A study of teaching methods to enhance creativity and critical thinking in graphic design

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A study of teaching methods to enhance creativity and critical thinking in graphic design

by

Samantha Colleen Barbour

A thesis submitted to the graduate faculty in partial fulfillment of the requirements for the degree of

MASTER OF FINE ARTS

Major: Graphic Design

Program of Study Committee:
Sunghyun R. Kang, Major Professor
Bernard Canniffe
Paula J. Curran
Connie Hargrave

Iowa State University

Ames, Iowa

2016

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ABSTRACT

Progress and change are important to improving old processes and educational methods are not an exception to these facts of life. Numerous studies have been conducted on different learning styles and methods individuals use to transfer what they learn to new situations. However, most of these studies do not reflect on what this research means for designers, specifically graphic designers.

Graphic designers play many roles as problem solvers, critical thinkers, and creative strategists. Generally speaking, success in graphic design is measured by the strength of a solution’s creativity. When a solution is creative it tends to address the need in a new way. A designer works through a process to find a solution that best meets the criteria of the problem or issue—research, ideation, final design development, and communication. Graphic design has been taught at universities for a long period of time, but there have not been many research studies that look specifically at how the processes of design problem-solving are taught to students at the university level. It is important that examines these processes to determine if there is a need for improvement in design education. It has often been said that there is no one perfect way to teach subject matter, but this does not imply stagnation. In this study, two group of students were recruited to examine select teaching methods. Then the two groups were compared based on different methods of instruction. The data were then examined to determine whether the students’ abilities to think critically and creatively are based on the design process and a limited interruption. This research is important because it offers a new method to understand how instructors teach graphic design to enable students to understand the processes they are being taught and transfer that knowledge to new situations.
CHAPTER 1. INTRODUCTION

Overview

Design education has traditionally focused on the final product as a measure of a student’s ability. Consequently, the process that students work through to complete their project needs to be analyzed for effectiveness. There are different methods of instructing design students from the beginning of their education to the end. It is one of the goals of academia to make certain that students are given the best education possible. With this goal in mind, it is important to continuously assess the methods and processes used to instruct students. A noted singer in the 1970s was concerned with change and innovation throughout his public career, Zappa (2011) posted that progress does not happen until one faces a wall and needs to be creative to move forward, often in a new direction.

There is a higher probability for failure if designers are unable to think critically and creatively for themselves. Giving students the opportunity to problem solve (PS) and think critically as well as creatively (CCS) can push the students to come up with better answers for their design solutions outside of school. Students are shown how to design by methods related to the medium for which they are designing; therefore, when they are allowed to design their own projects the students may think about the medium foremost when they should, instead, be assessing the problem through CCS and PS. After completing this process they are able to decide what is the best method to solve a problem with design.

Purpose, Need, and Objectives

It is important that students are able to think on their feet and be able to work from scratch because they will not always have project statements to direct them to a solution.
People may argue that the purpose of a project statement is to keep students on track rather than guide them how to complete the project. Nevertheless, in many cases, students do not separate project statements given in class from to-do lists. Students may be perceived as working to meet the requirements of the assignments to achieve a desired grade based on the instructor’s tastes rather than pushing the boundaries of their creative and critical thinking skills.

Design is unlike other fields, such as mathematics. Practitioners in design fields such as architecture, graphic design, and interior design do not work to come up with the same solution for each project. Designers are constantly looking for the next idea, a new solution, or a culturally relevant answer to solve a problem.

The objective of this study was to propose a new model of design process that will enhance critical thinking and creative thinking. The goal was to test the model to determine whether this method can make an impact for educators to change the current methods used to teach graphic design students.

**Limitations**

Although the specific goal of this researcher was to determine when is the best time to introduce CCS and PS, the study was carried out with some limitations. Population size and timing limited the information obtained from this study. Determining when CCS and PS can be introduced into design student’s education would require testing either sophomore or junior level students. The ability to determine what students know at each level also contributes to the data that are collected from testing. This study was limited to focusing on
graphic designers as the participants. In the future, this study may be tested in other fields within design and a comparison may be made to ascertain the differences between programs.

**Research Questions**

Three main questions were addressed in this study. These questions provided the framework used to make sense of the elements that contributed to the success of the methodology.

1. What are the PS and CCS skills that impact visual communication / graphic design student?
2. What is an instructor impact on a student’s ability to problem solve (PS), to think critically and creatively (CCS)?
3. How can an instructor embed PS and CCS in the graphic design projects to help students build these skills?

These questions were used to develop the testing method to determine if introducing PS and CCS earlier in a project results in better design choices. The new methodology would enable designers to strengthen their skills to apply to their work rather than strengthening each individual project.

**Thesis Organization**

The introduction and structure of the study was provided in this chapter. Literature reviewed that is related to the topic is presented in Chapter 2. Chapter 3 covers the methodology used for the study. Analysis of the tested methodology is included in Chapter 4. Chapter 5 provides a summary, conclusions, and recommendations for future study.
CHAPTER 2. LITERATURE REVIEW

Introduction

Non-linear coursework allows students to learn by doing and finding the answers themselves. In many design programs students are given a project to build their skills. Too often, graphic design programs give assignments with specifications that are so confining they tend to design the student’s project(s) or problem(s) for them. Furthermore, “design problems” discussed throughout this research are related to an issue that has been proposed by a client or instructor—one for which a graphic designer must find a solution. Regarding this research, the word “product” is open-ended as designers do not create within a numerable list of items within their field (e.g., logos, business cards, letterheads, websites, brochures, posters, etc.).

Design Processes

It is important to understand the design process to be able to comprehend the way designer functions and could be taught. Foremost, the design process can be defined as a systematic series of steps used in creating utilitarian products and processes. Many have outlined various series of the aforementioned design process steps. Additionally, there are many ways to look at design processes. Specifically, one can look at design processes in three specific ways. One way to look at design processes is the way an individual process is constructed. Moreover, one can analyze design processes in education and how each process relates to education. Finally, we can look at how an individual design field examines the process.
The book, *How Designers Think* (Lawson, 1990), discusses a map created for the Royal Institute of British Architects (RIBA) practice and management handbook, which shows an outline of a design process. This mapped series of steps is basic and was created by and for architects (Figure 1). While the outline was directly written in relation to architecture, the steps are and can be carried over to other creative and performance art fields such as graphic design.

![Figure 1. Work map of the design process (RIBA)](image)

The RIBA handbook explains in detail the specifics of each step of this design process and asserts that the process can be broken down into four phases: assimilation, general study, development, and communication.

- **Phase 1 Assimilation**: The accumulation and ordering of general information and information specifically related to the problem at hand.
- **Phase 2 General Study**: The investigation of the nature of the problem. The investigation of the possible solutions or means of a solution.
- **Phase 3 Development**: The development and refinement of one or more of the tentative solutions isolated during phase 2.
- **Phase 4 Communication**: The communication of one or more solutions to people inside or outside the design team. (Powell, 1967)

The RIBA example is just one way to look at the design process. Another way to look at design processes is to analyze those that allow others to aid with the process as well as to
allow the freedom to return to previous steps when more information is given and more exploration is needed.

Next, a design process can involve more than one team member. Lockwood (2009) created a design process that involves multiple team members working on a project, which is outlined in *Design Thinking*. Lockwood maintained that the design process is not necessarily a series of gates that must be stepped through to meet a desired design goal but, instead, should be seen as a vortex that allows constant access and exit to the project from all the members involved with the creation of a design solution (Figure 2).

![Figure 2. Integrated design management process (Lockwood, 2009)](image)

In *Design Thinking*, Lockwood (2009) continued to explain that “... the gray arrows indicate various team members coming and going, collaborating as needed throughout the project” (p. 2391). The beginning of the model is where the problem is defined or, as Lockwood preferred, the “manifesting of a symptom and not a real problem” (p. 2386).
The next step in Lockwood’s (2009) model is to develop insight. This enables designers to sort out the findings to discover opportunities. The ideation phase involves creating quick concepts, sketches, prototypes, etc. Finally, it is hoped that the ideation phase would lead to innovation.

While these processes tell us how designers can use a process to work through a problem, little is advised about how to teach design students about these processes. Consequently, Ellmers (2005) re-examined graphic design pedagogy by analyzing different design process and their relation to the student and teacher dynamic. Ellmers discussed a studio-based learning process developed by Kvan (Figure 3). According to Schön (1987) (as cited by, Ellmers, 2005):

…there is the formulation of the problem, then exploration of solutions through action-based activity, followed by problem re-examination, and finally to jury for examination. The first three steps are recycled until a satisfactory solution is realized before proceeding to examination. The relationship in this setting between teacher and student, is framed by the master-apprentice approach. (p. 2)

![Diagram](image.png)

Figure 3. Design studio teaching cycle (Kvan, 2001, p. 2)
Ellmers (2005) also provided beneficial information about problem-based learning and reflective practitioners. Reflective practitioners, according to D.A. gives us a framework for navigating studio design practice and activity and their processes. His work is based on a theory that “... the designer constructs their view of the world based on their experiences …” (Valkenburg & Dost, 1998, p. 3). In addition, regarding reflective practitioners, there are two types of reflections as explained in their paper: reflection-in-action and reflection-on-action. Foremost, reflection-in-action is what happens when the designer is not expecting a situation to arise while working on the solution. Whereas, reflection-on-action happens when the designer reviews actions from the past. Both of these reflections are important for designers to be aware of and practice. In either type of reflection, the professional graphic designer must be able to handle new situations that may be handed to them.

According to Ellmers (2005):

Valkenburg and Dorst (1998) applied Schön’s reflective practice theory to outline the process of design practice. They broke the design process down into four stages (Figure 4): Naming — the problem is articulated; framing — the context of the problem; moving — the actual design activity, and reflecting — the designer assesses the design development within the context of the frame. (p. 4).

Ellmers (2005) elaborated that the naming stage is when the problem is realized. In graphic design education this could be the point in which the problem statement or outline is handed to the student. Ellmers’s reflective practice theory is able to create a step-by-step guide to encourage the need for reflection in studio-based education because a reflection can create informed decisions. This theory can bridge gaps between student’s projects and create reflective conversations throughout problem-setting and -solving activities.
Figure 4. Schön’s reflective practice theory (cited by Valekenberg & Dorst, 1998, p. 4)

Ellmers also addressed the parallels Kvan examined between problem-based learning (PBL) and studio-based learning. PBL is a pedagogy focused around an open-ended problem that allows students to learn about a subject. It is through PBL that students are able to develop their skills of thinking strategies use of domain knowledge. PBL originated from medical school in the 1970s it has since shifted to other areas of education (Koschmann et al. 1994 p. 240).

In contrast, the studio-based model of education originated in the United States (Hargrove, 2011). Foremost, studio-based learning is typically used in creative and performing arts fields such as architecture, graphic design, and engineering. Studio-based education is diverse and is able to direct learning through the action and making of projects, processes, or performances—all of which can be assessed. For example, Kvan (2001) stated, “... PBL appears to emerge from the principles of studio-based learning” (p. 95). However,
he made the important point that, in light of problem-based learning practices: “... important opportunities for learning are omitted in the studio setting” (p. 95). Kvan pointed to problem-based learning’s focus on project process as compared to studio-based learning’s focus on the design project itself. Ellmers elaborated, “It is this failure of studio-based learning to include a formalisation of the design process that concerns Kvan,” (2001, p. 10). In other words, this means that the assessment process is different between problem-based and studio-based learning. The assessment of problem-based learning focuses on how the project is researched, created, and made, while studio-based learning focuses heavily on the end product. It seems to be Kvan’s opinion that the process and product belong together.

Koschmann (1994) laid out five steps to be used in problem-based learning (Figure 5). Ellmers (2005) and Kvan (2001) also wrote about this model related to the field of architecture.

Figure 5. Five steps in problem-based learning (Koschmann, 1994)
The student groups engage in the formulation of the problem, then identify what they need to learn to solve the problem (self-directed learning), and then re-examine the problem to test whether they have discovered the appropriate facts, skills or concepts to propose a solution. If the problem is not solved, the students cycle back through the first three stages until a satisfactory solution is developed. (Koschmann, 1994, p. 227)

Ellmers’s (2005) idea is important to any graphic design problem or project. This is because designers should be able to cycle back and check to make sure the goals and needs of the project have been met which can make or break a project—as outlined in Lockwood’s (2009) theory discussed at the beginning of this research. Consequently, if designers were to design a solution without looking back, many projects would fail to meet the needs of the client. Learning (about the project, client, and problem) happens through the creation of a solution. This information does not reveal itself at the beginning of a project. New questions arise during design processes; therefore, as Lockwood (2009), Ellmers (2005), and Kvan (2001, 2005) argued, it is important that at any stage designers are able to take a step back to previous steps.

**Instructional Design and Instructional Designers**

Instructional design is an approach to developing instructional materials to be used in classrooms, businesses, and particularly in projects. It looks at the needs, goals and level of detail to the delivery system that meets those needs. Instructional design is both diverse in methods and students. Good instructional design aims to teach a very specific learner and works with a diverse group of people.

The title of instructional designer is often used very loosely; often the people who know how to program educational technology, such as BlackBoard, are considered makers of instructional material. BlackBoard is a web-based system of managing courses. It is used to
facilitate learning for face-to-face learners as well as online learners. Instructional designers are the ones who create the materials, while technicians merely place the created content. These technicians do not give advice on how to make the content more effective for students, although technical operators of systems like BlackBoard may give suggestions for delivery to the students.

It is an instructional designer’s role to know as much as can be known about the students who will be interacting and learning from their proposed designed material. First, there are issues with this as the students are not always known by the instructional designer. Therefore, the question arises: how does one design a course and course materials without knowing the students? Many times an instructional designer needs to know how to create a class without knowing the students that will be registering for a course or using his or her material. Hence, to be able to design a course an instructional designer should begin by asking four questions, which are derived from a model in Designing Effective Instruction (Morrison, 2004):

1. For whom is the program developed?
2. What do you want the learners to learn?
3. How is the subject content or skills best learned?
4. How do you determine the extent to which the learning is achieved? (p. 14)

After these four questions have been answered, an instructional designer determines whether the instruction design materials are needed because, if they are not needed, it can waste a lot of people’s valuable time and money to create, build, and distribute the material. Furthermore, the process of deciding whether instructional design material is needed serves multiple purposes. First, it identifies a need for a task as well as critical needs of the
instruction that is being created or changed. It also sets priorities for the instruction, and establishes a baseline to assess the effectiveness of the instruction design created.

Once an instructional designer determines whether or not material is necessary, it is important that he or she determine the type of material needed. There are six types of material needs listed in *Designing Effective Instruction*: Normative needs, comparative needs, felt needs, expressed needs, anticipation or future needs, and finally critical incident needs (Morrison, 2004, pp. 33-36). These are further explained as follows:

1. **Normative needs** is when differences are compared between target audience and national standards.
2. **Comparative needs** is when you compare two similar groups.
3. **Felt needs** are when there is a desire to improve performance.
4. **Expressed needs** are when needs are turned into action.
5. **Anticipated or future needs** is when a future need for instruction design is seen and planned for.
6. **Critical incident needs** are when instruction design is critical issues arrive like damaging storms and mass injuries.

After the kind of need is known, an instructional designer conducts a needs assessment. This involves, planning, collecting data, data analysis, and a final report. Then a goal analysis is made followed by a performance assessment (Figure 6). Throughout the rest of an instructional designer’s process they will look at a variety of things to design the material used for instruction, including “... learner characteristics, task analysis,
The process of instructional design is lengthy but is a necessary process to prepare appropriate instruction that will help one’s students fully grasp the material. Moreover, instructional design relates to graphic design in that, as graphic design has processes, teaching graphic design requires a process for creating instructional material. There are many individuals who attend a school for either instructional design or graphic design; thus, the two professions are often seen as two different fields that are not related to each other. Instructional designers often refer to graphic designers on how to create graphic shorthand to make their instruction easier to understand. Graphic designers may seek instructional designers to have a process explained to them so they can visualize the material. In regards to this research study, the two go hand-in-hand. Instructional design is important to the creation
of new teaching methodologies, such as those proposed in this research. The objective of this study was to propose a new model of design process with components of critical thinking and creative thinking, and to determine whether there is need for graphic design education to make a change to current teaching methods; therefore, instructional design processes must be used.

**Problem Solvers and Solving Problems**

A new approach for teaching graphic design could begin to challenge the students to become better problem solvers. Currently, students and designers are given a project and they use problem-solving skills to complete it. To be able to problem solve outside school, they should be able to realize that there is a solution and work to find that solution. Bachanan (2009), who was a professor of design, management, and information systems, stated the following in the book, *Design Studies, A reader*:

> Although there are many variations of the linear model (wicked problems), its proponents hold that the design process is divided into two distinct phases: problem definition and problem solution. Problem definition is an analytic sequence in which the designer determines all of the elements of the problem and specifies all of the requirements that a successful design solution must have. Problem solution is a synthetic sequence in which the various requirements are combined and balanced against each other, yielding a final plan. (p. 97)

Designers must be able to determine all the elements on their own; that is, without the instructor’s help. If students are not able to determine these elements, they will most likely be unsuccessful in finding a solution within the given constraints and limitations as professional designers.

Problem solving is a process of realizing that there is something that needs to be fixed, changed, or created to come to the aid of another thing—human, ecological, or
machine—and then finding a solution that meets the most criteria to answer the issue(s). Problems can be classified into two categories: ill-defined and well-defined (Schnacter, 2010). On one hand, ill-defined problems are those that do not have a clear path, goal, or solution; while, on the other hand, well-defined problems have goals that are made clear and have a pre-assumed solution. Therefore, it may be assumed that a majority of designers automatically decide that a specific medium (such as a poster or brochure) is the answer to the solution; hence, process begins to start designing the problem around that medium. Designers should know how to use problem-solving skills to work toward a solution. The medium is merely the expression of the solution and should be considered last (or at least later in the process).

Pedagogical choices matter because designers have the opportunity to confront important problems and issues and should be equipped with the skills to do so. Foremost, designers not only need to be the makers of things but also the instigators for change. While designers can make environmental choices with the paper they are using or the waste that is left over after a project, there are other advocacies they should be aware of, such as environmental, ecological, and social change.

**Problem Solving and Transfer Learning**

With the world rapidly changing, it is important that graphic designers are able to shift and apply what they know to new concepts. New problems are arising constantly, from the need of ability friendly environments to the spread of world hunger—students need the ability to transfer their knowledge to fit these and other new situations. This is where problem solving and transfer learning come into play.
Dixon and Brown (2012) suggested that problem solving “...begins as soon as the problem solver generates enough information about the problem space to gain an understanding of the problem. Often, the problem solver is able to associate concepts from previous experience to solving a similar problem” (p. 4). The authors also noted that students bring multiple facets to the table when solving a problem, such as their depiction of the project, background experiences, and ability to understand the project. Dixon and Brown also noted that, “Students bring a wealth of knowledge to each learning situation and, without specific guidance from teachers, may fail to connect everyday knowledge to subjects taught in school.” (p. 6).

When a project is taught linearly, it can limit students’ chances to learn to problem solve on their own. Perkins and Salomon (1988) remarked that a transfer happens quickly within the subconscious when the problem solver realizes what can be transferred from past experiences to the present. It is important that students gain the skill to be able to transfer their knowledge to new situations so they are not having to relearn and waste time trying to understand the issue challenging them. Knowing that students need to be taught transfer learning is one step. The next step is determining how to teach using methods of transfer learning.

Williamson and Schell (n.d.), of the Center for Teaching and Learning at The University of Texas at Austin, offered four ways to teach transfer by focusing on: (a) big ideas, (b) hugging, (c) bridging, and (d) contrasting cases. Knowing about all four methods is important because not all students learn the same way; thus, one method may work better than the others for a particular student. It may be appropriate to make this assumption based on studies and testing that have been conducted on learning styles and teaching styles. There
are many different learning styles as well as methods of reaching students through different teaching styles. Williamson’s and Schell’s research can be applied to determine how these methods could apply to teaching design students.

Williamson and Schell’s (n.d.) described the first way of using transfer learning to help students is to focus on the big idea which involves looking at quality over quantity with students. According to Williamson and Schell, as cited by Wiggins and McTighe (2005), who explained that steady progression for teaching topics as well as testing can fail to plant a seed for anything to transfer. In design it is important to re-evaluate any project that is being worked on constantly. Oftentimes, projects can become so narrowed down, that often the big picture is missed entirely. Designers are scrutinizing and picking apart various elements of any project and can easily become lost in the scrutinizing.

The second method, hugging, does not refer to actual hugs being given. Williamson and Schell (n.d.) explained that a transfer of information can happen when an effort is made to foster it. This involves making a connection between the two similar points. As an example, they noted that “…an instructor who asks students to solve a physics problem using baseball examples and then has the students solve similar problem using softballs is hugging.” Students may need to be shown how what they learned can be linked to a new situation, and hugging is a way to do this discreetly. With design courses that are taught lineally, many of the things that students are taught are lost on the specific project. There is little besides technical techniques that students take away from a project. If students have more opportunities in class to work toward a solution to any given assignment, they may be better prepared to take what they have learned during each assignment and apply it to new and different projects in their future work. When teaching graphic design students, it is not
always obvious to the students that what they are being taught is more than just parts to the projects given in the class, and that what they are learning can be applied to projects in other classes.

The third method, bridging, is like hugging but used during more complicated instances. Williamson and Schell (n.d.) explained bridging, in the context of Mr. Miyagi and Daniel in the movie, Karate Kid. When Mr. Miyagi provides a chore or project for Daniel to do, the projects do not just teach Daniel how to wax a car or paint a fence, but they eventually teach him how to block properly when doing karate. Miyagi later tells Daniel that the skills are connected. Teaching students a subject and then later having them put that knowledge into a new context or having the students use what they learned on another project is a way of fostering transfer learning through bridging. There are multiple ways in which an instructor of design could use this method. One way could be to show students an example of how to do a specific task then have them work on an assignment. This is followed by working on another project in which there are less specifications to see if they connected that a solution to the second problem in which they use what they have learned while working on the first problem or assignment.

Contrasting cases is a way to promote transfers, which are near and far from each other. This method is used when a student needs to learn both the general and special characteristics of a subject. For example, sharks can used as an example in their paper. The same could be said for anything. For example, if the students do not know about sharks, they would study a single case of a breed of shark which would enable them to grasp what a shark is. When the students further their studies on their own about sharks, they would then be able to contrast single case with the contrasting case. Contrasting cases is a great method to help
students recognize and apply their understanding in ways they did not see possible beforehand. This is a longer and lengthier process of transfer and would happen most likely outside of class or after school. When the lessons are applied correctly, the students would be able to recognize that they already have some knowledge on a specific subject, apply it to the new case, and then either work with that knowledge or build upon it with new information.

Critical Thinking

Problem solving is important to any designer’s skill set. To problem solve, one must also need to develop the ability to think critically and creatively as a designer. In contrast, critical thinking is different than creative thinking. Critical thinking skills can help problem solvers evaluate a problem and to make decisions. Creative thinking, or lateral thinking, is completely imperative to derive new and fresh ideas to solve a problem or issue.

To be a critical thinker one needs to be able to think for herself, come up with worthy reasons, and take steps toward solving a problem systematically. A researcher of critical thinking who has published numerous articles, Gelder (2005) perceived that students are not getting the critical thinking skills they need while in school, and stated that “we need to generally improve our teaching and our educational systems” (p. 1). Gelder applied ideas from Bruer (1993) who argued that cognitive science is the best source for knowing what is working and why it is working in teaching. Gelder added that he does not believe that cognitive sciences gives one the whole picture, but that cognitive scientists still have something to offer when looking into critical thinking.

While Gelder’s paper is not specifically related to design, many of the ideas covered in the paper are related to the design field. Gelder (2005) explained that cognitive scientists
have come up with insights as to how we learn, and described six lessons teachers can to use to help their students strengthen their critical thinking skills: “Critical thinking is hard, Practice makes perfect, Practice for transfer, Practical theory, Map it out, and Belief Presentation” (p. 2).

In the first lesson, Gelder (2005) noted that critical thinking is hard, provided a detailed explanation of research conducted by Kuhn (year) on people’s ability to argue and support their own opinion. The study revealed that most individuals are not able to demonstrate basic skills of general reasoning even when they are prompted. Gelder made it a point by stating that, “humans are not naturally critical…” and then he asked the question “so if humans are not naturally critical what kind of thinkers are they?” (p. 2). They are pattern seekers and storytellers, and the problem that most people have is that they do not question if the pattern they are seeing is truly there or whether a story is true. If humans were naturally critical it would still be a hard skill to master because scientists have demeaned critical thinking to be a “high-order skill,” or a skill that is built out of the skills that are easier to obtain. Even when lower level skills are gained, to be applied to a better skill, they need to be combined effectively to have best impact.

The second lesson, practice makes perfect, points out that critical thinking is a skill and, like all other skills, not just in design, it takes practice to perfect. It takes trying something over and over to create perfection or in the least advance skill. In relation to teaching students to improve their critical thinking skills, students need to be engaged in the task of critical thinking. Gelder (2005) posited, “Unless the students are actively doing the thinking themselves, they will never improve…” and “critical thinking cannot be treated as just a kind of gloss on educational content made up for other real subjects” (p. 3).
In relation to the graphic design field, students should constantly be engaged in critical thinking skills in all their classes. Ericsson (1994) noted that, in order to master a skill it can take up to ten years of practice, or four hours a day. Practice begins in the earlier years of someone’s life, but professional skills can be built further in college. For graphic designers to succeed or gain critical thinking skills, something needs to happen in the classroom and it needs to begin with giving students the opportunity to practice these skills over and over.

The third lesson relates to the previously discussed topic on transfer. Lesson three, as titled by Gelder (2005), is practice for transfer. Practice for transfer is primarily making sure that what students are practicing can be applied in other situations—in or out of school, without a teacher needing to help make the connection for the student. If a transfer of learned skills in education is not made, then it could be said that learning has failed. If students are not able to apply what they have learned in new situations outside of class or in another class, then the time spent teaching them that skill was lost.

Practical theory is the fourth lesson. Transferring information requires that something is known about the situation in which students learned something and the new situation that is presented to them. Students will be able to perceive situations and issues better if they understand the theory of the discussion that requires their critical thinking abilities. This takes work on the students’ part. They must investigate about the academic vein in which they are involved and then be able to argue or discuss their points.

This leads to lesson five, map it out. Students must be able to execute good argument skills in the terms of being able to articulate and make logical points. Students may need to be able to sort their points into a hierarchy to effectively make an argument. Most people realize that an argument can be broken into hierarchal points, but not many realize that
complicated hierarchies can be placed into diagrams which can concretely justify each point, revealing that the answer to an issue is the same for multiple angles. This is important for designers to learn when focusing on critical thinking skills. A lot of chances are lost when focusing on one specific problem or issue for only one demographic. For example, when designing signage for a disability like blindness, the focus can be so narrow that the designer may not think about incorporating answers also for deaf or handicapped individuals. If the problem can have multiple solutions it can be designed for the better of the project. If students are able to prove that what they have concluded can answer a majority of the issues presented to them then they should be able to make a good argument.

Belief preservation is the sixth and final lesson. As humans we are inclined to a disposition of being swayed to illusions and distortions (Gelder, 2005) based on blind spots we are not aware of that exist. To become good critical thinkers, students need to be constantly aware that there are blind spots to their thinking, and either eliminate them or know when they need to counteract the negative influence by foreseeing any potential blind spots. Designers are predictors and chance takers; they foresee a problem and must work backwards to solve it. When using critical thinking skills, students should be aware they need to be looking at the problem or issue from all angles and that all blind spots should be identified to make a project a success.

In summary, Gelder (2005) advocated the need for teachers to include critical thinking in their classes, but was not able to touch upon the need for critical thinking outcomes to have creative solutions. Knowing how to think critically about a problem is extremely important. If the final outcome of designing to solve a problem is not any different than when the project was started then the problem was not truly solved. Design is not like
mathematics, in which creating the same answer is important in proving skill. Design is a field that asks for a different outcome than one previously created. The next section discusses creative thinking, which should be combined side-by-side with teaching critical thinking skills to enable students to think beyond to create new solutions to solve new or existing problems.

**Creative Thinking**

Creative thinking, which is also called lateral thinking, occurs when a non-direct path is made to make a decision to solve something. When using creative thinking a solution should not be obtainable by taking the usual path when presented with a problem. De Bono (2010), respected by many as the foremost expert in the fields of creativity and lateral thinking, noted that: “You cannot dig a hole in a differently place by digging the same hole deeper” (p. xx). In other words, if you want a new outcome, you cannot continue down the same path or a predicted path that has already been made. This is how creative thinking is different from critical thinking; nevertheless, they can be used together.

Creative thinking is teachable. De Bono (2010) noted, “…whereas insight, creativity and humour can only be prayed for, lateral thinking is more deliberate process. It is as definite a way of using the mind as logical thinking—but a very different way” (p. 1). De Bono also pointed out that “lateral thinking is closely related to creativity … creativity is too often only the description of a result lateral thinking is the description of a process” (p. 3). In other words, lateral thinking can be taught. Many people compliment a painter because they believe their work is the product of some sort of unknown sense that allows a person to be good at what they are doing, while not realizing that, like lateral or creative thinking, it is a
process that can be taught. Any individual can be taught to be a painter. It is simply through the processes of practicing that an individual can become good at any one task. In relation to transfer learning and critical thinking, creative thinking can be taught in the classroom and, if taught correctly, will allow a student to know how to create new and innovative solutions to new or existing problems.

The purpose of creative thinking in the design classroom is to teach students the skills they need while they are practicing their critical thinking and problem-solving skills. Whatever solution they reach through transfer learning and problem solving will have a higher chance of being new because the solution is creative. The *Business Dictionary* (www.businessdictionary.com) defined creative thinking “a way of looking at problems or situations from a fresh perspective that suggests unorthodox solutions (which may look unsettling at first). Creative thinking can be stimulated both by unstructured processes, such as brainstorming and by structured process such as lateral thinking.” This definition is related to De Bono’s (2010) writings. It is extremely important that all design solutions are new, or there would be a lot copyright infringements. Creative thinking is also important because new ideas are needed to solve issues created by old solutions or continuing issues. Without innovation and creativity nothing new would be made. Thus, creativity is more than an afterthought when creating curriculum to teach design to future designers.

What makes us think that creativity belongs in design education? Is it because we associate creativity with the arts? The answer is yes; however, many people associate creativity with the arts, but creativity is more just a skill of luck. While many may not approve of changing the way design is currently taught in the classroom, De Bono (2010)
made it a point to talk about this in his book on lateral thinking about, including lateral thinking more often and with more emphasis in the classroom. According to De Bono:

> It may seem artificial to separate lateral thinking and try to teach it on its own when it is so much part of thinking. There is a reason for doing this. Many the processes of lateral thinking are quite contradictory to the other processes of thinking (it is their function to be so), unless a clear distinction is made there is a the danger of giving the impression that lateral thinking undermines what is being taught elsewhere by introducing doubt. It is by keeping lateral thinking distinct from vertical thinking that one can avoid this danger and come to appreciate the value of both. Lateral thinking is not an attack on vertical thinking but a method of making it more effective by adding creativity. (p. 15)

Teaching creative thinking is not a replacement to how things are currently being taught, but more of a new set of tools that teachers apply to teach their students to enable them, in the long run, become better designers. Sternberg and Lubart (1995) discussed creativity and its relation to knowledge in education. They provided an example about a student who turned in a paper with creative ideas but it was written with poor typography, grammar, and direction. The student insisted that a good grade would be given on the paper because the idea is all the teacher cared about receiving. The student turned in the paper and received a bad grade. The point Sternberg and Lubart were attempting to make is that, without knowledge of how to present, the creative idea was lost and, thus, a bad grade was given.

The same concept could be used and reflexed in design classes. There is a difference between creativity and creative thinking. Creative thinking is coming up with ideas and thinking about things in a creative way. Creativity is taking creative thinking a step further to implement the students’ thoughts into action to generate new or improved outcomes. This establishes the rationale for including creativity in design education because it is not meant to
replace any other previous teaching style but, instead, enhance the outcomes for the students. Technique and creative thinking should be taught together to allow both to be ultimately successful.

Adobe (2012) published a survey on perceptions by professionals of the need for creativity in college education conducted by research firm, Edelman Berland Research Firm. Findings revealed that a population of “n=1,000 Americans ages 25+ who are college-educated and full-time (salaried) employees, and found that 88% of the surveyed Americans agree that “creativity should be built into education curriculums and 72% agree they were more focused on subject matter than creative thinking in school” (p. 6). They also found that “85% agree creative thinking is critical for problem solving in their career but nearly one-third (32%) do not feel comfortable thinking creatively at work” (p. 6). Even though this was a small sample, the findings revealed that a majority agreed that creativity should be emphasized more in school, while the study was carried out to establish that creativity should have its own class.

The study also revealed that the importance of creativity in college vs. now or outside of school increased by approximately 25%. While only 3% thought creativity was not important while in college, no (0%) participants agreed after college. The study revealed that creativity in people is “regarded as one of the top three personality traits most important to career success” (p. 7), while the other two are intelligence and personability. It is also interesting to note that 53% of women and 33% of men believed that creativity is needed more when being involved with people management, which is beneficial in design if a student desires to become an Art Director.
The final point of the Berland Firm’s study for Adobe (2012) in relation to the current research is that these beliefs are typical across the 15 professional areas that were involved in the survey, including art. Since designers work for many of these other vocations, it provides a strong case that higher education should be placing a greater emphasis on creativity in the classroom.

Assessing Critical Thinking Skills

Ennis (1993) noted that, “Although critical thinking has often been used as a goal of education throughout most of this century (for example, John Dewey’s How We Think 1910; and the Educational Policies Commission’s The Central Purpose of American Education, 1961), not a great deal has been done about it” (p. 179). Ennis’s paper on critical thinking assessment discussed critical thinking, purpose of critical thinking, traps, and published critical thinking tests. Ennis believed we needed to look at the word analysis. He provided broad examples of entities that could be analyzed, such as politics, chemical substances, and use of a word. He noted that none of these things have anything testable in common “except for the vague principles that it is often desirable to break things into parts” (p. 179). Ennis provided a new definition of critical thinking after looking at his original definition: “A definition of critical thinking that I once endorsed is that critical thinking is the correct assessing of statements” (p. 179). He lamented later that even when this “…definition is elaborated it suffers from excluding creative aspects of critical thinking such as conceiving of alternatives, formulating hypotheses and definitions, and developing plans for experiments” (p. 180). Ennis also believed that these concepts should be included when assessing critical
thinking. He believed his final definition was more inclusive: “Critical thinking is reasonable reflective thinking focused on deciding what to believe or do” (p. 180).

Ennis (1993) established an interdependent list of abilities and dispositions that can provide some guidance for critical thinking assessments. He noted that:

In reasonability and reflective going about deciding what to believe or do, a person characteristically needs to do most of these things (and do them independently):

1. Judge the credibility of sources.
2. Identify conclusions, reasons and assumptions.
3. Judge the quality of an argument, including the acceptability of its reasons, assumptions, and evidence.
4. Develop and defend a position on an issue.
5. Ask appropriate clarifying questions.
6. Plan experiments and judge experimental designs.
7. Define terms in a way appropriate for the context.
8. Be open-minded.
9. Try to be well informed.
10. Draw conclusions when warranted, but with caution. (p. 180)

Ennis (1993, p. 180) made the point that one can use this elaboration to help judge whether a critical thinking test is comprehensive or whether it assesses critical thinking at all. According to Ennis, the purpose of critical thinking can also be broken down into a list of 7 points:

1. Diagnosing the levels of students’ critical thinking.
2. Giving students feedback about their critical thinking prowess.
3. Motivating students to be better at critical thinking.
4. Informing teachers about the success of their efforts to teach students to think critically.
5. Doing research about critical thinking instructional questions and issues.
6. Providing help in deciding whether a student should enter an educational program.
7. Providing information for holding schools accountable for critical thinking prowess of their students.

These purposes helped the current researcher in designing the instructional material for the methodology in this study. It was deemed less likely by this researcher that number 6 will be beneficial in the current study because the students who will be the participants are already in an educational program.

Along with the purposes, Ennis (1993, p. 181) continued to warn educators of the traps that come with assessing critical thinking. These are important to helping us avoid collecting data incorrectly:

1. Test results may be compared with norms, and the claim made that the difference, or similarity, is the result of instruction
2. A pretest and posttest may be given without comparing the class to a control group
3. The use of the same test for the pretest and posttest has the problem of alerting the students to the test questions
4. Most critical thinking tests are not comprehensive, especially those that are easy to use, the multiple choice tests
5. Another problem is the use of (especially) multiple choice tests lies in the difference in background beliefs and assumptions between test maker and test taker
6. Significant results may be expected in too short a time period. Learning to think critically takes a long time.
7. High-stakes purposes often interfere with the validity of a test.

In relation to the purpose of the current study Ennis talked about the creation of making your own tests. He discussed about the value of multiple choice test, essay testing and
performance assessment. Since the outcome of the methodology is to look at how students perform his section on performance assessment. Ennis noted:

A more structured performance assessment is exemplified by an exploratory assessment effort by the National Assessment of Educational Progress (Blumberg, Epstein, MacDonald, and Mullis, 1986). A student is given a variety of material and asked to investigate what factor affects the rate at which sugar cubes dissolve. The observer asks questions and watches to see whether the student goes about the task scientifically. In this kind of performance assessment, structure is provided by the assignment of a task, which is designed to check things of interest. (p. 185)

This was a factor the current researcher took into consideration when looking at the survey created by Valencia College for the purpose of assessing their student’s critical thinking skills. The survey was created as a multiple choice survey. Each of the choices the students were allowed to pick answers that would give the investigators insight regarding the participants’ actual level of thinking. Survey option A for each question would depict a beginning level of critical thinking. Option B would show the investigators a developing understanding, C would be competent and D would show accomplished critical thinking skills. A total of 4,075 of the surveys were conducted in the period between August 24, 2005 and December 19, 2005. Some of the questions on the survey were written in a way that would be helpful when looking into critical thinking for an overall demographic of students. Since the focus of the current study was specifically on graphic design students, the questions would need to be written to focus more on critical thinking skills of graphic design students.

**Assessing Creative Thinking Skills**

In his blog, Four Ways to Measure Creativity, Nilsson (2012) noted that one of the four ways to assess creativity was devised by psychologist J. P. Guilford, who used the
divergent thinking in lieu of creative thinking. Nilsson presented Guilford’s four ways to assess creative thinking when discussing the Guilford test:

1. Fluency: How many responses?

2. Flexibility: How many types of responses?

3. Originality: The unusualness of the responses?

4. Elaboration: The detail of the responses?

The Guilford test asks participants to find as many uses for a simple item as possible and then assess them based on the above criteria. In the article an example is given of the Guilford test that was given to a sample of five participants. The participants were prompted to use a circle to draw something and to draw for two minutes (Figure 7). According to Nilsson, the evaluations on these responses by the participants were assessed as follows:

Anna drew the most drawings, even though her drawings were all faces.
   She has the highest fluency.

Benji drew the most types of responses, even though he has fewer total responses than Anna.
   He has the highest flexibility

Carol drew two wheels and a ball -- Nice geometry!
   No prizes alas

Darlene drew only two responses, but no one else drew a balloon or a bomb.
   She has the highest originality.

Edward drew only three faces, but with more detail than the others.
   He has the highest elaboration.

This would be a beneficial way of assessing creativity for this research due to the study being around design oriented fields.
The second method of assessing creativity included in the article is through the “Taxonomy of Creative Design: Measuring how creative a work is.” It looks at creative work as a product. “The taxonomy enables the analysis of a work in the context of its antecedents. How far does it step away from previous works? How great a leap in form or content has the creator taken” (Nilsson, 2012, blog)

The Taxonomy of Creative Design (Figure 8) looks at: original creation, transformation, combination, variation, and imitation. Questions addressed in each part of the taxonomy are as follows:
Figure 8. Taxonomy of creative design (Nilsson, 2012)

1. Imitation: Is the creation the same or virtually the same as something that already exists.
2. Variation: Is it a slight change to an existing object, such that it is different but still retains the identity of the original object?
3. Combination: Is it a mixture of two or more things, such that it can be said to be both or all?
4. Transformation: Is it a re-creation of something in a new context, such that it has some characteristics of the original object, but it cannot be said to still be that kind of object?
5. Original Creation: Does it appear to have no discernible qualities of pre-existing objects or ideas? (Nilsson, 2012, blog)

Nilsson (2012) stated that the strengths of this study is that it “Measures creative work in relation to other works. Assesses novelty and influence” (blog). This also has a weakness because “tells nothing of the relevance, value or effectiveness of their work” (blog).
A third method that Nilsson (2012) talked about in his paper is the Requirements Model: Measuring creative work against criteria. This model assess creative work based on gauges designed before the work is created. In this explanation Nilsson explains the use of this method by discussing architecture. With the design of a house an architect is given specific rules (e.g., how many rooms and style). When the project is completed one can look at back at those rules and assess whether those requirements were met, but one can also look at things to look at—items that are a little more complex. “Does the house feel open or cozy, as desired? Is the space used efficiently” (blog)? Nilsson remarked:

…answering these questions offers direct evaluation of the seemingly more abstract program requirements. So if we set careful requirements for creative work, we can straightforwardly assess it. We often feel that creative work falls in the realm of aesthetic subjectivity, but most aesthetic or subjective responses come from discrete pieces of information that we can measure. (blog)

This model can help when designing a rubric to ascertain if the projects that were designed were creative. Like the second model, Nilsson (2012) noted the strengths and weakness of this model as well. The strengths are that it allows us to “measure relevance, value, or effectiveness against clearly set requirements” (blog). The weakness of the test is that it does not allow the work to be compared against other work, only its own.

The final model that Nilsson (2012) discussed in his article is Csikszentmihalyi’s Systems Model: Measuring the social value of creative work. Nilsson referred to the model as MC, and argued that “the value of a work lies in the relationship between three parties: the person (or his or work), the category to which the work belongs, and the other people who engage the work. These parties go under three names: the person, the domain, and the field” (blog). This work can relate to Barthes’s, Death of an author. Barthes (as cited by Nilsson,
2012) argued that the work is not creative until it has been critiqued by the reader. The same can be said about this model. MC, suggests that “creativity is what happens when a Person creates a work, the Field embraces it and the Domain changes as a result. If a writer pens a novel that expands how we understand novels, and the field of critics, consumers and other writers embrace it, then it is a work of creativity” (blog). According to Nilsson, this method is weak for assessing creativity because it can be highly subjective in nature, based on who is assessing it and what they consider to be successful. It would be like looking at a new style of painting and deciding that it was not art because it didn’t follow guidelines from other genres that have already been declared as art. The only strength of this model is that it can “measure the relevance or value in context of a community” (blog). This may become important to the current research in that it may be used to examine social design problems and how designers can think more critically and creatively to solve these problems or projects presented to them.

**Student Opportunities in Studio**

The purpose for teaching students problem solving skills is to enable the students to take what they learned during their classes not only to complete the project but also learn how to apply what they learned in new situations. If students fail to see how what they learned in class can be applied to solve similar problems, then what they are being taught could be seen as ineffective. Since the majority of the classes a design student takes are studio classes, the classes can be seen as good opportunity to teach these skills to the students. In addition, some students need to be encouraged to work on their problem solving skills. McCade (1990) studied problem solving, and wrote about teaching design and its
relationship to industrial arts and technology. McCade quoted two separate authors when discussing teaching design—Hatch and Vilon:

When teaching design, a strategy must be developed which not only tolerates but rewards alternative solutions. This type of problem solving should involve a divergent as opposed to a convergent thinking process (Hatch, 1988). Students who are encouraged to take control of their own learning will be much more likely to develop a broad rather than a narrowly focused approach to problem solving. The idea that students can help teach themselves (Villalon, 1982) is appropriate for teaching design. (p. 6)

Graphic design studio courses rely on projects to teach the students design skills. The projects primarily lay out the problems through project outlines, and the method for a solution and the courses are taught linearly without room to allow the students to problem solve. A project outline is a quick commentary of a project. Project outline typically gives an outline of what the project should accomplish by the end of the project.

While not all projects need to be focused on problem solving or creative thinking, most projects should include some sort of problem solving or creative thinking requirements, otherwise we are only teaching designers technical skills and failing to grasp at a opportunity to teach them critical thinking and creative thinking skills. If all graphic design is technical skills, then the statement that “everyone is a designer” would be true, but this is not the case. Designers should consider not only aesthetically pleasing but accomplished its purpose. This makes it difficult for students to learn the proper problem solving and creative thinking skills they will need once they have graduated. When speaking of designers, Schön (1987) noted:

In designing, first of all, things are made under conditions of complexity. Designers discover or construct many different variables. These interact in multiple ways, never wholly predicable ahead of time. As result, a designer must fashion each move to satisfy a variety of requirements and can never make a move that has only the consequences intended for it. (p. 182)
Schön (1987) added that, “Designing triggers awareness of new criteria for design: problem solving triggers problem setting” (p. 185). Thus, if a design student does not have the ability or skills necessary to problem solve and predict a solution’s outcome to the best of their abilities, universities are subsequently setting students up to fail. An advantage that could be afforded to them could be handed to them by teaching them great problem solving and creative thinking skills in the classroom.

**Disadvantages of Current Teaching Methods**

In design education, design is taught using various teaching methods, the majority of which revolve around the learner working on one project with distinct project specifications set by the instructors or university. The focus of these methods is typically based on teaching students design applications and techniques. A design vehicle is the application in which something is designed. For example, a brochure would be considered one design vehicle. Design vehicles are the mode in which an idea is presented to the masses. A teaching methodology could allow students to do one or more of the following: think on their own, begin to use their critical thinking skills, start problem solving before designing, as well as let them learn they can apply what they learn in higher education to work experience. In short, there is more to design than brochures, posters, flyers, logos and websites.

Graphic design can actually change behavior, environment, and opinion for both the intended audience and the designer. These elements should be the main focus of teaching design while teaching typical design elements, such as typography, design principles, paper choice, printing, and software skills. Design school teaches students a vast amount of technical knowledge and technical skills for working in the real world. Universities have an
opportunity to teach their higher education students a valuable skill that can change the way they and the world perceive design. Design undergraduate education needs to employ teaching critical thinking, creative thinking, and problem solving as part of the curriculum, and these skills need to be a keystone in design-specific learning environments.

Aesthetics should not be the main priority of designers. Designers have the opportunity to use both their skills and knowledge to do something great. Designer and educator Papanek (1972), who was influential in the future of design and education wrote: “Design has become the most powerful tool with which man shapes his tools and environment (and, by extension, society and himself)” (p. ix, Reference B). He also noted that “only a small part of our [designer’s] responsibility lies in the area of aesthetics” (p. 62, Reference B). Ultimately, what good is aesthetics if it does not accomplish anything?

**Conclusion**

The literature review discussed the potential impact designers could have on social, economic, and environmental change, the importance of teaching problem solving skills, creating better problem solvers, using transfer learning to use the skills students gain from learning how to problem solve, and using creative and critical thinking to better solve design related issues. This review was not meant to be an attack on the methods currently being taught; rather, it was compiled to make the point that graphic design courses need to continually evolve to meet the needs of current students in today’s world and that of the future.

“Designers now have an ever-widening expanse of choices and tools to help them. Sometimes there are too many choices and too many tools. Designers can get caught up in
the power and speed of the software, rather than slowing down and concentrating on the particular design problem at hand” (Glaser, n.d.) This statement summarizes the reason higher education design programs should be teaching more advanced skills such as creative and critical thinking that students need to prepare them for the ever changing and fast moving world of graphic design and problem solving.
CHAPTER 3. METHODOLOGY

The purpose and objective of this study was to propose a model of design process with components of critical thinking and creative thinking, to determine whether there is need to make a change in current methods of how graphic design students are instructed to think about their projects. The design of this new methodology, or pedagogy, is based on the instructional design process designed by Morrison, Ross, Kalman, and Kemp (2010) in *Creating Effective Instruction*. We will examine the model created and the data collected by testing the model.

**Topic Selection**

Many books and papers in the field of design have been on topics such as design for good or social design. What if future designer in higher education are taught to become a better problem solver, creative thinker, and critical thinker to enable them to create to solve social, ecological, and environmental problems? There are problems with the world in which we live in and they can be either small or large. With skills as problem solvers, creative and critical thinkers, graphic designers can potentially make changes to a few of these problems that maybe other professions may not currently be able to answer. A small problem might address: How can we design a trashcan that is more environmentally friendly? Can trashcans be made of recycled material? Should all trash cans compost trash into energy or composts for gardens? A bigger problem could tackle how designers might be involved in providing a solution to solve the problem of bicycle related deaths.

Why is it important that designers start designing smarter? Sclain and Taute (2012) remarked, “It’s easy to read up on why designers should apply their talents to world ills like
poverty, global warming, and overconsumption, but no one tells you in practical terms, how to make socially conscious design part of your day to day work life” (p. 162). If designers design smarter then more of the world’s problems may begin to change and, hopefully, for the positive.

In the book, *Just design: Socially conscious design for critical causes*, Simmons (2011) discussed tipping point which involves all of us: “climate change, peak oil, deforestation species extinction and water scarcity: (p. 91). Simmons put it into context what he termed: “bad news, the worse news and, finally the good news” (p. 89). He noted that the bad news is the tipping point previously mentioned. The worse news could possibly be too late to change the way we (as a world) are headed. With the worse news, he noted that we have three options: pessimism, delusions, or optimism. Finally, Simmons mentioned the good news that, as designers we have the option to be optimistic. He added:

I believe that most designers are optimistic and passionate about what’s next, not what’s now or what’s been. This makes them unlike politicians, religious leaders or most corporate executives who are largely acting to protect the power or resources that they already have accumulated. The future will be defined more by what we do now than what we did before. Now is the time for designers to step up and use what they know how to do to help shape a positive future for people and the planet. (p. 106)

Heller (2003) continued the conversation by stating, “However, to be what in this book we call a “citizen designer” requires more than talent. As Glaser notes, the key is to ask questions, for the answers will result in responsible decisions. Without responsibility, talent is too easily wasted on waste” (p. 196).

In this study, as the researcher, I wanted the testing to have the ability to be tested across different levels of graphic design for a varied number of topics. This meant that the topic for testing was “X” and any topic replaces X. For further explanation, the participants
could have been asked to design a logo for health food, animal shelter, or diabetes, etc. To test the design process and implications of intervention, I decided the topic would be community gardens. While active, the participants would not be designing anything more than a logo for a community garden due to the limitation of time, the purpose of selecting the topic of community garden, would carry further into future research to see how students engage with social design and community design. For example, a designer can create projects that lead to better opportunities for communities, people, designers, and clients. A community can mean more than one entity. It can mean a group of people living in the same geographical location with the same desires, a client, or a group of people attending an exhibition. The focus of future research might be to develop a creative strategy and, from that creative strategy, create deliverables that give a better response to a problem. This topic was chosen for the purpose of taking a step that may lead to continued research in understanding how creative strategy can benefit topics of social and community engagement as well as the student designer’s involvement with those topics.

**Workshop Material Design**

When initiating instruction design there are questions a person can ask herself to know if the instructional design is necessary. The questions to ask are simple, but it can make a huge difference in knowing whether or not one should move forward with designing new instructional methods. What is the problem that needs to be solved? Will instruction fix the problem? If not, what is another method of solving the issue? Once a decision is made that the instruction needs to be tested, a plan was devised to determine what needs to be known and tested. Following are the four phases that were worked through for this instructional
design creation and testing the hypothesis. The first phase shows the plan for the entire test. Phases 3-4 break down the individual parts of the planning phase (Figures 10 – 13).

Phase 2 entailed collecting the data. This was the initial plan of the study. It was initially planned that the target audience would be 12 students because it was believed that it would be a good size based on available time to gather participants and the availability of the demographic. It was also decided that there would be two groups: group A and B. Group A would not have an intervention whereas group B would be the group that is tested with an intervention during the research phase of the design process.

Figure 9. Phase 1: Planning
Figure 10. Phase 2: Data collection

Figure 11. Phase 3: Data analysis
Phase 3 of the research looked at what would happen after the test was concluded, and the information that would be analyzed. While the original plan was to look at how quickly the students came up with solutions, this was later removed from the study for the purpose of giving all participants equal time for each phase of the study. The reasoning behind this was built on the idea that, if all students were given equal amounts of time, then the analysis could focus more on the process and the outcome rather than the time spent on the outcome.

Phase 4 of the research plan was to conclude based on the purpose of this research. The researcher determined how the testing went, and examined the data collected, results revealed, and implications for future research.

Figure 12. Phase 4: Final report
Need for Instruction

The purpose of using “Designing effective instruction to enhance critical thinking and creative thinking,” for this research study was to strengthen the findings of this study. Using a model that has shown multiple times to create effective instruction enabled me to look more closely at the findings of the study and spend less time analyzing whether the instructional design materials were necessary or created correctly. The instructional design material included a collection of investigations carried out to learn more about the target audience, the need for the instructional, the process, content, and context analysis as well as the material created for testing the critical thinking and creative thinking skills of graphic designer sophomore students. It was hoped that this research would be successful by designing and developing engaging materials that would help design students work on developing their ability to think creatively and critically when working through a design process. Based on the research discussed in the literature, the goal of this study was to confirm that introducing of a new step into the design process will improve the students’ ability to create more creative projects. For future studies it would be interesting to see if the addition of this method improves transfer learning to other assignments outside educational settings.

Process Analysis

Experience as a student in graphic design programs and an instructor in both a studio and lecture setting, the researcher has noticed that the way that courses have been taught seem to be unchanged over many years. Some instructors do point out to students the importance of critical and creative thinking skills, but there is a lack in instructional materials
that cover this topic. The literature on design education has identified critical and creative thinking skills as an important set of skills for students to develop.

In addition to the need of instruction identified through the researcher’s personal experiences and the supporting literature, a pre-survey was conducted for the target students to identify their skills in critical thinking. The pre-survey was conducted using a survey created by this researcher based the Think Test designed by Valencia Community College.

The pre-test/ pre-observation was conducted using anecdotal notes taken during a student presentation early in the semester. Additionally, peer evaluations were conducted using evaluation rubrics for a presentation. Students used the rubrics to evaluate each other’s work and, thus, provided and unbiased view of their presentation skills and abilities prior to being exposed to the instruction.

**Content Analysis**

Content was evaluated based on a research study on assessing students’ creative and critical thinking skills discussed in the literature review. In addition, content was analyzed based on observation from the researcher’s knowledge of graphic design and from teaching sophomore level students. To analyze the result of the design solution, participants were given a pre-survey to get an understanding of their knowledge and abilities in critical thinking. Intention of this survey was to get a better understanding of how the students see their skills and then compare the outcomes of their sketches, final logo, moodboard, and final communication. With this intent, the first group applied their knowledge of the design process and solved a design project problem without having an intervention or were asked to think about the project differently. The second group was asked to do the same tasks, only
they did not have an intervention during the research phase to see if thinking about the problem in a new way creates different and better outcomes. Finally, the projects were reviewed and their ability was assessed based on critical thinking and creativity.

**Orienting Context**

The anticipated goal of this study was to see how students generate ideas and make decisions when working through a design process. As a facilitator, the researcher managed the time and provided participants with the framework to work through the design process by suggesting that they research and design during specific phases of the study. The successful outcome of this workshop from the participants revealed the students’ research abilities, scope of ideation, and decision-making skills. The process of intervention during group B was the variable change to allow for observation.

**Instructional Context**

The environment was an educational format wherein the learning activities take place in a typical design studio setting. Participants worked individually on the project given to them. They were also free to customize their ideation and development of their project by choice using the tools available at the study, including, markers, paper, pencils, pens, colored pencils, and tracing paper. General space lighting and functional desk lighting was provided within the studio space. Ergonomic seats were provided in the studio space as well. Participants needed to bring their own laptops to research, and these laptops were required to have the ability to search the internet and the ability to write in a word software.
**Process**

The study went through the International Review Board (IRB) approval process. This study was granted approval as an exempted research. The IRB was a choice taken so that the researcher could observe participants (see Appendix B). As part of the IRB process, scripts were developed for contacting participants and instructors for the recruitment of participants for the study. Participants were contacted by email, word of mouth, or in person. A majority of the participants were directed to the study by their studio instructor.

Materials developed for the workshop included a pre-survey, an introduction script that would be used by the primary investigator and, finally, a list was created for the steps that would be taken during testing for group A and group B. The pre-survey was designed to look at the level at which the sophomore participants are able to think critically (Appendix A). This assessment was designed on a model based on a study that measures critically thinking skills based upon the indicators for the Valencia Community College Core Competency THINK program. Questions 1 and 2 of the survey were redesigned to fit the participant and study demographic more accurately. Questions 3, 4 and 5 were unchanged from the original study of the THINK program.

It was hoped by this researcher to not only assess how the participants who were 18 years or older and a sophomore level classification, self-assess their critically thinking skills, but also that the questions would enable the investigator to compare the results with other outcomes of the workshop.

The testing had two processes due to there being two groups tested. Group A went through a typical design process of research, ideation, development, and conclusion. Group B went through the same process but intervention section was given during the research phase.
Table 1 illustrates the steps taken for group A and B as well as the times participants were given for each step. The steps and script for group A and group B are shown in Table 2 and 3, respectively.

Phase 1 through 4 reflect the five steps in problem solving. Phase one is considered the problem formulation which looks at the accumulation and ordering of general information and information specifically related to the problem at hand. The reason for asking the students to make a mood-board of the information they research is to see how creative and critical they are thinking about what information they need to know when starting a project. This phase relates back to five steps in problem solving included in the literature review. This phase would be considered the problem formulation.

Table 1. Steps taken for group A and B
### Table 2. Steps and script for group A

<table>
<thead>
<tr>
<th>Step</th>
<th>Context</th>
<th>Script</th>
<th>Time allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participants are given the consent letter to read and sign</td>
<td>This is the informed consent letter. Please take a moment to read it over to understand more about this study and research. You are not required to stay for the study and your participation is completely voluntary.</td>
<td>5 minutes</td>
</tr>
<tr>
<td>2</td>
<td>Participants are given self-assessment sheet (critical thinking survey)</td>
<td>This is a self-assessment sheet. Please fill it out as honestly as possible. I will give you about 5-10 minutes to fill out this sheet and we will begin.</td>
<td>5 to 10 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Explanation of Project</td>
<td>For this survey you will be asked to design a logo for community garden. You will be given 20 minutes to accumulate and put together the information you believe you will need to solve the problem at hand. You will then be given 15-20 time to investigate the nature of the problem and investigate possible solutions. I will provide creative supplies, papers, pens, pencils, and markers. Finally, you will be given 40-50 time to develop and refine one or more of the tentative solutions that you came up with on phase 2.</td>
<td>2 to 5 minutes</td>
</tr>
<tr>
<td>4</td>
<td>Phase One (Research)</td>
<td>The first phase will be research. For this you will be allowed to use your computer. Please compile a mood board of the information, you investigate. Please include words searched, websites looked at images saved and any other pieces you will use to help define your design.</td>
<td>20 minutes</td>
</tr>
<tr>
<td>5</td>
<td>Phase Two Identify the Problem (Ideation)</td>
<td>For this part of the study you will be given 20 minutes to sketch logo ideas. You are welcome during this time to use any of the materials provided, including markers, pencils, paper, and tracing paper. You will not have your computer open during this time.</td>
<td>20 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Phase Three Development (final logo)</td>
<td>As stated before this is the part in the process where you will be refining your final idea. You will have 40-50 minutes to complete this idea. This is the part of the study where you will come up with sketches and work through your ideas. The next step will involving finalizing one of your ideas.</td>
<td>40 minutes</td>
</tr>
<tr>
<td>7</td>
<td>Phase Four Communication</td>
<td>Lastly, I would like you to communicate the reasoning behind what you created. Write a few short paragraphs explaining your reasoning behind your design. Once you have completed writing the paragraph or two within your moodboard/word document, please send that file to <a href="mailto:sbarbour@iastate.edu">sbarbour@iastate.edu</a>.</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>
Table 3. Steps and script for group B

<table>
<thead>
<tr>
<th>Step</th>
<th>Context</th>
<th>Script</th>
<th>Time allotted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Participants are given the consent letter to read over and sign</td>
<td>This is the informed consent letter. Please take a moment to read it over to understand more about this study and research. You are not required to stay for the study and your participation is completely voluntary.</td>
<td>5 min</td>
</tr>
<tr>
<td>2</td>
<td>Participants are given self-assessment sheet. (critical thinking survey)</td>
<td>This is a self-assessment sheet. Please fill it out as honestly as possible. I will give you about 5-10 minutes to fill out this sheet and we will begin.</td>
<td>5 to 10 min</td>
</tr>
<tr>
<td>3</td>
<td>Explanation of Project</td>
<td>For this survey you will be asked to design a logo for community garden. You will be given 20 minutes to accumulate and put together the information you believe you will need to solve the problem at hand. You will then be given 15-20 time to investigate the nature of the problem and investigate possible solutions. I will provide creative supplies, papers, pens, pencils, and markers. Finally, you will be given 40-50 time to develop and refine one or more of the tentative solutions that you came up with on phase 2.</td>
<td>2 to 5 min</td>
</tr>
<tr>
<td>4</td>
<td>Phase One (Research)</td>
<td>The first phase will be research. For this you will be allowed to use your computer. Please compile a mood board of the information, you investigate. Please include words searched, websites looked at images saved and any other pieces you will use to help define your design.</td>
<td>15 minutes</td>
</tr>
<tr>
<td>5</td>
<td>INTERVENTION</td>
<td>While walking around and looking at what you are working on, I would ask that you think to yourself and not speak your answer, what is it that a community garden can do for the community.</td>
<td>2 to 3 min</td>
</tr>
<tr>
<td>6</td>
<td>Phase One - Continued</td>
<td></td>
<td>5 minutes</td>
</tr>
<tr>
<td>7</td>
<td>Phase Two Identify the Problem (Ideation)</td>
<td>For this part of the study you will be given 20 minutes to sketch logo ideas. You are welcome during this time to use any of the materials provided, including markers, pencils, paper, and tracing paper. You will not have your computer open during this time</td>
<td>20 minutes</td>
</tr>
<tr>
<td>8</td>
<td>Phase Three Development (final logo)</td>
<td>As stated before this is the part in the process where you will be refining your final idea. You will have 40-50 minutes to complete this idea. This is the part of the study where you will come up with sketches and work through your ideas. The next step will involving finalizing one of your ideas.</td>
<td>40 minutes</td>
</tr>
<tr>
<td>9</td>
<td>Phase Four Communication</td>
<td>Lastly I would like you to communicate the reasoning behind what you created. Write a few short paragraphs explaining your reasoning behind your design. Once you have completed writing the paragraph or two within your moodboard/word document, please send that file to <a href="mailto:sbarbour@iastate.edu">sbarbour@iastate.edu</a>.</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>
It was the intent to interrupt the process differently for group 2. In the literature review of this research in section 2.6 it is mentioned that most individuals are not able to show basic skills of general reasoning even when prompted. Humans are pattern seekers and storytellers and the problem that most people have is that they do not question if the pattern they are seeing is truly there or whether the story is true. By interrupting the participants at this point of the process and ask them to now think about the project in a new way that is not their first choice. It is believed the participants will begin to start ignoring the patterns and begin coming up with new solutions that are more creative than group 1.

It is known that by introducing new information to a study group that this introduction of information will create a change in the data, but it does not tell us if the data will make a change for the better or worse of the study. It is my belief that by interrupting the process in which designers are asked to work through a solution we will learn what if introducing new methods of working through the design process will help students in the field of design come up with better solutions for assignments.

Phase two is the ideation phase. This phase would be considered the self directed learning stage. The participants are self motivating to come up sketches and ideas based on their research. While phase three would be considered the problem re-examination stage and finally phase four is considered the abstraction and reflection stages.

**Objectives of Instruction**

As mentioned previously in this research, the purpose of this instruction testing was to observe the process through which students think both critically and creatively about a project that is given to them. Before analysis it was expected that there will be differences
between the two groups of participants and their interaction with the primary investigator. It was unknown whether the data will show that positive impact on the project in the form of more sketches, completeness of the final design, and ability to communicate about the final design based on interrupted or uninterrupted design process.

**Instructional Design Documentation**

Examples of the materials created for the research sessions with both group A and B can be found in Appendix A. Examples of participant work will be discussed in chapter five, while examples of outcomes will appear in Appendix C.
CHAPTER 4. RESULTS AND DISCUSSION

Results

This chapter discusses the workshop and results. The workshop was tested between study 1 and study 2. The chapter covers the analysis of the participants and their interaction during the phases of the workshop including, mood-board, pre-survey, ideation, final logo, and final communication. Participants’ comments and comparisons are made at the end of the chapter for all parts of the study.

Participant analysis

The participant demographic for this workshop is comprised of students who are enrolled in college courses in the area of design, and are in their beginning years of the program. The participants recruited for this study were sophomore level at the time of the study for both study 1 and study 2.

Among the 15 participants who were part of the group studies, at study 1 only 14 were able to be used in this study. One student had to leave the workshop early due to work complications and was deleted. This meant that the number of participants in group A and B from the study 1 was uneven, with eight in group A and six in group B. Due to the limited time to gather data and the number of participants available at the university, these were the only participants the researcher could acquire.

Among the studies done with the 10 participants from study 2, 2 participants’ information had to be removed from the workshop data. One participant did not agree to consent, and did not wish to send the mood-board or final communication despite participating in the sketches and final ideation portion of the workshop. The other participant
did not send the mood-board and communication until a day later. These data were excluded because it was not known whether any data was altered after the study ended. During the survey section of workshop one participant from study 2 chose multiple answers during the survey. The participants from study 2 had an equal number of participants from each side, four for group A and four for group B. The participants’ demographic information collected from both schools is shown in Table 4 and 5.

**Workshop participant performance analysis**

Various forms of analysis were used to look at the data gathered from the testing. Each part not only needed its own analysis but it also needed to be compared to other parts. Survey results were

<table>
<thead>
<tr>
<th>Participants</th>
<th>Classification</th>
<th>Gender</th>
<th>Test Group</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sophomore</td>
<td>Male</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sophomore</td>
<td>Male</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sophomore</td>
<td>Female</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td>Left testing early</td>
</tr>
<tr>
<td>7</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sophomore</td>
<td>Male</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Sophomore</td>
<td>Female</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Sophomore</td>
<td>Female</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Sophomore</td>
<td>Female</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Sophomore</td>
<td>Female</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>
Table 5. Data collected from 8 sophomore students in study 2

<table>
<thead>
<tr>
<th>Participants</th>
<th>Classification</th>
<th>Gender</th>
<th>Test Group</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sophomore</td>
<td>Male</td>
<td>A</td>
<td>Gave multiple answers</td>
</tr>
<tr>
<td>3</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sophomore</td>
<td>Female</td>
<td>A</td>
<td>Participated but did not fill out survey or send final document</td>
</tr>
<tr>
<td>10</td>
<td>Sophomore</td>
<td>Male</td>
<td>B</td>
<td>Did not send final material until late. Excluded because information could have been tampered with.</td>
</tr>
</tbody>
</table>

analyzed separately and then later compared to the outcome of the sketches and mood-boards which were also analyzed separately. The same procedure was used for the final rough logos from each student.

The survey was analyzed different ways. One analysis was by looking at the answers for group A with study 1 and comparing them with the answers for group B of the same study. Then the same steps were applied to study 2. After this, a comparison was made between study answers and study 2 answers.

Next sketches or ideation were analyzed from the testing session. These were more complicated in nature to observe. The sketches were assessed according to the literature review on Assessing Creative Thinking Skills by evaluating the responses according to number (of sketches), type, unusualness, and detail. Sketches were categorized in the end based on the kinds of responses: illustrative, abstract, type only, or typography combination and other.
The final logo marks were analyzed according to finished category: illustrative, abstract, typographic only, or typographic combination. These were assessed and compared between outcomes for group A and B for study 1 and study 2. A final check was made to determine what was included in the design of the mark between group A and B.

The mood-boards were looked at in different ways and analyzed individually as either a mood-board from group A or B from study 1 and study 2. The groups the mood-boards were assessed and compared as to how many words were searched and the words that were used. It was expected that group B would have researched different words than group A due to the intervention. Also the mood-board will have included websites and images. While not all participants were expected to research the same, it was informative to assess the relationship between what was researched and the participants’ final designs.

The final communication analyzed how the participants explained their final design. Any relationship to the words searched and the words used in the explanation was also observed. Final communication of the logo compared to questions such as: How great a role does previous research and sources play on explanation and final design? What type of proof, if any is used to defend conclusion or main ideas of the logo in the written text? Finally, How does the participant’s written text compare and contrast to other participants?

After each section was thoroughly examined, the final step was to do a comparative analysis between all the parts to see the effects between the parts. A chart was created to show the visual representation of the parts and their connection to one another for comparison purposes. The survey was compared against all other parts because critical thinking is an important component of the entire process. Sketches were compared with mood-board, while the mood-board was also compared against the final logos and the written
communication. Logos were then looked at in comparison to what was written in the communication about the final design.

**Pre-survey analysis**

In the literature review, eight assessing critical thinking skills were researched. It was in this section that survey or testing was discussed as a method of assessing the critical thinking skills of a target audience. For this workshop the survey created by Valencia College for the Think project was modified and used to assess the participants of this study. The survey was modified by retaining the same number of questions. Questions one and two were revised to be directed to the target demographic and to be less general. Questions three, four, and five remained the same because the questions the participants answered were about their critical thinking skills in ways that are important to design.

The choices available to the participants were placed in a specific order to allow the data to be collected quickly at the end of the study. Participants who chose A on any of the questions revealed that they had beginning critical thinking skills. Those who chose B revealed developing skills, C showed competent skills and D revealed accomplished skills of critical thinking.

After surveying the responses from each participant for group A or B the responses percentages were analyzed separately for study 1 and study 2. The results showed the overall percentages between participants’ choices in choosing either beginning, developing, competent, or accomplished skills throughout all 5 questions. The overall percentages across all participants from both studies are important to note because they provide an average for the choices that tend to be made for the target demographic. Generally, participants in study
1 tended to choose C over all other answers while A was chosen less than all others. Study 2 also chose A less often and C and D more frequently.

After looking over the data from the A and B groups as a whole and their percentages for choosing A, B, C or D, it is also important to look at the individual participant’s responses to each question. Next, group A and B are assessed separately from study 1 and their responses to the questions in the survey as well as their reasoning for each question. The choices for each question are provided in Appendix A.2. Figures of the percentages as a whole for each question are also provided.

Question 1 asked, “When I analyze information for a design project or problem (facts and research) or ideas, either at work or in class......” This question was important to understanding the students’ ability to think critically about researching. As shown in Figure 13, group A was divided between B and C while group B was split three ways between B, C, and D. This means that group B chose answers that revealed they believed they were more confident in their critical thinking skills.

As stated previously, a participant from group A, study 2 had chosen multiple answers for the survey. This participant’s data appears as “other” on group A for study 2. As shown in Figure 14, the data collected from the survey for Group A and B, from study 2. The participant that chose multiple answers, chose B, C, and D for question 1. The statistics show that Group B felt more confident with researching. In 4.1.9 we will discuss how participants’ responses to these questions compare with the results of the study.
Figure 13. Response rate (%) for group A and B, Study 1 – Question 1

Figure 14. Response rate (%) for group A and B, Study 2 – Question 1

Question 2 asked, “When I try to apply principles, skills, or themes to a new problem, assignment, or solution…..” This question specifically deals with the participant taking the research and applying it with critical thinking skills to come up with ideas and solutions for a task given. As shown in Figure 15, one can see that with Group A, the participants once again did not chose answer A which would have revealed a beginning understanding of critical thinking in the area of applying research and knowledge to problem solving. The data show that Group B has more confident on their critical thinking skills.
In study 2, group B also chose A which continues to show they were at the beginning stage of critical thinking. The participant from Group A chose answers C and D for question 2. This shows that group A felt more confident with taking what they research and applying it with previous knowledge to come up with ideas and solutions for a task assigned to them.

Question 3 asked, “When I try to think about a subject, problem, or situation from more than one point of view…. ” This question assessed how critically the participants would look at the task assigned to them to look for solutions. This question posed to see if participants were more likely to choose an obvious answer for a task or continue to look for solutions that were new or original. This is important to critical and creative thinking. Having
strong critical thinking skills would show that the participants looked for solutions beyond the obvious. As revealed in the data illustrated in Figure 17 for group A and B with study 1, group B felt more skilled regarding original solutions, Group A was split between developing, competent and accomplished skills, but more of the participants chose developing.

Study 2 had similar results for this question (Figure 18). The participant who chose more than one answer for this question chose B, C, and D. This means that both groups believed they were able to think above the beginning levels of critical thinking.

Question 4 asked, “When I try to come to a conclusion about something I am thinking…..” This question focuses on finalizing ideas into development. When a participant needs finalize what they have idealized they come to a conclusion that all their research and ideation has helped them come up with a solution that meets the needs of the project. Participants from group A, study 1 were more likely to be at the beginning level of critical thinking than group B (Figure 19).

![Figure 17. Response rate (%) for group A and B, Study 1 – Question 3](image-url)
This means that participants for group B felt more confident coming up with a final solution based on their research and ideations.

As shown in study 2 (Figure 20), it was group B was spread evenly across all choices available to them in question four, while participants from group A were divided between beginning critical thinking skills and accomplished thinking skills. The participant who selected multiple answers for this question, chose B, C, and D again. This participant was more confident than others in their workshop.
Question 5 asked, “When I try to pull ideas together to get the big picture….” This question, unlike the last, assessed only the level participants believed their skills were for communicating about their final solution. It is interesting to note that group B from study 1 was more confident about coming up with finalized solutions but were less confident in their skills to communicate about their solutions (Figure 21). When assessing the communication at the end of the workshop one can see how group A and B were able to respond about their finalized design. The next step was to compare if the participants were correct in choosing their critical thinking skill level.

The percentage of responses for this question from the survey participants at the study 2 were nearly equal (Figure 22). However, one participant may have selected more than one response for their questions.

Figures 23 and 24 illustrate full response rates for all 5 questions for participants in study 1 and 2, groups A and B, respectively. When looking back at the literature review section about assessing critical thinking skills, one can see that using a pre-survey has its merits as well as its issues. Ennis (1993) stated that a problem with the use of multiple choice
tests lies in the differences in background beliefs and assumptions between test maker and test taker. Ennis made a point in his argument that the traps that come with assessing critical thinking. However, in the current study, it was decided that the background belief and assumptions made by the participants were not a trap with this survey, the reason being that the study was interested in understanding the participants’ belief in their abilities. Since this survey was created to compare the participants’ beliefs with their actual abilities it was seen as a positive to use a multiple choice survey for this study.
Group A

Group B

Figure 23. Full responses (%) from study 1, group A and group B

Group A

Group B

Table 24. Full percentage responses from study 2, group A and group B
Another issue mentioned by Ennis (1993) was the use of a survey/test at the beginning and end of a study. It was mentioned that this could alert students to the survey questions. It was decided that, for this workshop, the researcher was not interested in determining whether the workshop changed the participants’ opinions on their level of critical thinking. In the future this may be an avenue to pursue when moving forward with future studies. Other issues that were mentioned in the literature by Ennis were also considered. Ennis cautioned that high stakes could often interfere with the study, so there was no attempt made to pressure students to perform in this workshop. However, time was considered an issue when assessing critical thinking. While this may not have been a direct association with surveying it was considered when looking at the time the participants had in other areas of the workshop.

**Mood-board**

During the workshop the participants were asked first to do research as part of phase one. While the participants were researching they were asked to write the words they used to research, the websites they visited, the images they looked at, and then to place their findings into an MSWord document and send it to the researcher. This enabled an analysis to be made that compared group A and B, study 1 and 2. A list was also compiled of the images that were looked at by the participants and compared by them and the researcher.

The analysis revealed, on average, that study 1, group B researched more words than group A. Figure 25 illustrates that group A averaged about 3.5 words searched per participant, while group B averaged 8.3 words searched per participant. The word count almost doubled between group A and group B. The interruption happened five minutes
before the end of the research phase. Nevertheless, participant in Group B found more to research on the topic. When compared to the survey one can see that group B rated higher in critical thinking according to their survey answers for question 1, which was the question that looked specifically at understanding how students perceive their research abilities.

Study 2 indicated the average image search was reversed from study 1, and group A researched more words than group B. Although the researcher was not comparing study 1 to study 2, the differences may account for the differences revealed later in the study. Figure 26 illustrates that Group A averaged about 8.25 words searched per participant, while group B averaged 6 words searched per participant. Looking back at the survey, one can see that
both groups were closer in comparison when choosing their answers for question one of the survey, although group B was more confident about their research skills. However, an analysis of the data from their mood boards revealed that group A was actually more critical with their research and looked for more than group B. Nevertheless, the number of words researched is only one level of looking at the critical thinking skills of the participants. Other ways of looking at the data come from kinds of words searched and the images that were viewed.

The mood-board and research phase. The data were compiled in two ways to reveal the results. One shows the words that were searched by each participant and then the kind of images that were included in their mood-board files. Figure 27 shows a comparison of words searched between group A and B with study 1, whereas Figure 28 illustrates the kinds of images that were looked at by the participants. The results were categorized according to: photographic, illustrative, vector logos, paintings, diagrams, and sketches. In study 1, group
**Figure 27. Images searched by participants, Study 1**

<table>
<thead>
<tr>
<th>GROUP A</th>
<th>GROUP B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Community Gardens, and Previous Logos</td>
<td>1 Community in garden, veggies, cartoon gardeners</td>
</tr>
<tr>
<td>2 Gardens, people holding veggies</td>
<td>2 Hands</td>
</tr>
<tr>
<td>3 Garden Logos on Pinterest, Community Garden logos, Google, plant Logos</td>
<td>3 No images examples given</td>
</tr>
<tr>
<td>4 Gnomes, planting techniques, weather, bees, garden illustrations, logos</td>
<td>4 Garden, Vegetable Tops, Communities, Vegetables, Healthy</td>
</tr>
<tr>
<td>5 Biblical Images</td>
<td>5 No images examples given</td>
</tr>
<tr>
<td>6 Gardens and Sketches</td>
<td>6 Community Gardens</td>
</tr>
<tr>
<td>7 Mood board colors, and other logos</td>
<td></td>
</tr>
<tr>
<td>8 Logos, type, neiman gardens,</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 28. Kinds of images searched by participants, Study 1**

<table>
<thead>
<tr>
<th>GROUP A</th>
<th>GROUP B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PHOTOGRAPHS</td>
<td>1 PHOTOGRAPHS, ILLUSTRATIONS</td>
</tr>
<tr>
<td>2 PHOTOGRAPHS, VECTOR LOGOS</td>
<td>2 PHOTOGRAPHS</td>
</tr>
<tr>
<td>3 PHOTOGRAPHS, VECTOR LOGOS</td>
<td>3 No images examples given</td>
</tr>
<tr>
<td>4 ILLUSTRATIONS, PHOTOGRAPHS</td>
<td>4 PHOTOGRAPHS</td>
</tr>
<tr>
<td>5 PAINTINGS</td>
<td>5 No images examples given</td>
</tr>
<tr>
<td>6 PHOTOGRAPHS AND SKETCHES</td>
<td>6 PHOTOGRAPHS</td>
</tr>
<tr>
<td>7 PHOTOGRAPHS</td>
<td></td>
</tr>
<tr>
<td>8 ART, VECTOR LOGOS</td>
<td></td>
</tr>
</tbody>
</table>
B there were two of participants who did not provide enough information on the images that they searched. These participants are shown in gray.

Another point to make is the differences in words searched between group A and B in study 1. While most participants in group A searched garden plots and veggies, group B searched community, people, and gardens. When looking at the kinds of images the participants looked at one can see that both groups looked more frequently at photographic images, whereas group A tended to look for logos, color schemes, and illustrations. This will be compared later to the ideation phase to ascertain if logos tended to remain stylized according to what the participants researched or if they changed.

Figure 29 provides a comparison of words searched by group A and B, study 2, and Figure 30 shows the kinds of images that were viewed. These were categorized by the same methods for study 1. In group A one participant did not give enough information to tell what images they looked at, while group B had two participants who did not give enough information either. These participants are also shown in gray. In study 2, participants less information was given to the investigators about their research which caused the research to perceive that both groups were fairly similar with their research methods. Group A searched for words related to gardening and plants, while group B also tended to look at garden images as well as logos. With the kinds of images looked at by both group A and B, in study 2 (Figure 29), one can see that they were also fairly close in types of images (Figure 30) viewed in relation to the missing information that was not provided by the participants.
Ideation sketches

During the ideation phase of the workshop, the participants were asked to work on sketches for a logo that would be for a community garden. The first part of the ideation phase looked the number of sketches made by group A or group B. This was in part due to the research reviewed in the Assessing Creative Thinking section of the literature review. The researcher incorporated how to assess creative thinking by looking at four aspects as described in the literature: fluency, flexibility originality, and elaboration. The results of the study includes looking at the number of sketches between groups, types of responses between groups, unusualness of the responses, and level of detail used.
On average group A study 1 created about 18.5 sketches while group B that was
interrupted was 21.83 sketches. While group A, study 2, had about 12.75 sketches and group
B had about 6 (see Figure 31 and 32). It should be noted that it was not the purpose of the
workshop to compare study 1 with study 2. The purpose of this workshop was to compare
group A that worked through a typical design process and group B that also worked through
the design process but was interrupted during the research process. This data was collected in
relation to fluency or how many responses were made. It was important to note how many
sketches were made by each group to see if the intervention had impact on the participant's
ability to come up with sketches or ideas.

All sketches were look over broadly at first and categories were developed. The
categories enabled the researcher to see if the intervention also impacted the kind of sketches
that were created. Categorized areas were designated as: illustrative, abstract, typography
only, and typography combination. The illustrative category was determined based on the
level of detail that was included in the sketch. When a logo is illustrative it is much more
picture-like in quality and less symbolic. This is where the abstraction category was created
to include logo sketches that are less pictorial and more individual shapes that stray away
from telling the whole story in a straightforward manner. The third category, typographic
only, is the category where the participants used only written words in varying typographic
forms to depict their logo. The typography combination was developed for the sketches of
logos that included either illustrative or abstract marks, and type as well. This section was
developed, in part, in relation to the Guilford test mentioned in the literature review that
looked at flexibility, or how many types of responses.
An analysis of the group that participated in study 1 revealed that group B created more sketches, on average, with the intervention than group A. As shown in Figure 31, besides making more sketches, group B created more illustrative logos than group A. Group A accelerated in the areas of abstraction, type, and typography combination. Looking back at question 2 of the survey reveals that group B tended to select answers that showed higher critical thinking skills than group A, but not by a large percentage.
One can also note by comparison to the research done by group A and B according to their mood-boards that, by looking heavily into photographs and less into sketches and logos, Group B tended to illustrate their own ideations, whereas group A tended to become more abstract and include typography. The researcher perceives that group A tended to include more type and type combinations with their sketches because their mood-board showed they viewed more previously designed marks and logos which, in most cases, typically includes some form of typography.

Between the groups that participated in study 2, group A created more sketches than the interrupted group B. This is interesting in relation to question 2 of the survey. The responses from both A and B revealed that group A answered more frequently indicating they were more skilled in critical thinking regarding generating ideas for a project, while group B tended to select answers that indicated they exhibited beginning critical thinking skills. This may have been a factor in the number of sketches made by each group. Group B also tended to provide less data on words searched and images looked at during research than group A. This could have been a factor in why group A exceeded more on ideation than group B.

**Final logo design**

The final logo was developed during the development phase of the design process. This is the phase in which participants chose one idea from their sketches and finalize it. To analyze this phase of the workshop, the researcher looked at number of finalized ideation sketches, style type of the logo, content or theme of the logo, and words used on the logo if any. When broken down into charts, one can see the variation between group A and group B
at both study 1 and study 2. This part of the survey relates again back to the Guilford test. In this section of the workshop the data analyzed participants’ content and the unusualness of responses. This was important to the study because it is believed that unusual responses reveal a higher level of creative thinking according to the research done in the section of the literature review that discusses assessing creative thinking.

Beginning with Group A from study 1, Figure 31 illustrates that the participants carried over their style from ideation that was heavy into abstraction and type combo into their final designs. Group B participants also retained a similar style from their sketches that were mainly illustrative onto their final sketches (Figure 32). When comparing the two groups one can see that group B became more experimental with their logo designs, by showing more than vegetables or grass. With the topic being community garden, group B tended to consider the garden as an aspect of the design, but also chose to look at the community aspect alongside when working through their final design decisions. The participants in group B might be considered to have thought more critically or creatively about the solution during the developmental stage and did not design the obvious. In other words, if students were asked to design a logo for a flower shop, it is believed that most participants with early critical thinking skills would start designing a logo with a flower included but if they are interrupted to think differently they begin to bend ideas to come up with new solutions. Group B, when looking back at the survey, chose more confidently about their skills for composing ideas into final development. This tends to be true when one further examines the final designs and development phase data.
<table>
<thead>
<tr>
<th>Participant</th>
<th># of Finals</th>
<th>Type of Final</th>
<th>Logo Content</th>
<th>Word Used for type if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Illustrative</td>
<td>Veggies</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Type +</td>
<td>Plant and Hands</td>
<td>Garden</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
<td>Abstract</td>
<td>Leaf</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>Type +</td>
<td>Tree</td>
<td>The Collective Backyard</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>Abstract</td>
<td>Ribbon like shape</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Type +</td>
<td>Veggies and Garden Supplies</td>
<td>Just like Home City Garden Center</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Type +</td>
<td>Abstract Flower</td>
<td>The Community Garden</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Type +</td>
<td>Grass</td>
<td>Growth Community Garden</td>
</tr>
</tbody>
</table>

Average 4.5

Figure 33. Final sketches – Group A, Study 1

<table>
<thead>
<tr>
<th>Participant</th>
<th># of Finals</th>
<th>Type of Final</th>
<th>Logo Content</th>
<th>Words used for type if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Type +</td>
<td>Hands and Sun</td>
<td>Community Garden</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Illustrative</td>
<td>Man pulling plant in wagon or hands w/ Leaf</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Type +</td>
<td>Veggie Buildings</td>
<td>Urban Garden</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Illustrative</td>
<td>Hands with carrot between them</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Illustrative</td>
<td>Veggie with City Inside</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>Abstract</td>
<td>Water like drops falling down to a plant</td>
<td></td>
</tr>
</tbody>
</table>

Average 3

Figure 34. Final sketches – Group B, Study 1
When examining study 2 one can see that the final designs remained the same when it came to design style from ideation to development (Figure 35 & 36). All participants in study 2 used some form or typography in their designs. All participants also used either the word “Community” or “Garden” in their designs. Both group A and B had participants who used hands or vines. There was one participant in both group A and B who focused on a typographic heavy design. After looking at both groups from this college, it became apparent the participants had developed logos that revealed equal skills in critical and creative thinking. The survey revealed that participants from group A and B tended to be more reserved in this phase of the survey. The participants from study 2 tended to select answers to question 4 that showed either beginning level of thinking or developing skills. This shows in their developmental stage as both group A and B tended to play it safe with their designs and not push their critical and creative thinking skills.

<table>
<thead>
<tr>
<th>Participant</th>
<th># of Finals</th>
<th>Type of Final</th>
<th>Logo Content</th>
<th>Word Used for type if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Type +</td>
<td>C and G combined</td>
<td>Community Garden</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Type +</td>
<td>Vines and Type</td>
<td>Community Garden</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Type +</td>
<td>Hand with Flower inside and vines</td>
<td>Community Garden</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Type +</td>
<td>Hands with flowers that were house shaped and a sun</td>
<td>Community Garden</td>
</tr>
<tr>
<td>Average</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 35. Final sketches – Group A, Study 2
Final communication

In the communication phase of the workshop participants were asked to talk about their decisions on why they developed their final logo in the way they chose. The communication phase of the study is important because it enables the participants to speak about the work they created and provide reasons for their decisions. When a designer speaks to a client about the final design it is important to the designer client relationship that the designer is able to effectively communicate their decisions for the design.

As shown in Figure 37 and 38, participants in study 1, group A averaged 158.125 words in their final communication, whereas group B averaged 205.5 words. Group B also tended to exhibit high levels of communication when it came explaining their audience and decisions they made about their final designs. Initially this investigator also looked at whether the participants spoke about the images they researched, but the response was surprisingly an overall “No” from all participants, so this was removed from the data so that
### Figure 37. Final communication – Group A, Study 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Audience</th>
<th>Level</th>
<th>Decisions</th>
<th>Level</th>
<th>Overall Level</th>
<th># of Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td>N/A</td>
<td>Yes</td>
<td>Little</td>
<td>Medium</td>
<td>117</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
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<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
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<td>3</td>
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<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>218</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Little</td>
<td>Yes</td>
<td>Little</td>
<td>Low</td>
<td>58</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>N/A</td>
<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>133</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>Medium</td>
<td>Yes</td>
<td>Medium</td>
<td>High</td>
<td>176</td>
</tr>
<tr>
<td>7</td>
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<td>Little</td>
<td>Yes</td>
<td>Little</td>
<td>Medium</td>
<td>136</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>Little</td>
<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>167</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>158.125</strong></td>
</tr>
</tbody>
</table>

### Figure 38. Final communication – Group B, Study 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Audience</th>
<th>Level</th>
<th>Decisions</th>
<th>Level</th>
<th>Overall Level</th>
<th># of Words</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Medium</td>
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<td>Medium</td>
<td>Medium</td>
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</tr>
<tr>
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<td>Medium</td>
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<td>Medium</td>
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<tr>
<td>4</td>
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<td>Medium</td>
<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>189</td>
</tr>
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<td>5</td>
<td>Yes</td>
<td>Little</td>
<td>Yes</td>
<td>Medium</td>
<td>High</td>
<td>207</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>Medium</td>
<td>Yes</td>
<td>Medium</td>
<td>Medium</td>
<td>137</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>205.5</strong></td>
</tr>
</tbody>
</table>
attention could be focused on the level of communication, which was the primary objective during this phase.

Looking back at question 5 of the survey, one can see that group B did not reveal as much confidence. Option D with question 5 said “I can link ideas together in complicated patterns and explain complex relationships.” There were a few participants in group B who showed they were able to do this in their explanation but did not select option D.

As shown in Figure 39 and 40, study 2 did not reveal high levels of communication about the participants’ final designs. In fact, the participants showed very little skill in explaining their work. At maximum, one participant from study 2 used 73 words to explain their design. While more words do not justify that a response shows critical thinking or that a participant was creative in their thought process it does however show us how much the participant was able to explain about their design. Since they were not able to go into high detail, it is believed that their critical thinking skills for communication were low. Group Averaged 59.5 words per response while group B averaged 47.5.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Audience</th>
<th>Level</th>
<th>Decisions</th>
<th>Level</th>
<th>Overall Level</th>
<th># of Words</th>
</tr>
</thead>
<tbody>
<tr>
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<td>N/A</td>
<td>Yes</td>
<td>Little</td>
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<td>73</td>
</tr>
<tr>
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<td>N/A</td>
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<td>Little</td>
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</tr>
<tr>
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<td>N/A</td>
<td>No</td>
<td>N/A</td>
<td>Low</td>
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</tr>
<tr>
<td>4</td>
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<td>N/A</td>
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<td>Little</td>
<td>Low</td>
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<tr>
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<td>N/A</td>
<td>Yes</td>
<td>Little</td>
<td>Low</td>
<td>59.5</td>
</tr>
</tbody>
</table>

Figure 39. Final communication – Group A, Study 2
Participant comments

During the study some participants spoke about what they thought about the study and what they were asked to do. While this part of the study was not examined as part of the data collection, these participants’ remarks were very interesting and may be taken into account regarding future research.

At the end of one workshop one participant from study 1 who was part of group B, mentioned enjoying the quickness of the workshop in helping him personally to generate more ideas quicker. He lamented that the projects given in classes took too long and, if he had less time for steps, he would be forced to think faster and, in the long run, spend more time on perfecting designs. He also said he would try to use the time restraint applied in the study on future projects to help him come up with ideas quicker.

Another participant who was part of group A from study 1 expressed an opposite opinion. The participant said their group became nervous because they were expected to come up with ideas so quickly, but that their professors would give them more time in their
classes. These contrasting remarks related to this study could lead to research on the
difference time plays in the outcome and the results.

**Findings**

When looking over all the data presented one might conclude there were differences
between group A that was uninterrupted and group B that was interrupted in study 1. There
were also small differences between group A and B in study 2.

Regarding study 1, it was discovered that the group that was intervened (group B)
was more critical and creative than group A that was not intervened. Group B researched
more and their research looked more into the community not just gardens and plots. It was
also noted that group B made more sketches in the ideation phase than group A and, at the
end, were more creative with their final design as well as more thorough in their final
communication.

Regarding study 2, group A tended to be more critical in their process; however, the
data between group A and B was close in comparison, especially in phase three and four of
the workshop. Group A only researched more when it came to number of words and they had
the same image search as group B. Group A also made more sketches in the ideation phase of
the workshop.

The findings also revealed that some participants perceived that the workshop helped
them see the benefits of coming up with quick research and ideation, while others found they
work better when given more time. The participants’ comments were helpful and, along with
the findings, might lead to future research which will be discussed in Chapter 5.
CHAPTER 5. CONCLUSIONS

Summary

Education is an important fundamental aspect to becoming a designer, and it is an instructor’s role to make students think differently. How and when an instructor intervenes can have a large impact on the outcome of students' projects. How an instructor and student interact in the classroom setting can impact the level of critical and creative thinking skills students acquire while at college or university. One of the first questions this study looked at was, “What is PS and CCS that impact visual communication and the graphic design student?” Surveys were handed to participants at the beginning of the study to help answer this question. The questions asked participants to indicate how they respond to the needs of a design project, whether they think both critically and creatively as well as how much help they require to problem solve. The data revealed that only a few participants perceived they were at a higher level of thinking while a majority of the participants tended to answer in the mid range or lower range of critical thinking. It was also noted that, with the intervention, students were actually able to show they had skills beyond their answers to the survey. Overall, one might conclude that students are able to exceed their abilities with the help and guidance of an instructor.

The second question this study looked at was, “What is an instructor impact on a student’s ability to problem solve (PS), think critically and creatively (CCS)?” During the workshop we were able to look at this question by separating participants into either group A or group B. The workshop was conducted differently depending whether the participant was in group A or group B. Group A progressed through the workshop without interventions
from the investigator, while group B participants were given an intervention during the research phase. Use of the term intervene does not mean that the participants were disrupted in a negative way. The intervention in the study occurred at a point in time when the investigator spoke aloud to the participants with a question to see if the interaction would positively or negatively affect the participant's ability to think more critically and creatively. The study revealed that intervention during the research phase may have assisted the participants to think more critically or creatively.

The last question of this study was limited due to only being able to test the intervention during the research phase. This study was not able to be fully implemented with the final question. The question, “How can an instructor embed PS and CCS in the graphic design projects to help students build on these skills?” revealed that the interaction between the instructor and the student has a strong impact on how the students are able to perform and their level of PS and CCS. Study 1 revealed that that students who had an intervention from the primary investigator showed a higher level of PS and CCS in the number of sketches, level of research, documentation, and development of their designs. Participants in study 2 who did not have an intervention tended to perform approximately the same throughout the workshop.

The purpose of this study was to propose a new model of design process to enhance critical thinking and creative thinking. Understanding and applying critical thinking skills is important in developing successful designers. Using a critical thinking self-assessment survey at the beginning of the semester is recommended because it enables students to chart their progress. Intervention is recommended in each design process that focuses on individual skills practiced of critical and creative thinking. Although a short intervention was provided
in the research phase of this study, an intervention could potentially be implemented at each stage of design process.

**Limitations**

There were a several limitations that affected the outcomes of this study. First the number of participants varied between the workshop groups. This was due to the timing of the workshops and participant availability. Other impacts on group size included participants not appearing at the workshop after signing up. A few participants had to leave mid-workshop due to work conflicts. Other impacts that limited the study involved participants not participating in all workshop material or not sending mood-boards and communication until it was too late. These participants’ materials were discarded due to the unknown impact of missing data or altered data.

Issues with IRB approval caused the workshops to be held late in the Spring semester which made it difficult to assemble enough participants as most were preparing for final exams. The IRB was originally approved but it was not sent back to the investigator at the correct email address. The prolonged changes made to the IRB pushed back testing. This in limited the study because of time to gather participants and have workshop testing.

The final limitation was not being able to test an intervention during all stages of the design process. The study enabled the researcher and participants to experience the effect of the intervention that was applies only during the research phase. It is believed that, had there been opportunities for more participants to engage in the study as well as more time, this study could have explored the impact of interventions at different stages of the study. Nevertheless, the findings generated from this study provide important implications for
practice and meaningful future research. This study supports the need to teach and measure student progress regarding the value of student/participant critical and creative thinking skills in the field of graphic design. Future studies may provide additional information regarding the process of critical and creative thinking regarding timely instruction and intervention to gain knowledge through action.

**Future Study**

The results of the workshop has generated ideas for several directions for future research. It appears that the instructor’s role in initiating good practice skills in critical and creative thinking is crucial to the design process students work through during a design project and on the outcome of their assignment.

Future research interrupting different phases of the workshop with interventions would provide more valuable information in how students work through the design process and which parts of the phases are most important for the student to interact with the instructor for transferring information to other phases. In addition, looking at different levels of college students, such as juniors and seniors, could generate more knowledge regarding the skills of design students throughout education and their ability to work through the design process.

Another aspect this research provided direction to determine how students perform on an assignment with a project sheet as well as study the effect of self-initiated tasks. Another question to ask is: Are students as successful without the guidance of a project sheet or task assignment? This workshop only gave student’s direction through word of mouth and they were not given a project statement to follow. Looking into design student’s interaction with project sheets and the outcome of assignments would be an interesting and informative study in the field of design education.
Finally, this research opens an opportunity to test the amount of time spent that is allotted for specific tasks. Would outcomes be different if the workshop lasted longer than a hour and a half? Would having the workshops last over a few days or weeks change the productivity and outcomes of the assignment?

These questions and many others could be answered with further research. Through additional research, one can gain a better understanding at how design students work through the design process, the instructor’s impact on student work and transferability of information to future projects outside the educational setting. By researching these areas more we may be able to improve the process in which design students are taught to practice their critical and creative thinking skills to better serve them outside university classroom settings.
APPENDIX A. TESTING MATERIALS

A-1. Consent Document

Title of Study: Studies of Design Processes
Participants: Faculty Supervisor: Sungyun Kang, BFA, MA, MFA
Principal Investigator: Samantha Barbour

This is a workshop study on design pedagogy. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time. No items will be purchased during the session. No personal or financial information will be collected during the session. Participants will be provided with the appropriate testing apparatus, whether it is a smartphone or computer.

DESCRIPTION OF PROCEDURES
If you agree to participate in this study, participation will last for approximately 150 minutes. During the study you may expect the following study procedures to be followed.

1) The researchers will contact prospective participants to schedule a usability study and will send informed consent document.

2) On the selected date of the usability study, you will be given a copy of the Informed Consent Document for review and to sign prior to the start of the session. If you agree, and sign the Informed Consent Document the session will begin.

3) Information regarding the project will be read before the session.

4) The participants will perform a series of tasks on the workshop study. You will be asked to “think aloud” (explaining your actions as you perform them). You may skip any tasks that you do not wish to perform or that makes you feel uncomfortable.

RISKS
There are no foreseeable risks in this study. However, you may leave the study at any time without penalty.

BENEFITS
There is no direct benefit to the participant. However, the knowledge gained can be expected to provide significant opportunities to improve usability of the interface for the general public.

COSTS AND COMPENSATION
You will not have any costs from participating in this study. There will not be any compensation to participate in this study.

PARTICIPANT RIGHTS
Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. During the testing, if you feel uncomfortable at any time you can quit.

CONFIDENTIALITY
Records no names or faces that identify participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.
To ensure confidentiality to the extent permitted by law, the following measures will be taken.

The participant’s identity will be anonymous to outside sources throughout the study. Only the researchers will have access to the data. The data will be entered and kept in a password-protected computer located on the researchers computers. Any field notes taken during this study will not contain the names of the participants. Questionnaires and field notes will be shredded after all the information is entered into the computer. Once the study has been concluded, all data files may be retained for future use pertaining to this research (process). Your work can be used in the thesis study.

QUESTIONS OR PROBLEMS
You are encouraged to ask questions at any time during this study. For further information about the study contact Sunghyun Kang. You are encouraged to ask questions at any time during this study. For further information about the study contact Sunghyun Kang, Faculty Supervisor, phone 515-294-1669, email shrkang@iastate.edu, and Samantha Barbour, Principal Investigator, sbarbour@iastate.edu.

If you have any questions about the rights of research subjects or research-related injury, please contact IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, Office for Responsible Research, (515) 294-3115, 1138 Pearson Hall, Ames, IA 50011.

******************************************************************************

SUBJECT SIGNATURE
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the signed and dated written informed consent prior to your participation in the study.

Subject’s Name (printed) ____________________________
(Subject’s Signature) ___________________ (Date)
A-2. Survey

**STUDENT SURVEY**

1. When I analyze information for a design project or problem (facts and research) or ideas, either at work or in class.....

   - 1a. I often copy the work of others and have trouble coming up with solutions

   - 1b. Generally, I can design based on what I have read or researched, with only using others' work minimally to help me come up with solutions

   - 1c. I can figure out how to use the research and ideas to solve problems or complete assignments that are similar to examples I have seen.

   - 1d. I can provide in-depth research of the data or ideas that I use to solve problems or complete assignments.

2. When I try to apply principles, skills, or themes to a new problem, assignment, or solution......

   - 2a. I have trouble thinking of concepts to use

   - 2b. Usually, I can think of a new concept, but I often have trouble applying it to the project or problem

   - 2c. I can use the concept accurately – if the situation or problem is familiar

   - 2d. I can use concepts accurately to solve new problems or new solutions
3. When I try to think about a subject, problem, or situation from more than one point of view....

☐ 3a Most of the time, I can think of only one way to see it

☐ 3b I can see two sides of any issue, but tend to think one of them is right

☐ 3c I can see the value in viewing things from many points of view

☐ 3d I can see most issues from multiple points of view

4. When I try to come to a conclusion about something I am thinking.....

☐ 4a I have trouble thinking of anything to say

☐ 4b I can comfortable restate what has been said

☐ 4c My conclusion matches the evidence that has been presented

☐ 4d I can create a conclusion that is logical and that reflects my ideas, too
5. When I try to pull ideas together to get the big picture....

☐ 5a I often see the pieces better than the big picture

☐ 5b I can arrange most ideas into a pattern, if it's not too complicated

☐ 5c I can arrange the ideas into a pattern that includes clear relationships among ideas

☐ 5d I can link ideas together in complicated patterns and explain complex relationships
A-3. Workshop Procedures for Group A and B

Attachment 7 a. Workshop Content Attachment

Steps for Group A

1. Participants are given consent form to read over and sign (Maximum 5 minutes)
2. Participants given self assessment sheet.
3. Will work through the typical design process.
4. Explanation of Project
   4. Phase one - Assimilation
      The accumulation and ordering of general information and information specifically related to the problem at hand.
5. Phase two - General Study
   The investigation of the nature of the problem.
   The investigation of the possible solutions or means of a solution.
6. Phase three - Development
   The development and refinement of one or more of the tentative solutions isolated during phase 2.
7. Phase four - Communication
   The communication of one or more solutions to people inside or outside the design team.

Attachment 7 b. Workshop Content Attachment

Steps for Group B

1. Participants are given consent form to read over and sign (Maximum 5 minutes)
2. Participants given self assessment sheet.
3. Will work through the typical design process.
4. Explanation of Project
5. Introduce creative thinking (This step will be added to this group and not group A)
6. Phase One - Assimilation
   The accumulation and ordering of general information and information specifically related to the problem at hand.
7. Phase Two - General Study
   The investigation of the nature of the problem.
   The investigation of the possible solutions or means of a solution.
8. Phase Three - Development
   The development and refinement of one or more of the tentative solutions isolated during phase 2.

9. Phase Four - Communication
   The communication of one or more solutions to people inside or outside the design team.
APPENDIX B: INSTITUTIONAL REVIEW BOARD APPROVAL

IOSTATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2307
515 294-4566
FAX 515 294-4267

Date: 3/25/2016
To: Samantha Barbour
150 NE 41st St Unit 306, Ankeny, IA 50021

IRB ID: 16-083

Study Review Date: 3/25/2016

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (1) Research conducted in established or commonly accepted educational settings involving normal education practices, such as:
  - Research on regular and special education instructional strategies; or
  - Research on the effectiveness, of, or the comparison among, instructional techniques, curricula, or classroom management methods.

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where:
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- You do not need to submit an application for annual continuing review.

- You must conduct the research as described in the IRB application. Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.) that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found in the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. Only the IRB or designees may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

Please be aware that approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holder of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.
REFERENCES


Scalin, N. A., & Taute, M. (2012). *The design activist’s handbook: How to change the world (or at least your part of it) with socially conscious design*. Iola, WI: F + w Media.


Without Deviation from the Norm Progress is Not Possible. (2011, Dec. 3). Retrieved March 15, 2016, from Youtube: https://www.youtube.com/watch?v=mOHCV-QO5HA