduce subjectivity, the researcher-observer's understanding of how to explore solutions to each research questions was considered during the coding process of qualitative data. When coding the reflective statements produced by the student-participants, the researcher-observer sought to align codes for critical thinking with the course objectives, the APA's established definition for critical thinking (Facione, 1990), and different levels of Bloom's Taxonomy (Anderson & Krathwohl, 2002). A peer review process was used to crosscheck and validate the codes produced during the qualitative process. To validate the quantitative data collected during the study, the researcher-observer worked with an Assistant Professor of Psychology at Foothills University. Through peer review, the subjectivity of the researcher-observer within the qualitative coding process and quantitative analysis is addressed.

Conclusion

Tutorial based learning in introductory design application courses is widespread in graphic arts degree programs. When step-by-step instruction is solely used in a course, educators miss opportunities to improve upon 21st century skill sets, specifically the ability to think critically about graphic arts. Traditional approaches to graphic arts education in portfolio-based schools primarily focus upon design techniques and program specific skills. An abundance of designs can be produced by students when they understand how to use tools and techniques specific to a design application. When this approach is used in graphic arts courses, the design process is often overlooked. This can cause students to produce incoherent and irrelevant art. When tutorial-based instruction is

focused upon the mass production of work, the primary measure of learning is the final design. Beyond the appropriate use of design application skills, it can be unclear what students have actually learned and are able to transfer to future assignments.

Three implications for practice were revealed in the findings: educators should introduce and require use of a design process throughout assigned projects; educators should assess critical thinking throughout the design process with an assessment tool that measures a student's capability to reflect upon knowledge and design skills; and educators using reflective practice should create prompts that have students produce detailed statements about design techniques and skills. In addition to implications for practice, three implications for future research were revealed: researchers can determine the impact of the scenario-based design challenges by using a comparative study; researchers can study the development of critical thinking skills in graphic arts through PjBL; and researchers can measure critical thinking and problem solving in upper level graphic arts courses to improve upon ideation and creativity. The limitations of the mixed methods study include a condensed timeframe for data collection; the results cannot be generalized to other design application courses, and the subjectivity of the researcher-observer.

The outcomes from this study suggest that scenario-based design challenges and the use of reflective practice can positively impact the development of critical thinking in first-year university students. Through learning opportunities that engage students in critical thinking through steps in a design process, learning can be transferred from one project to another. The outcomes suggest that scenario-based design challenges promote

the proper use and application of design skills, while also impacting the student's ability to reflect upon previous work, use a design process, and create memorable art.

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APPENDIX A

SAMPLE OF PARTICIPANT INFORMATION LETTER AND ASSENT FORM

Dear Applications and Foundations for Image Manipulation Student:

During our class this academic session, I would like permission to collect data from you in the form of surveys, reflective statements, project grades, and interviews. I will keep you informed about all data collection and analysis.

I will use the data that I collect within a research study in the field of curriculum and instruction. The collected data may also act as supporting materials for presentations at state or national conferences, and institutes of higher education. If I do so, I will take extreme care to ensure confidentiality. I will use pseudonyms in my writing/speaking and will not directly refer to you as a student by name or do anything that might indicate who my participants are.

I am interested in researching how the inclusion of design challenges and reflective statements may enhance critical thinking and reflective skill sets within an introductory image manipulation course. Very little work has been done in this area, and you will be contributing to the body of knowledge about teaching and learning within the visual communication and design classroom. I believe that this is important work and will be helpful to students and to other professional educators.

Your participation is strictly voluntary, and there will be no penalty if you choose not to participate. One of the ethics of research is to “do no harm,” and that is my commitment to you. I will be honored if you decide to allow me to use data from our class this academic session, but I want you to know that your well-being will always take precedence over my research study.

Sincerely,

Chad Treado

Consent

I have read the information contained in the letter/memo about the above titled study, which describes what I will be asked to do if I decide to participate. I have been told that the decision is up to me, and that I do not have to participate. I have been told that I can stop participating at any time I choose, and my final course grade will not be affected.

Yes – I want to participate in the study.

-OR-

No – I do not want to participate in the study.

Student's Signature

Date

Age

APPENDIX B

QUESTIONNAIRE FOR DEMOGRAPHIC INFORMATION

Applications and Foundations for Image Manipulation Demographics

The following 10 questions will provide the researcher with demographic information.

Please answer each question below through selection, drop down menu, or text entry.

Q1 What is your age?

18-19

20-21

22-23

23+ _____

Q2 To which gender do you most identify:

- Female
- Male
- Transgender Female
- Transgender Male
- Gender Variant/Non-Conforming
- Not Listed _____
- Prefer Not To Answer
-

Q11 Are you of Hispanic, Latino, or Spanish origin?

- Yes
- No
-

Q3 How would you describe yourself?

African American/Black

Asian/Pacific Islander

Hispanic/Latino

Multiracial

Native American/American Indian

White

Not Listed _____

Prefer Not To Answer

Q4 What college are enrolled in?

- South Carolina School of the Arts
 - College of Arts and Sciences
 - College of Business
 - College of Christian Studies
 - College of Education
 - College of Health Professions
 - School of Interior Design
 - School of Public Service and Administration
-

Q5 What is your major?

Q6 What place (town/city) do you consider to be your home?

Q9 Are you the first in your family to attend college/university?

- Yes
 - No
-

Q7 I was admitted to the university on the basis of my academic record from:

High School

Home School

General Education Development (GED)

Bachelor's Degree

Master's Degree

Other _____

APPENDIX C

QUESTIONNAIRE FOR PRIOR KNOWLEDGE

Image Manipulation Knowledge

The following 20 question quiz will establish a baseline of your Photoshop and Image Manipulation knowledge.

This quiz will not affect your course average.

Please answer each question to the best of your ability.

Q26 Name:

Q1 Which of these Photoshop tools lets you paint on your computer screen?

- Paintbrush
 - Gradient Tool
 - Move Tool
-

Q3 Which of these tools lets you select a range of colors?

- Paintbrush
 - Gradient Tool
 - Magic Wand Tool
-

Q4 What does Photoshop automatically do when you copy/paste an image onto an image?

- Creates a new layer
 - Changes the foreground color
 - Creates a duplicate layer
-

Q5 Which tool is used to sample a color in an image?

- Sponge Tool
 - Sharpen Tool
 - Eyedropper Tool
-

Q7 Which tool blends 2 colors perfectly?

- Blur Tool
 - Dodge Tool
 - Gradient Tool
-

Q8 When using the SAVE AS: feature, the _____ file type saves my graphic design with all layers visible for changes upon opening the next time.

- .gif
 - .psd
 - .png
-

Q9 Colored pencil, watercolor, plastic wrap, and poster edges are all examples of artistic _____?

- Colors
 - Filters
 - Brushes
-

Q10 What does a gray and white checkerboard background indicate?

- The image has a gray and white color scheme
 - The image is transparent
 - The image is broken
-

Q11 When you resize, rotate, or flip a layer, you MUST press _____ to apply the transformation.

- Enter
 - Shift
 - Backspace
-

Q12 When editing an image, it is important to use multiple _____ to separate parts of your image

- Files
 - Layers
 - Filters
-

Q13 The purpose of a layer mask is to hide some layer pixels from view.

- True
 - False
-

Q14 Which of the following image formats is most often used for photographs?

- .png
 - .jpg
 - .tiff
-

Q15 Which tool puts text on top of the image?

- Content Aware Move
 - Type Tool
 - History Brush
-

Q16 Which tool allows you to move around the image when zoomed in?

- The Hand Tool
 - The Move Tool
 - The Zoom Tool
-

Q17 Digital images are measured in

- Inches
 - Points
 - Pixels
-

Q18 In Photoshop, the _____ is the area in which image manipulation takes place.

- Layout
 - Workspace
 - Desktop
-

Q19 Once you build layers in an image manipulation, you cannot rearrange them.

- True
- False

Q20 The _____ tool allows you to select a rectangular or circular area of a layer to change or delete.

- Marquee
- Crop
- Hand

Q21 To resize a graphic in a layer, select the _____ tool, then check mark _____ to see selection handles.

- Marquee; resize
 - Move; show bounding box
 - Marquee; show bounding box
-

Q22 Drop shadow, inner glow and bevel are examples of _____ you need to use with text.

- filters
- blending options
- layer modes

APPENDIX D

DESIGN CHALLENGES

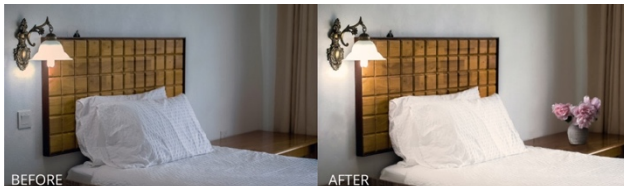
Design Challenge One:

Using the Photoshop tools and image composite techniques discussed throughout the week, analyze and evaluate the image.

During the image evaluation, record everything that you notice or that comes to mind. You will use this information to complete this week's design challenge.

Scenario: As a junior designer, you will work with a variety of clients and be assigned specific portions of a project to complete. You have been assigned to an advertising campaign and tasked with the development of a magazine advertisement for an interior design company. The project manager sends you an image that is supplied by the client and poorly lit. To help improve the presentation and impress the client, you have to apply minor image adjustments to properly show future design elements.

You decide to access the design firm's digital archive and download a before and after image from a former interior design client. Use this image to evaluate the work of senior designers within the firm. You would like to understand image adjustments commonly used in presentation boards.



Domonkos, E. (Photographer). Before-after.sm [Online image] Retrieved from <https://a-idea.studio/2017/02/06/art-website-images->

In a series of reflective statements, answer the following questions:

- 1) Using current knowledge of Photoshop tools and techniques, how would you describe the before and after image? What specific updates did the previous designer apply to this client image?
- 2) Looking closely at the flower vase and flowers, describe how these were transformed and placed within the image? How would you transform and place an additional flower vase?

For Digital Submission to Canvas:

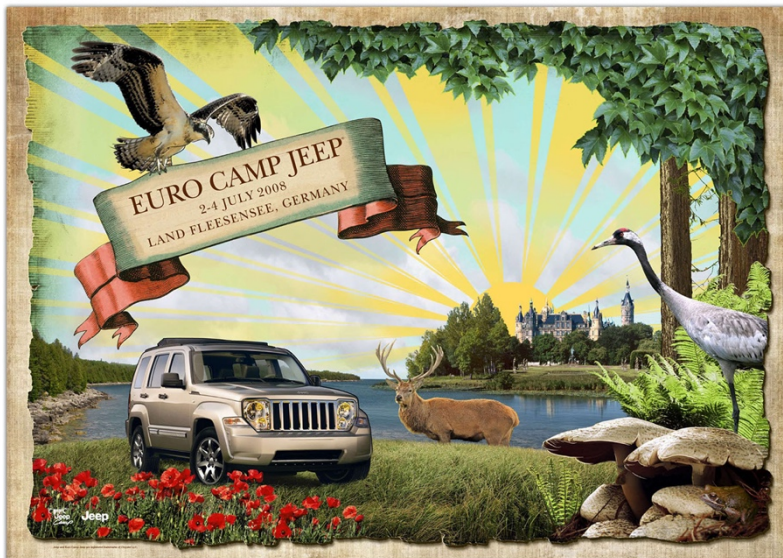
1. Your notes from the image evaluation.
2. Your responses to the design challenge questions.

Design Challenge Two:

Using the Photoshop tools and image composite techniques discussed throughout the week, analyze and evaluate the image.

During the image evaluation, record everything that you notice or that comes to mind. You will use this information to complete this week's design challenge.

Scenario: A new client, The Chrysler Academy, has agreed to work with the design firm. You have been assigned to the design team for this project. Your task is to assist in the development of a promotional poster for a classic car show. You decide to access the digital archives again and locate a comparably themed poster from a previous client for inspiration.



Rockwell, K. (Graphic Designer). Euro Camp Jeep 2 [Online image] Retrieved from <https://www.behance.net/gallery/26854893/Euro-Camp-Jeep2>

In a series of reflective statements, answer the following questions:

- 1) After analyzing the digital image, estimate how many graphics were used to create this promotional image?
- 2) How many layers can you identify in this image?
- 3) Identify and describe how drawing tools were used in this promotional image?
- 4) Describe the image selection techniques used to create this promotional image.

For Digital Submission to Canvas:

1. Your notes from the image evaluation.
2. Your responses to the design challenge questions.

Design Challenge Three:

Using the Photoshop tools and image composite techniques discussed throughout the week, analyze and evaluate the image.

During the image evaluation, record everything that you notice or that comes to mind. You will use this information to complete this week's design challenge.

Scenario: Peasant Kitchen, a local restaurant, has hired the design firm to redevelop their brand identity through a farm to table concept. The project manager invites you to a design meeting for planning purposes. You are assigned the task of creating a profile of the new head chef. For background research purposes, the project manager would like you to research “unique and earthy” visuals in the digital archives. You come across the following graphic and must deconstruct the image for inspirational purposes and the establishment of a brand identity. Along with the design team, you will be presenting your findings to the owners of Peasant Kitchen.



Baillargeon, N. (Digital Photographer). National bank rebrand [Online image] Retrieved from https://www.behance.net/gallery/44190339/National-Bank-rebrand?tracking_source=curated_galleries_list

In a series of reflective statements, answer the following questions:

- 1) Estimate how many graphics were used to create this image.
- 2) How many layers can you detect in this image?
- 3) Describe the image selection techniques used to construct this image composite.
- 4) Describe two image transformations used by the designer to build the presentation board.
- 5) Identify and describe two color changes or enhancements that were applied to the images.
- 6) Describe how typography could be used in this image. Where should it be located?

For digital submission to Canvas:

- 1) Your notes from the image evaluation.
- 2) Your responses to the design challenge questions.

APPENDIX E

PROJECT GRADING RUBRIC

	Weight	Mile.			Beg.		None
		5	4	3	2	1	
Idea (Ideas that informed both the process and product): Identifies problems, needs, and opportunities. Generates imaginative idea/concept development and solutions. Compares new, unique, and different ideas with research. Evaluates a number of solutions and moves the best ideas to completion.	15%						
Documentation (Research, design, planning, evaluation): Investigation and interpretation. Researches contemporary and historical approaches and contexts appropriate to design.	15%						
Skills and Technique (Quality and utility of features and choices): Identifies and demonstrates skills, craftsmanship, knowledge of design principles, and technical abilities.	30%						
Process (The journey that led to the final design): Pushes beyond boundaries in an imaginative way. The capacity to create an original design. Makes connections among research and preliminary designs.	15%						
Presentation/Production (The final design): Presents work in a pre-professional manner appropriate for introductory work.	15%						
Identity and Practice (The student's ability to articulate their understanding, utilization, and application of any of the above): Reflection through a design statement that shows skills in understanding, application, evaluation, and creativity that have been applied to their final design. Connections are made between case studies and online discussions.	10%						
Total Weighting							

APPENDIX F

HOLISTIC CRITICAL THINKING SCORING RUBRIC FACIONE AND FACIONE

4	<p>Consistently does all or almost all of the following:</p> <ul style="list-style-type: none"> Accurately interprets evidence, statements, graphics, questions, etc. Identifies the salient arguments (reasons and claims) pro and con. Thoughtfully analyzes and evaluates major alternative points of view. Draws warranted, judicious, non-fallacious conclusions. Justifies key results and procedures, explains assumptions and reasons. Fair-mindedly follows where evidence and reasons lead.
3	<p>Does most or many of the following:</p> <ul style="list-style-type: none"> Accurately interprets evidence, statements, graphics, questions, etc. Identifies relevant arguments (reasons and claims) pro and con. Offers analyses and evaluations of obvious alternative points of view. Draws warranted, non-fallacious conclusions. Justifies some results or procedures, explains reasons. Fair-mindedly follows where evidence and reasons lead.
2	<p>Does most or many of the following:</p> <ul style="list-style-type: none"> Misinterprets evidence, statements, graphics, questions, etc. Fails to identify strong, relevant counter-arguments. Ignores or superficially evaluates obvious alternative points of view. Draws unwarranted or fallacious conclusions. Justifies few results or procedures, seldom explains reasons. Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.
1	<p>Consistently does all or almost all of the following:</p> <ul style="list-style-type: none"> Offers biased interpretations of evidence, statements, graphics, questions, information, or the points of view of others. Fails to identify or hastily dismisses strong, relevant counter-arguments. Ignores or superficially evaluates obvious alternative points of view. Argues using fallacious or irrelevant reasons, and unwarranted claims. Does not justify results or procedures, nor explain reasons. Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions. Exhibits close-mindedness or hostility to reason.

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Retrieved October 29, 2016 from <https://www.insightassessment.com/Resources/Holistic-Critical-Thinking-Scoring-Rubric-HCTSR>

APPENDIX G

SEMI-STRUCTURED INTERVIEW

Sample Questions for the semi-structured interview

1. How would you define critical thinking? How would you define reflection?
2. How did the design challenges influence the decisions made in assigned projects?
3. As you progressed through the assigned projects, did you find yourself thinking critically or reflecting about your designs in a different way? Was this a different process than before the design challenges?
4. How did the reflective statements improve your understanding of image manipulation tools and techniques?
5. As you progress in your coursework and into your future career, do you envision yourself applying these reflective practices to your work?