EXPLORING INTRINSIC VALUE OF EDUCATING MILITARY PLANNERS IN DESIGN THINKING: A CASE STUDY

by

John Paul Mangold

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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2014

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ABSTRACT

The purpose of this qualitative single instrumental, exploratory, theory-building, holistic researcher case study was to explore a novel approach to military transformation; a prototype of a problem solving methodology that accounts for an inescapable reality in the current and future operational environment: complexity and uncertainty. Design thinking was used as an essential component supporting a theoretical framework to explore the process of solving complex, ill-structured problems. Fifteen participants from a senior U.S. military service college were studied using observations, interviews, and site documents. The data analyzed used the systematic, analytic procedures of Stake (1995, 2008) and Merriam, (1998, 2009) whereby analysis begins as data are collected and more focus is applied to the problem solving process and collaborative learning. Separately, much has been written on the theories of design thinking, problem solving, program improvement, and collaborative learning. However, no material exists that explores the intrinsic value of a design thinking-led education for military planners in a practical setting. Based on the themes that formed through observations, document analysis and individual interviews, I concluded that when presented with a complex, ill-defined problem and in the absence of receiving comprehensive and specific planning guidance, participants effectively collaborated and used the design thinking methodology.

Keywords: Conceptual thinking, continuous activity, critical thinking, creative thinking, general systems theory, sense-making, structured learning, design, design thinking, professional military education.

Table of Contents

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

This chapter introduces the framework for the study, and gives the reader a general overview of the research as well as the underpinning for the problem that necessitates the research. The chapter also presents an overview of literature, which the research is founded upon, and distinguishes the importance of the research as introduced by the use of the research questions. This introductory chapter contains numerous subsections: the background of the study, the situation of the researcher, the problem statement, the purpose statement, the significance of the study, research questions, the research plan, and the delimitations and limitations of the study.

Background

Nothing is new in war. War continues to be a very human and capital competition. Once started, the only constant is uncertainty. The world adjacent to war, however, continues to change and have both direct and indirect effects on how military engagement is waged (Akin, 2009; Banach, 2009; Bousquet, 2009; Buchanan, Doordan, & Margolin, 2010; Conklin, 2008; de Czege, 2009). Today, super-empowered actors and non-state organizations take on roles held previously by nation states (Friedman, 2000), resulting in tremendous complexity and uncertainty.

As evidenced by recent United States military operations such as the Global War on Terrorism, also referred as the "Long War" (Carafano & Rosenzweig, 2005), Operations TOMODACHI (Japan's tsunami/earthquake, 2011), ODYSSEY DAWN (international military operations in Libya, 2011), and more recently combating the Islamic State of Iraq and the Levant, today's military commanders must plan against innumerable problems within the expansive range of military operations. In the context of a highly interconnected, multi-faceted

operating environment, simple solutions often fail to accomplish the mission (Rutledge, 2009; U. S. Army [USA], 2012). In order to solve more complex problems, incorporating *design thinking*, a human-centric process, with a supporting methodology to develop an approach to this multifactorial task is necessary (Dorst, 2009; Heaney, 2013; Lindberg, Noweski, & Meinel, 2010). Failure to using design thinking continues to put national assets at great risk. Today's military would be well advised by incorporating design thinking into their planning process, and what this research studied is a methodology to do so (Banach & Ryan, 2009; Branch, 1998; Brown & Wyatt, 2010; Brown, 2009; Conklin, 2008; Cross, 2001; De Bono, 1967; de Czege, 2009; Department of the Army [DA], 2010; Dorst, 2011; Dunne & Martin, 2006; Eikmeier, 2010; Greenwood & Hammes, 2009; Hart, Winn, & McPherson, 2010; Heilhecker, 2008; Hobday, Boddington, & Grantham, 2012; Kem, 2009; Mangold, 2013c; Meadows, 2008; Papanek, 1971; Schmitt, 2010; Schön, 1984; U. S. Army, 2012; U. S. Army War College, 2011; U.S. Marine Corps, 2010). The recommended approach integrates the conceptual planning aspects from existing joint and military service doctrine and adapts them for application to address today's non-linear problems (Heaney, 2013; Mangold, 2013c). In addition, design thinking supports effective problem solving while providing a broad perspective that deepens understanding and visualization of the problem. Understanding the problem and visualizing an approach in a particular operational environment to confront it sets the framework for detailed planning, which follows.

This study aimed to explore the intrinsic value of a design thinking-led problem-solving education for collaborative learning of military student planners to solve complex, ill-structured problems. While much has been written on design thinking, material exploring the concept remains stalled at the theoretical level. Lacking is any research that applies design thinking

theory in a practical, collaborative/team-based learning environment to advance organizational learning.

Situation to Self

I am a retired U.S. Marine Corps Lieutenant Colonel, with extensive planning experience. The motivation for conducting this study emanates from my role as a U.S. Marine, educator, and school administrator operating in the professional military education continuum. In these roles, I have an ardent interest in the area of general command and control, and more specifically, military problem solving and decision-making processes. As a Marine, I served a number of years as a military planner and as such led many planning teams to solve problems in a collaborative/team-based learning environment. The planning process has been codified in military doctrine for decades. This process facilitated planning teams to use a standardized process to work together to develop options to address problems.

Being an educator, I am responsible for providing the best, most relevant educational experience to military men and women who will serve on operational-level maritime staffs. As such, it is necessary to blend learning with practice and application. Wenger (2009) proposed to move beyond "merely acquiring stuff to learning as a changing relationship of participation in the world" (p. 4). Likewise, Cook and Brown (1999), proposed that knowledge ensues as people grapple with the complexities of real-world events and create a way to a solution (Cook, 1999).

As a school administrator, I recognize that knowing is a function of how students apply, combine, and build upon knowledge in any given situation. I am responsible for the design, performance, and maintenance of a current, relevant, and rigorous curriculum. When students complete their educational experience, they will, as Wenger suggested, need the ability to collaborate as a member of an interdisciplinary team (Wenger, 2009). I am also responsible for

ensuring that faculty members encourage an inquisitive mindset in which they are eager to impart "their knowledge as *part of,* but not all of, the applicable knowledge—a notion Wenger referred to as *engaged partiality*" (Scott, 2011, p. 5). I encourage this because most work will be done in collaborative groups where one's knowledge and experience will be co-dependent on the contribution of others, and must be negotiated with one's peers.

Lastly, the motivation for conducting this study is because I believe, as does Maxwell (2005), that,

> The most admirable thinkers within the scholarly community . . . do not split their work from their lives. They seem to take both too seriously to allow such dissociation, and they want to use each for the enrichment of the other. (p. 38)

My motivation for conducting this study originates in the importance of evolving the body of Naval planning theory to better embrace conceptual design theory to overmatch modern ill-structured problems.

Problem Statement

The current problem-solving process used by the military is inadequate to address today's complex issues (Akin, 2009; Banach, 2009; Bousquet, 2009; Buchanan, Doordan, & Margolin, 2010; Conklin, 2008; de Czege, 2009). Military education may not be developing the necessary skills required for staff officers to keep pace in their abilities to advise decision makers (Utting, 2009). Integrating design thinking into the planning process encourages a more complete understanding of the problem confronted, the operating environment, and the purpose of an operation (Brown & Wyatt, 2010; de Czege, 2009; Eikmeier, 2010; Hobday et al., 2012; Kem, 2009; Schmitt, 2010; U. S. Army, 2012; U. S. Army War College, 2011).

Design thinking benefits from elements of bounded rationality theory (Simon, 1957),

general systems theory (Von Bertalanffy, 1950), complexity theory (Simon, 1995), design theory (Simon, 1969), planning theory (Rittel, 1973), lateral thinking theory (De Bono, 1991), loops of learning theory (Argyris, 1976; Argyris & Schön,1995; Senge et al., 2005), and the theory of reflective professional learning (Schön, 1983). Employing a comprehensive approach to tackling military transformation from a complexity paradigm offers a useful intellectual approach to address transformational issues (Banach, 2009; Brown, 2008; Utting, 2009; de Czege, 2009; Tsekeris, 2010).

Purpose Statement

The purpose of this qualitative single instrumental researcher case study was to explore and discover the intrinsic value of a design thinking-led problem-solving education for collaborative learning of military student-planners at a senior U.S. military service college.

Significance of the Study

The significance of the study is that it may have a positive influence on the military leadership community by providing insight on how important it is to target the right problems to solve and develop viable options to address them. Findings from this study may also have an impact on other areas of the military such as doctrine, leadership, organization, and education and training. The study suggests all military officers be introduced to design thinking and a new problem solving process at the earliest opportunity and throughout the continuum in professional military education. By introducing military officers to the methodology and supporting concepts of design thinking, they will be aided in understanding problems and be better equipped to analyze underlying causes of complex, ill-structured problems and synthesize viable options to confront them.

Moreover, because solving complex, ill-structured problems is not limited to the military,

other organizational entities would benefit from an improved problem-solving process. Such a process would be applicable to the whole of government whereby the ultimate objective is for all U.S. government security agencies to plan and conduct operations from a shared perspective (Gockel, 2008). According to Hobday, Boddington, and Grantham (2012), "Leading proponents of design thinking (e.g., Buchanan, Conklin, and Hatchuel) argue that it potentially applies to other arenas of creative human activity where *wicked problems* are confronted" (p. 25). These arenas encompass government and public policy, education, health care, and socio-economic matters, and so on (Burnham, 2009). Similarly, Hobday et al. (2012) asserted, "Design thinking goes beyond the technical and business domain to broader social, policy, and economic applications. Its main contribution is to offer new opportunities for problem-solving and solution generation through a collective social approach to wicked problems" (p. 28).

While much has been written on the theory of design thinking, its origin, and where it might be applied, no research has been done that advances the design theory into practice using collaborative, team-based learning to achieve organizational learning to solve complex problems. This study addressed the gap in the literature and added to the body of knowledge concerning the value of design thinking education. This study exploits the opportunity to consider the implications of a simulation-based education model where students deploy design methodologies as a prelude to detailed planning.

Research Questions

The purpose of this qualitative case study was to explore and discover the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners at a senior military service college. According to Creswell (2007), qualitative researchers ask at least one central question and several sub-questions. Central questions are

generally broad and serve as the foundation for the development of subsequent questions. Sub-questions are typically narrow and serve as a method to focus interviews, close observations, and document analysis (Creswell, 2007).

Qualitative researchers begin questions with words such as *how* or *what* and use exploratory verbs, such as *explore* or *describe*. They ask general questions to "allow the participants to explain their ideas" (Creswell, 2007, p. 141). Creswell additionally divided sub-questions into issue-oriented and procedural-oriented sub-questions. Whereas issue-oriented sub-questions are theoretical and designed to separate the central question into subtopics and issues, procedural-oriented sub-questions are process-related and meet the researcher's requirement for information relative to the intent of the research (Creswell, 2007).

Design thinking is crucial to ensuring today's decision makers accurately distinguish the right problem to solve. Effective application of design thinking is the distinction concerning solving a problem rightly and solving the true problem. The central research question, along with issue and procedural oriented sub-questions guided the study.

Central Question

How can military planners be better prepared to solve complex, ill-structured problems through design thinking? This primary research question was central to the research study, as the answer to this question provides the potential to inform military educators as to how they can provide relevant and rigorous planning instruction to student-planners (Banach, 2009; Bousquet, 2009; Conklin, 2008; Di Russo, 2013; Jablonsky, 2010; Leifer & Steinert, 2011; Rutledge, 2009; Schmitt, 2010).

Issue Oriented Sub-Questions

1. How can military planners receive comprehensive planning guidance needed to address

complex, ill-structured problems? The answer to this question offers the potential to inform military leaders as to how they can provide essential planning guidance and transfer knowledge to the collective planning team members (Akin, 2009; Banach, 2009; Bousquet, 2009; Conklin, 2008; Cross, 2011; Di Russo, 2013; Dorst, 2011; Eikmeier, 2010; Jablonsky, 2010; Jensen, 2009; Leifer & Steinert, 2011; Rutledge, 2009; Schmitt, 2010; Zweibelson, 2011).

2. What methods do military planners use to confront complex, ill-structured problems? This question is important because the answer serves as a driving function that critically examines the process used by planners to solve problems (Di Russo, 2013; Eikmeier, 2010; Jablonsky, 2010; Rutledge, 2009; Schmitt, 2010; Zweibelson, 2011).

Procedural Oriented Sub-Questions

1. How, or in what ways, do military planners collectively integrate design thinking into problem solving to achieve collaborative learning? Understanding how and in what ways planners collaborate is helpful in developing and delivering future professional military education (Burnham, 2009; Grigsby, 2011; Heaney, 2013; Kem, 2009; Machin, Harding, & Derbyshir, 2009; Mangold, 2011, 2013a; Norton, 2012; Paparone, 2012; Scott, 2011; Teal, 2010; Tuckman, 2009).
2. How can the current problem-solving process be improved? Understanding how the problem-solving process can be improved is essential to curriculum development and discovery of effective teaching methods (Banach, 2009; Berger, 2009; Brown & Wyatt, 2010; Brown, 2009; Hart et al., 2010; Kimbell, 2010, 2011; Knowles, 2011; Utting, 2009).

Research Plan

According to Creswell (2013), "A [qualitative] case study is a good approach when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the case" (p. 100). Case study research may be carried out using a positivist (e.g., Eisenhardt, 1989, 1991; Yin, 2009) or an interpretive (e.g., Lincoln & Guba, 1985; Stake, 2008) tradition. This research was conducted within the interpretive tradition.

A bounded, single, instrumental, exploratory case study design was selected for the purpose of conducting this research study. The instrumental type of case study was selected because the proposed study involves using a single case to advance understanding of a particular phenomenon as well as an expectation that knowledge can be used to refine further theory (Stake, 1995, 2008). Use of a single case may be considered a strength because a single case study presents conditions that make it possible to gain in-depth information about the phenomenon in context (Flyvbjerg, 2006), and the prospect to consider several contexts within the case (Voss, Tsikriktsis, & Frohlich, 2002).

According to Stake (2005), instrumental cases:

> do not rely on a priori hypotheses to develop intrinsic themes; rather… themes can emerge during the course of data collection and analyses in a continual process of interpreting and reinterpreting data. Moreover, the use of the case study method enables researchers to find "interactivity" and "connectedness. (p. 452)

This is accomplished whereby participants convey their experiences to the reader by way of a narrative describing the case; Stake (2005) suggested portrayal "in sufficient descriptive narrative so that readers can experience these happenings vicariously and draw their own conclusions" (p. 450).

In the case of this study, there was a question or a set of predetermined criteria or a theory that was being explored and tested through the case study. Exploratory case studies are described by Bassey (1999) as theory seeking. Additionally, Yin (2009) asserted the "rationale for a single case study is where the case represents a *unique* case" (p. 47). Yin (2009) explained the significance of the unit, or case, by contending, "If the unit of analysis is a small group, for instance, the persons to be included within the group must be distinguished from those who are outside" it (p. 32).

Creswell (2007) regarded single case study research as a methodology, along with an outcome of the study. A qualitative case study is chosen because, according to Creswell (2007),

> Case study research is a qualitative approach in which the investigator explores a bounded system (case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information (for example, observations, interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes. (p. 73)

This research was a bounded case study of a cross-functional, inter-disciplinary group of military student-planners' ability to solve complex, ill-structured, non-linear problems. Participants comprised a homogeneous group of military student-planners who were presented a scenario from which the group had to collaborate and propose a variety of solutions. Performing a case study, students enrolled in a planning course at a military service college in New England were observed in the process through which students go about solving a complex, non-linear problem incorporating design thinking. While much has been written separately on design theory, collaborative learning, and problem solving, there has been no documented research conducted that studies those topics in a practical setting. Discussion of delimitations of this

study follows.

Delimitations

Delimitations of this study should not be regarded as deficiencies or weaknesses. Instead, delimitations should be viewed more as boundaries, as the researcher has thought through implications in order to constrain the study to be less unwieldy (Glatthorn & Joyner, 2005). Accordingly, delimiting occurred by setting boundaries or limits on the study. This study only included military student-planners attending a planning course at the Naval War College. Additionally, study participants were limited to mid-level military officers attending the course due the convenience of the setting. Finally, the setting was limited to a single group of military student-planners comprised of 15 military student-planners.

Limitations

Limitations are those "boundaries" (Creswell, 2013, p. 102) of the case. These boundaries may be in terms of time, events, and processes. The current study contained some limitations due to some vulnerability that existed with the research methodology, analysis, and participants. Although qualitative research provides valuable insight into thoughts, perceptions, and processes, they are vulnerable. In this qualitative study, knowledge assembled may not generalize to other populations and other settings. Because findings are unique to one specific site and group of participants, rendering transference of findings to other locations and groups is less than viable.

In any event, the main limitation to this research was related to gathering data about problem solving under the research context. Conducting the interviews was demanding on research resources because some decision processes typically span periods of months.

Therefore, I was obliged to rely on the traces of the completed design-thinking-led problem solving process in the minds of those people who would carry it out.

Another limitation for this study was researcher bias because I am a faculty member of the academic institution from which the case study population was drawn. For example, I could be viewed as prejudiced regarding the development and delivery of the educational experience. In order to mitigate this risk, I maintained a research journal through the research and analysis stages of the proposed research. To further limit possible research bias, I arranged for a third unbiased party to review notes and journal entries.

Another limitation involved the activities and dialogue surrounding the case. Activities and dialogue had the potential to be affected because of awareness of the study. In order to mitigate this risk, participants were observed in their natural educational environments first and interviewed following completion of observations.

Summary

Chapter One has asserted the problem and purpose statements, research questions, and significance of the study, as well as defined relevant terms and addressed delimitations and limitations of the study. Going forward, Chapter Two comprises the review of literature and research relevant to the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student planners at a military service college. The methodology and procedures used to gather and analyze the data for the study are addressed in Chapter Three. Results of analyses and findings from this study are reported in Chapter Four. Finally, Chapter Five covers a synopsis of the study and discusses findings, as well as recommendations for further study.

CHAPTER TWO: LITERATURE REVIEW

Introduction

According to Fraenkel and Wallen (2006), a literature review helps researchers glean the ideas of others interested in a particular research question. They established sequential "steps involved in a literature search," that includes the following:

1. Define the research problem as precisely as possible.
2. Look at relevant secondary sources.
3. Select and peruse one or two appropriate general reference works.
4. Formulate search terms (key words or phrases) pertinent to the problem or question of interest.
5. Search the general references for relevant primary sources.
6. Obtain and read relevant primary sources, and note and summarize key points in the sources. (p. 68)

The above steps guided the review of literature that is stalled at the theoretical level.

Literature regarding design thinking is not new. In fact, the subject has gained momentum in the last decade, particularly regarding business and organizational development. Current literature is focusing on design thinking as a means to close the problem-framing gap in problem solving, especially in the area of complex problems. However, existing literature remains at the theoretical level impaired by prolific esoteric lexicon with no research dedicated to advancing the subject of design thinking from theory to practice.

Background

The need for transformation is, if anything, greater now than ever before. No matter where one looks, there are problems that can be solved only through innovation, such as:

unaffordable or unavailable health care, billions of people trying to live on just a few dollars a day, energy usage that outpaces the planet's ability to support it, education systems that fail many students, and companies whose traditional markets are disrupted by new technologies or demographic shifts. These problems all have people at their heart. They require a human-centered, creative, iterative, and practical approach to finding the best ideas and ultimate solutions. Design thinking is just such an approach to innovation (Brown, 2008).

Design thinking can be described as human-centered and having a wider and more forward-looking approach to solving problems (Borja de Mozota, 2010; Carlgren, 2013; Cruickshank & Evans, 2012; Hobday et al., 2012;.Von Stamm, 2010). The linear problem-solving process used by the military proved to be adequate during the period of World War II through the Korean War. However, it fails to address today's complex issues (Akin, 2009; Banach, 2009; Bell, 2006; Bousquet, 2009; Buchanan et al., 2010; Conklin, 2008; de Czege, 2009; Heaney, 2013; Mattis, 2009; Naveh, 2007; Paparone, 2012; Rutledge, 2009; Utting, 2009). Integrating design thinking into the linear planning process encourages a more complete understanding of the problem confronted, the operating environment, and the purpose of an operation (U. S. Army, 2012; Brown & Wyatt, 2010; U. S. Army War College, 2011; de Czege, 2009; Eikmeier, 2010; Hobday, et al., 2012; Kem, 2009; Schmitt, 2010).

There are several theories that suggest there is a high degree of intrinsic value in a design-thinking-led problem solving education for collaborative learning of military student-planners. The review of the literature presents a variety of theories for this phenomenon; all have the same objective, which is to close the problem-framing (and re-framing) gap in problem solving, especially in complex problems. This case study sought to answer one primary research question and four sub-questions: (a) How can military planners better address complex, ill-

structured problems?; (b) What methods do military planners use to confront complex, ill-structured problems?; (c) How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning?; and (d) How can the current problem-solving process be improved?

This review of literature begins by defining some fundamental terms followed by a short discussion on the purpose of a literature review. Next, I present my personal epistemology and its relationship to the approach to the study. Then, I build a theoretical framework of design grounded in theory from elements of various theories such as bounded rationality, complexity, systems, and planning theories. The actual review of the literature addresses each of these theories separately and concludes with a synthesis of the various theories, thereby introducing the concept of design thinking. Finally, a conceptual framework illustrates a methodology of how design thinking can be integrated into a linear problem-solving process. Although there are numerous planning processes used by militaries around the world, they share many similarities to include their linear approach.

In addition to the above, the literature review focuses on the challenges, processes, and methodologies of solving complex, ill-structured problems. It explored approaches of military planners which encourage thought, innovation, and creativity as well as the value of design thinking to provide sufficient guidelines for successful military operation planning. Moreover, the literature examines a variety of theories and how design thinking brings planning (theory) into action (practice).

As indicated earlier, while literature regarding design thinking is abundant, it remains at the theoretical level. There has been no research of advancing the subject of design thinking from theory to practice. Where literature regarding practical application is available, it is

anecdotal and based on historical examples to demonstrate how design thinking could have been applied in a particular setting or circumstance. No literature explores the intrinsic value of a design-thinking-led problem-solving education. Therefore, the purpose of this qualitative study was to add to the literature by further exploring this phenomenon.

Discussion of Key Terms

In light of these facts, the following definitions of foundational terms are what researchers and theorists have concluded on this topic—terms that will be used frequently to discuss significant aspects of the research.

Design Thinking

There are no precise definitions of the terms design, design research, and design thinking. They are often used interchangeably and are contested in philosophical forums. Design thinking is described as an inter-disciplinary human-centered innovation method inspired by the ways designers think and work (Brown, 2008; Carlgren, 2013; Kimbell, 2011). While Collopy (2010) expressed the essence of design thinking (or sensing) through the traditional caricature of the left-brain (logical/analytical) versus right-brain (creative/imaginative) distinctions, both are needed. *Design thinking* became a turn of phrase by Rowe (1987) when he referred to how designers approach design problems, even though design researchers had been studying the theoretical process for many years (Schön, 1983; Simon, 1986). Design thinking is considered as foundational for the framework inter-disciplinary teams can use to communicate and to coordinate activity (Lindberg et al., 2010). Design thinking can also be described as iteration between the parts and the whole (Cross, 2011; Rowe, 1987), and as a co-development of solution and problem space (Cross, 2011). In descriptions of how designers relate to problems, the focus is on problem setting, sometimes referred to as "framing" rather than problem solving. Schön

(1983) refers to the ability to continuously frame and reframe a problem or situation in different ways – "problem setting" rather than problem solving. According to the U.S. Army's definition, "Design thinking is a methodology for applying critical and creative thinking to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them" (U. S. Army, 2010, p. 4). Therefore, the prerequisite to applying design thinking is to have a basic understanding of critical and creative thinking, and complex, ill-structured problems. Banach (2009) said, "Whereas scientists describe how the world is, designers suggest how it might be" (p.105), which presented an approach that encourages critical thought, innovation, and creativity and is not intended to be prescriptive. Rather, the intent of design thinking is to investigate effective practices to provide representative design principles for planning.

This research explored how design thinking can inform planning for the execution of military operations and introduces theory to explain the art of design thinking while providing an approach for presenting a response to a complex situation. Design thinking is more than just a way of thinking. In order to be effective, design must move from just thinking about problem solving to taking action in addressing problems. According to Norton, (2012) Design thinking is focused on solving problems, and as such requires active intervention, not just thinking and understanding. For this exploration of design thinking, a broad-spectrum definition was used.

Complex, Ill-Structured Problems

This is a study that explores the intrinsic value of design thinking to solve complex, ill-structured problems. "Military organizations struggle today with complexity. 21st century complex environments appear to be unpredictable, chaotic, and often unresponsive to the reductionist and mechanistic narratives generated by the detailed planning system of logic" (Zweibelson, 2011, p. 11). Russell L. Ackoff (1974) referred to complex problems as messes.

He wrote that "every problem interacts with other problems and is therefore part of a set of interrelated problems, a system of problems…. [and I] choose to call such a system a mess" (p. 3). Analogously, the term "Wicked Problem" was devised by Horst Rittel and Melvin Webber (1973) in the perspective of social planning. Wicked problems are not readily responsive to traditional analytical problem-solving processes because these types of problems are ill-structured and poorly defined. The concept of wicked problems was offered in response to the then prevailing rational problem-solving methodology as characterized through the work of Herbert Simon (Simon, 1945, 1957, 1969). Rittel and Webber (1973) expounded that wicked problems are ill-defined, with numerous, complicated effects. As such, they concluded, "wicked problems cannot be solved using linear operations" (Rittel & Webber, 1973, p. 4).

Military Problem-Solving Process

The U.S. military uses a rational analytical approach to problem solving and in understanding the operational environment. The analytical approach pursues best solutions to linear problems as a result of deliberate, comprehensive analysis. The military problem solving is a step-based process and was created from basic deduction that deconstructs complexity into individual parts so that the whole might be understood. The process has six steps: mission analysis, course of action development, war game/analysis, comparison and decision, orders development, and transition to execution. The process also makes use of an interdisciplinary group of expertise to explore optimal solutions to problems.

This process depends on a prescribed, sequential methodology to analyze the assigned mission, isolate the source of and define the problem and its underlying causes, and produce options to solve the problem. The options are then evaluated using various modeling techniques. The options are then compared against each other and a specified corroborated set of standards.

Lastly, the interdisciplinary team ascertains measurements to assess the degree of success of carrying out the chosen option.

The analytical approach to problem solving can be a very effective method; however, it is prone to be ineffective and detrimental by generatng overly optimized solutions that are inflexible to changes in the operating environment (DeJarnette, 2001). As Bell (2010) points out, "This linear approach limits the ability of the military to adapt when faced with rivals who do not adhere to similar methodologies" (p. 5). Carlson and Bloom (2005) explained problem-solving behaviors as a framework. This framework has four phases: orientation, planning, executing, and checking. Furthermore, this framework is also characterized by attributes such as resources, affect, heuristics, and monitoring.

Abductive Reasoning

The solution-based approach to problem solving originated from inter-disciplinary foundations rather than conventional management theory and is grounded in systems theory. It can be compared against problem solving in the sciences. The scientific approach is to focus on the problem at hand. This approach requires rigorous analysis and is based on deductive reasoning. Design, on the other hand, requires more than analysis. Design thinking requires synthesis and is based on abductive reasoning. Nigel Cross (2011) referred to this as "constructive thinking" (p. 136). Abductive reasoning, contrasted with deductive and inductive reasoning, is a form of logical inference that moves from observation to a hypothesis that attempts to analyze trustworthy data (observation) and seeks to rationalize relevant evidence. "Various authors (Morello, Cross, Simon, Martin) have characterized design as demonstrative of the abductive reasoning model characterized as guessing in contexts of limited information" (Norton, 2012, p. 3). Dorst, (2011) contended how a core element of design thinking is problem

framing and that problem framing can be understood as a manner of abductive reasoning. Correspondingly, Thagard and Cameron (1997) explained abductive reasoning classically begins with an incomplete set of observations and advances to the likeliest possible explanation.

Intrinsic Value

Intrinsic value is something which has value "in itself," or "for its own sake," or "as such," or "in its own right" (Zimmerman, 2010). The degree (value) of preparedness and overall satisfaction that education in integrating design thinking into the linear planning process encourages a more complete understanding of the problem, the operating environment and the purpose of an operation. Thereby, one develops the necessary skills required for military planners in their ability to advise decision makers.

Purpose of the Literature Review

Boote and Beile (2005) wrote, "A thorough, sophisticated literature review is the foundation and inspiration for substantial, useful research. The complex nature of educational research demands such thorough, sophisticated reviews" (p.3). Conducting the literature review is an intricately involved, even a byzantine, process described as "an interpretation of a selection of published and/or unpublished documents available from various sources on a specific topic that optimally involves summarization, analysis, evaluation, and synthesis of the documents" (Onwuegbuzie, Leech, & Collins, 2010, p. 173). What follows provides a context that explicitly arranges the problem this research confronts, to explore and discover the intrinsic value of a design-thinking-led problem-solving education. There is an extensive body of theoretical literature, doctrinal publications and journal articles, policy and so on that has relevance to the study; however, as mentioned several times earlier, no research literature exists that advances the theory into practice.

This study looked at design-thinking-led problem-solving education for collaborative learning of military student planners at a military service college. Therefore, central to this study is the design theory. In order to understand design, the theory behind the concept was explored through literature. Theorists such as Archer (1979), Buchanan (1992), Cross (2001), and Simon (1969) offered a comprehensive basis for the application of a design-led problem-solving approach, which is an integral part of design thinking. The literature also provides a historical perspective of design thinking, which discloses the importance of applying the concept when solving complex problems.

Not only are the military student-planners' experiences with design thinking considered, but the tactics, techniques, and procedures for teaching design thinking are discussed, as well. Thus, the theory behind the design thinking activity needs to be examined if the experiences of military student planners applying design thinking effectively are to be understood. In addition to literature review, this study also investigates the role of the educator in teaching design thinking.

Personal Epistemology

This study used theory from the beginning because theory provides structure upon which to build, starting with research questions. In this manner, theory filters and structures the data. This particular research was epistemological in nature as it was concerned with the *how* and *scope* of knowledge (Hofer, 2002). The field of epistemology emphasizes investigating the nature of knowledge and how it relates to linked concepts such as belief and reasoning.

Epistemology also deals with the method of creation of knowledge. I believe that knowledge is constructed and therefore essentially subjective. This constructivist view is aligned with the study that interpreted knowledge as being produced to maintain the status quo. Thus, it

is intended to produce research that can lead to educational change by stimulating that knowledge. Constructivists maintain that people construct knowledge and meaning during the course of their experiences and that these meanings are revised throughout a process of accommodation and/or assimilation of new experiences (Applefield, Huber, & Moallem, 2001; Bruner, 1960; Piaget, 1950; von Glasersfeld, 1995).

According to Applefield, Huber, and Moallem (2001), learning is more about the construction of knowledge rather than the transmission of knowledge. Therefore, the construction of meaning is a constant, dynamic process that is affected mainly from pre-existing knowledge. From the groundwork of Piaget (1950) on the theory of cognitive development, Bruner (1960) determined that learning transpired from a process of reasoning based on one's experiences by choosing and synthesizing information, and constructing assumptions. This learning process resulted in a knowledge base with which to construct meaning for future decision making. Similarly, von Glasersfeld (1995) suggested that the process of learning allows the learner to create meaning of his or her experiences. Thus, the more sense one can make, the better one is prepared to provide meaning to comparable experiences. It follows then, that the manner of how one decides is more significant than the decision itself (von Glasersfeld, 1995).

The epistemological assumptions that influence the approach to this study are also aligned with King and Kitchener's (1994) *Reflective Judgment Model*. They wrote that the reflective judgment model could be compared with critical thinking. However, what distinguishes the reflective judgment model centers on the importance given to the sophisticated tasks involved in "open-ended problem solving rather than closed-ended, the attention to epistemic assumptions, and the articulation of stages of development" (Hofer, 2001, p. 358).

There are two primary ways reflective judgment contrasts with critical thinking. First,

critical thinking is viewed as a process in problem solving, whereby the assumption is that learning a set of skills and how to use them will bring about critical thinking; however, with reflective judgment, assumptions are central in problems that do not have certainty or recognize that problems exist (King & Kitchener, 1994). The second way reflective judgment contrasts with critical thinking is a matter of perspective. Critical thinking is best suited to focus on those problems that are well understood and structured, contrasted with those which are ill-defined with little structure and are less understood. Problems that can be referred to as well-structured are characterized as having solutions and do not require one to "consider alternative arguments, seek new evidence, or validate information. Conversely, ill-structured problems are more complex and the outcome may not be known (or known with certainty)" (King & Kitchener, 1994, p. 12).

Theoretical Framework

A number of respected authors have expressed varying thoughts regarding the use of a theoretical framework in research. Maxwell (2005), explains the literature review this way:

> the point is not to summarize what has already been done in the field. Instead, it is to ground your proposed study in the relevant previous work and give the reader a clear sense of your theoretical approach to the phenomena that you propose to study. (p. 123)

Stake (1995) posited that the use of theory can be absent from studies which focus on describing the case and its questions. On the other hand, Yin (2009) stated that theory should serve to guide the case study in an inquisitive manner. Creswell (2007) proposed that theory be used toward the end of the research in order to provide an evaluation from which former theories are compared and contrasted with the theory advanced in the case study. In accordance with Camp (2001), theoretical frameworks attempt to provide an accounting of the phenomenon. Merriam

(1998) further clarified that a theoretical framework provides the researcher the lens to view the world and asserted, "it would be difficult to imagine a study without a theoretical or conceptual framework" (p. 45). Knobloch (2003) cites Gall, Gall, and Borg (1996), who state that "a theoretical framework is a framework for explanations about the phenomenon being investigated" (p. 2). Gall et al. (1996) continued to define a theoretical framework as an "explanation of a certain set of observed phenomena in terms of a system of constructs and laws that relate these constructs to each other" (p. 8). Finally, Omirin and Falola (2011) added that theoretical frameworks are constructed with "established, coherent explanation of certain phenomena and relations … using theories that have been proven reliable" (p. 1). Each of the above authors expressed varying thoughts regarding the use of a theoretical framework in research. However, all are in agreement that the theoretical framework is central to any qualitative study.

Maxwell (2005) posited that a "framework explains, either graphically or in narrative form, the main things to be studied—the key factors, constructs or variables—and the presumed relationships among them" (p. 33). The body of information that emerged through the literature is quite voluminous. In search of theoretical understanding and its application to the study and practice, I constructed a theoretical framework. This framework also served as a map or guide for the study (Sinclair, 2007).

The literature review led to developing a theoretical framework for this study illustrated in Figure 1. It depicts how design theory is central to the proposed study and how design thinking is the integration of several theories that suggest the intrinsic value. The figure also illustrates how design is rooted in systems, bounded rationality, complexity, and planning theories. The illustration also indicates design thinking benefits from elements of other theories,

such as loop learning and lateral thinking. Also depicted is a continuous theme of process improvement theory that permeates throughout the framework that explored intrinsic value of design education in problem solving. Moving from theory to practice is also indicated by a dashed line in the illustration. Additionally, because military problem solving involves an inter-disciplinary group of creative-thinking individuals, it is necessary to apply organizational, adult learning, and collaborative/team and solution-based learning theories when addressing complex and ill-structured problems requiring military intervention. The gap in research literature is also illustrated to indicate the void when moving from theory to practice.

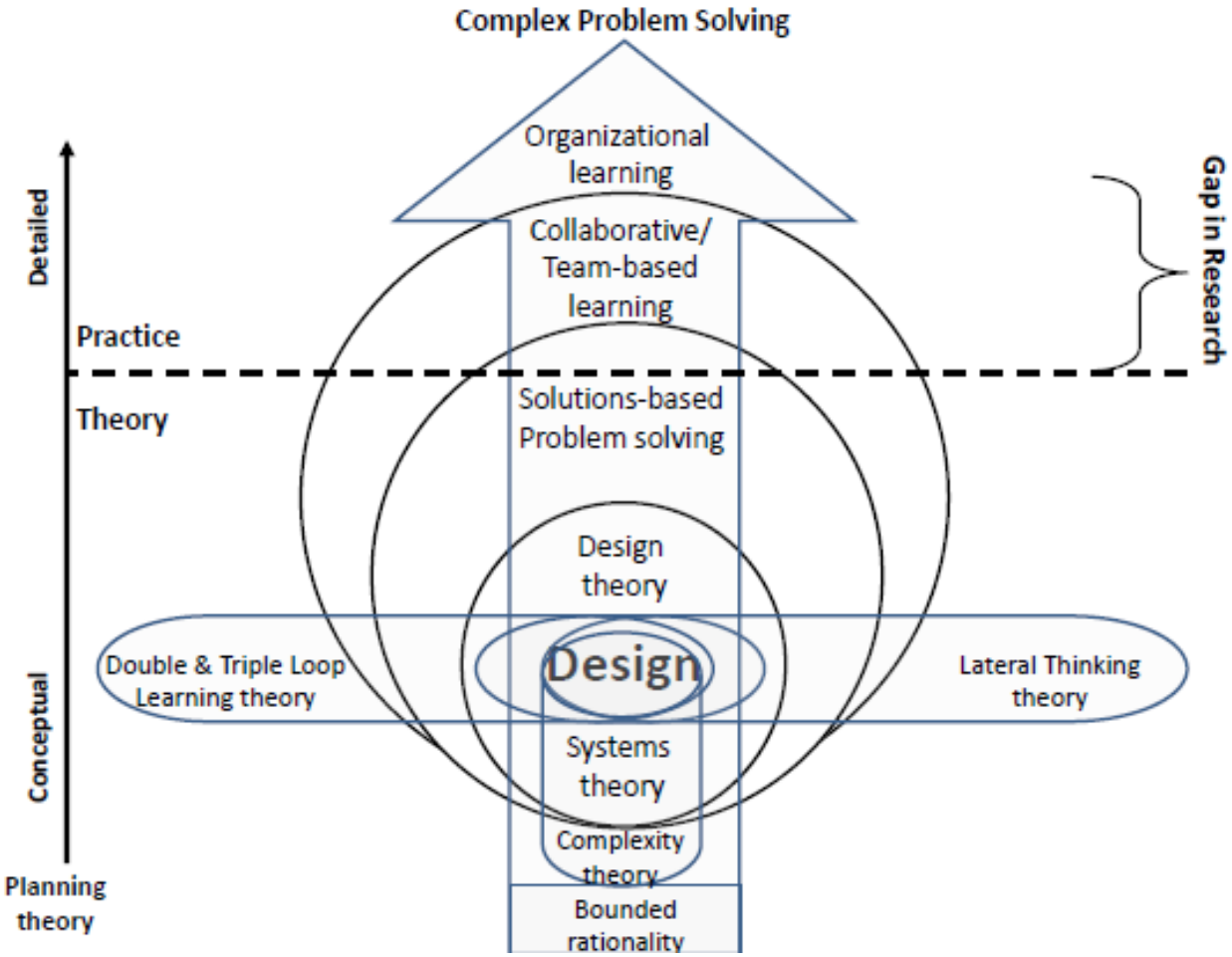

Figure 1. Theoretical Framework

Related Literature

Specifically, this research explored how participants experience the phenomena of design-thinking-led problem solving in how military student-planners synthesize the operating environment to solve complex, ill-defined problems. The absence of agreement on an accepted definition of design thinking and whether the topic establishes a science rather than a discipline is a matter of philosophical debate. Ambiguity notwithstanding, design thinking is acknowledged as a methodology of "creative problem solving and as such has become an integral part of modern business practices" (LeBlanc, 2008, p. 1). A review of the literature revealed that researchers agree that "the understanding of the complexity requires holistic thinking, and therefore demands the implication of expert disciplines in the process of building design knowledge" (p. 1). Therefore, this study was designed using a blend of theories. The following highlights what researchers and theorists have found on this topic.

Design Thinking

The concept of design thinking as a "way of thinking" can be discovered in the well-read work of Herbert A. Simon, *The Sciences of the Artificial*. Simon (1969) wrote that the world is a constructed "artifice," unnatural objects are created by man, and concluded the decisive artifice is, in fact, the human brain. Other scholarly contributors to this way of thinking include Horst Rittel in his work, *Dilemmas in General Planning Theory*. Rittel (1973) explained that a wicked problem is,

> unique, ambiguous and has no definite solution . . . distinguished from problems in the natural sciences, which are definable . . . problems of governmental planning—and especially those of social or policy planning, are ill-defined and are never solved . . . at best they are only re-solved—over and over again. (Rittel, 1973, p. 160)

A review of Victor Papanek, (1971) known for his work in his book, *Design for the Real World: Human Ecology and Social Change*, revealed that scholars held differing views of the concept of design thinking. Elkus and Burke, (2010) said, "The ultimate source for the focus on the design and planning of campaigns emerged primarily from the military intellectual renaissance of the late 1970s and early 80s" (p. 2). *Design Thinking* by Peter Rowe (1987) was the first significant use of the term in the literature on design thinking and provided a methodical explanation of problem-solving procedures.

Soon afterward, Richard Buchanan (1992) penned an article entitled, *Wicked Problems in Design Thinking*, which articulated a comprehensive examination of design thinking. The article discussed the emergence of design thinking in the 20th century and the basis for it not being reduced as an extension of the neo-positivist. Rather, design thinking lies in concert with the arts and sciences alike but is in some ways suited for complex problems. Buchanan and Margolin, (1992, 1995) considered design thinking more of a liberal art pertaining to "propositional discourse in contingent contexts Buchanan has termed, the four orders of design" (Norton, 2012, p. 8). In the framework described by Buchanan et al.:

> First-order problems focus on communication and the delivery of information through images and symbols. Second-order problems focus on the issues surrounding the construction of tangible artifacts of any scale. Third-order problems focus on the planning and implementation of actions, interactions, processes, and services. Finally, fourth-order problems focus on how we organize the complex wholes that surround us and provide the systems and environments of human culture. (Buchanan, Doordan, & Margolin, 2010, pp. 2-3)

Concomittantly, Paparone (2001) defined design as "a multi-dimensional undertaking with the

decision maker, environment, organization (vertical and horizontal), planning, learning and procedures as its major aspects" (p. 48). Wylant (2008) considered design thinking as a process that raises good questions rather than seeking the right answers. Wang and Wang (2011) state that "Design thinking is different from critical thinking in that design thinking is process-oriented wheras critical thinking is judgement-oriented" (p. 209). Buchanan combined theory with practice for productive purposes. This is the reason further investigation into design thinking is needed for greater insight. Presently, there is extensive academic and business attention in design thinking and design cognition (Cross, 2011) as supported by a continuing series of symposia on research in design thinking (Earl, 2013).

Design Grounded In Theory

A review of the literature revealed that design thinking is grounded in a variety of theories. Design thinking benefits from the merger of many elements of bounded rationality, systems, general planning, and complexity theories. Design thinking can also be compared to lateral thinking and loop learning theories. Because the setting for this research involved a homogeneous group of adults organized as a collaborative inter-disciplinary team to solve complex, ill-structured problems to inform decision makers for organizational learning, these theories were also explored. Hence, design thinking is the synthesis of many theories. What follows is a review of each of these theories that culminates with building a theoretical framework.

Bounded Rationality

Bounded rationality is established on the assumption that reality is complex and replete with uncertainty, resulting in people discovering ways of coping rationally rather than acting rationally (Augier & Kreiner, 2000). Bounded rationality recognizes the limited cognitive

capacity of decision makers and suggests that, in reality, decision makers do not calculate the best possible action, instead seeking an option that is good enough (March, 1994). Said another way, the concept of bounded rationality is that after decision makers simplify available choices, they make decisions based on a balancing of available information, limitations of their minds, and the limited amount of time they have to make a decision.

Bounded rationality closely resembles the U.S. military's perspective of rationality regarding decision making. This perspective is in recognition that it is not possible to know and understand everything; consequently, the military planning process navigates planners toward options which may be less than optimal, but are good enough to work, though not necessarily the best solutions (Bell, 2010). Similarly, Herbert A. Simon (1945, 1957) posited that limitations placed upon decision makers require them to become "satisficers in that they acquiesce a satisfactory resolution that is sufficient for their purposes instead of attaining the optimum solution" (Augier, 2001, p. 12).

Complexity Theory

Complexity theory refers to the study of complex (adaptive) systems and has been utilized in the areas of organizational and strategic management and inquiry. Complexity theory, closely allied with chaos theory, is used to understand the effectiveness of organizations' abilities to adapt to the operating environment and by what means they manage uncertainty. In his book, *In the Wake of Chaos*, Stephen Kellert (1993) similarly described chaos theory as the qualitative study of erratic aperiodic behavior in turbulent, nonlinear systems.

Williams (1997) described "a complex system" as "one in which numerous independent elements continuously interact and spontaneously organize and reorganize themselves into more and more elaborate structures over time" (p. 234). Characteristics of a complex system include:

(a) a whole host of comparable but self-regulating entities; (b) continual association to and among other entities; (c) ability of the entity to adjust to different circumstances; (d) self-governing, in which harmony in the entity is established naturally; (e) authoritative regulations that pertain to each entity; (f) apt to become bigger, more advanced and increasingly complex; and (g) self-organizing complex entities are unpredictable and cannot be examined in isolation (Valle, 2000).

Akin (2009) explained complexity theory by saying, "It serves as a superb …repository of insight into human behavior in warfare" (p. 122). Akin (2009) then discussed a concept of using a nonlinear approach to warfare whereby, "events in battle happen simultaneously and chaotically…that capturing the process of intelligent agents in conflict, set within a widely divergent set of possible futures, leads to a rich set of possible trajectories of system evolution for analysis to consider" (p.122). Lastly, Williams (1997) stated that chaos and complexity could be caused by simple events. Complexity theory then can be useful toward understanding how organizations adjust to the operating environment and manage uncertainty.

Systems Theory

According to Vego (2009), the single key theory supporting design thinking is general systems theory. Systems theory was made known by biologist Ludwig von Bertalanffy in the 1930s and used by scientists and philosophers to explain how objects functioned in the universe. His foremost production, *General System Theory: Foundations, Development, Applications*, (1968) was based in large part on an article written in 1945. The theory offered a method relevant to understanding the effect on an organization from a holistic viewpoint from social interactions among stakeholders and to analyze the assorted components that make up the system in order to understand the impact individual parts of the system have on behaviors observed.

The theory was used to demonstrate inter-relationships and overlap among separate disciplines. Along with increased understanding, the disciplines fractured into chemistry, physics, biology, and then biophysics, biochemistry, etc. One result was that associated elements of a problem were examined in great detail but in isolation.

Systems theory encouraged investigators to appreciate the integration of parts of a problem. Complex problems are unsolvable if they are deliberated in isolation from inter-related components. Von Bertalanffy (1950) referred to systems theory as a general science of "wholeness...the significance of the rather transcendent dictum, the whole is more than the sum of its parts" is merely that constitutive characteristics are not expandable from the characteristics of the isolated parts. The characteristics of the complex, therefore, appear as "new" or "emergent" (1968, p. 31).

Planning Theory

Melville Branch (1998), who authored *Comprehensive Planning for the 21st Century*, suggested that planning has been characteristic in personal and societal activities, and acknowledged it as vital to the conduct of government, commerce and war since the earliest days of mankind (Branch, 1998). Paparone (2001) defined planning as, "the art and science of envisioning a desired future and laying out effective ways to bring it about, influencing events before they occur" (p. 50). The U.S. Marine Corps (2010) described a range of planning from the lowest level with *how-to* applications, called "detailed planning," to the highest level, "operational planning," that involves concepts, intent, goals and objectives, called conceptual planning.

Schneider (1994) contended, "detailed planning uses a teleological approach where the entire process is purpose-driven; the "ends are determined first and then directed by action

(ways) with means" (p. 24). In between detailed and conceptual planning is support planning, called "functional planning that focuses on performing intelligence, logistics, etc." (p. 26). Paparone (2001) wrote, "The levels are interactive; concepts will drive functional and detailed planning, and details will influence functional and conceptual planning" (p. 50). One common characteristic is that planning theories address problems in a linear fashion. This study sought to explore a novel approach to address non-linear problems.

A variety of planning theories were introduced in the 20th century. Based on the research of Hudson (1979), these theoretical viewpoints are as follows:

1. Synoptic planning, or the rational linear approach, is the main view that is practiced and serves as basis for most other planning approaches. Other approaches "represent either modifications of synoptic rationality or reactions against it" (Hudson, 1979, p. 388).
2. Incremental planning emphasizes that policy decisions are reached by way of alternating between driving and drawing as a way of getting things done through decentralized processes. Incremental planning is also referred to as "partisan mutual adjustment" or "disjointed incrementalism" (Hudson, 1979, p. 389).
3. Transactive planning refers to the evolution of decentralized planning and emphasizes the experience of peoples' lives illuminating policy matters to be addressed. Transactive planning is performed through "face-to-face contact with the people affected by decisions" (Hudson, 1979, p. 389).
4. Advocacy planning is typically utilized when protecting the welfare of the vulnerable counter to formidable community groups. Advocacy planning originated in the legal profession and is typically used in matters relating to "environmental causes, the

poor, and the disenfranchised against the established powers of business and government" (Hudson, 1979, pp. 389-390).

5. Lastly, the radical planning approach is indistinct and abstruse. Radical planning occurs when two established views of thinking merge together.

Problems with Current Linear Problem Solving

Every planning theory has strengths and weaknesses and each have been exposed, even prone, to criticism. The U.S. military uses the synoptic, linear planning approach (Paparone, 2012). There are many shortcomings with the synoptic approach (Banach, 2009; Bell, 2006, 2010; de Czege, 2011; Elkus & Burke, 2010; Heaney, 2013; Hudson, 1979; Mattis, 2009; Paparone, 2012; Rudesheim, 2011). During the industrial age, planning theory perceived military power akin to machines. Meticulous processes of movement schedules and sustainment and troop movements required staffs that possessed scientific calculation expertise. Paparone (2001) wrote, "In Von Moltke's time, the Germans proved that an army that could plan detailed requirements, orchestrate capabilities rapidly and implement them precisely would win large-scale wars of national mobilization" (p. 45). They accomplished this through analysis, whereby enough information was accumulated to reduce uncertainty and increase their ability to detect the enemy's disposition and intentions (Bell, 2010; Van Creveld, 1985).

The circumstances we live in today are far more complex, requiring an innovative approach to solving complex, ill-structured problems. Mattis (2009) noted that "Our current doctrine falls short of providing a coherent operational design process that helps the commander visualize the desired end-state and devise an approach" (p. 32). Mattis (2009) also points out that in recent times a scientific procedural focus has come at the price of creative thinking and integration of all elements of national power.

The military planning process used today is a linear, systems-based methodology that separates and analyzes elements of the problem and attempts to reassemble them before arriving at a solution. From the start, such a methodology is fraught with limitations, obstacles, and constraints and tends to limit creativity. It is a process based on certainty whereby planners must transform assumptions into either facts or falsehoods and is not suitable when confronting ambiguous and/or complex problems. When this linear process is applied to the often multidimensional environment in which the military conducts operations, this scientific approach sometimes fails to holistically recognize the complexity of the environment (Bell, 2006). Bell (2006) stated that "The military then tries to solve the wrong problem better rather than identifying the right problem and managing the system within a determined limit of tolerance" (p.12).

Accordingly, the most significant deficiency, even danger, in using a linear problem solving process is being excessively systematic, thereby "creating a tendency toward premature closure in the process of formulating stratagems" (Paparone, 2001, p. 50). It is a process whereby planners work "from the desired end state back to the present is such a pervasive concept that it is both a constant process and generally an accepted 'root metaphor' that defies critical introspection" (Kem, 2009, p. 15). Zweibelson (2011) pointed out that,

> [this] emphasis on reductionist and mechanistic thinking cause the military to prefer description to explanation, and reduction of complexities instead of holistic comprehension—we describe each part of the bicycle in tremendous detail but never get to the assembled product being ridden to a destination. (p. 10)

Guerlac (1986) noted that "Reductionism breaks things apart and relies on categorization and description; these core tenets fueled humankind's leap into the Scientific and Industrial Ages,

and it has become quite difficult to escape her seductive embrace" (p. 67). Conklin (2008) also foresaw that, "Forcing the logic of linear causality, reductionism, and mechanistic theory to make sense of non-linear, complex systems appears to be becoming a larger institutional problem for the military in the 21st century" (p.4). While decision makers may be more adept with procedural attributes of problem solving, they may devote insufficient consideration to the less-structured, and yet more important, action of producing stratagems in the first place. Zweibelson (2011) succinctly summed up the problem by stating, "A vast lexicon emerged to describe the complexity phenomenon, words such as irregular, asymmetrical, ill-structured, and messy merely describe these abnormalities that plague detailed planning explanations of how the world should function, but does not" (p. 7).

Another major problem with the current problem-solving process used in the military is that it begins with mission analysis. Greenwood and Hammes (2009) noted that the,

> process starts with initiation and quickly jumps to mission analysis. Unfortunately, this approach is often reflected in our planning process when we completely overlook the critical step of developing a working definition of the problem. Instead, we assume that the problem will already be defined by the political leadership. (p. 52)

Consequently, it is dangerous to execute any developed courses of action if the initial definition of the problem is not understood. This research explored an attempt to use such a novel approach that combines design with synoptic, linear planning.

Lateral Thinking Theory

Edward de Bono (1967) introduced the concept of lateral thinking as a way to generate ideas free from previously locked assumptions. The lateral thinking learning theory asserted that various problems need assorted viewpoints to solve effectively. Lateral thinking differs from

critical thinking which assesses the consequences of assertions and looks for flaws, whereas lateral thinking approaches problem solving indirectly through creativity (De Bono, 1967).

Edward de Bono (1967) suggested there are four essential factors linked with lateral thinking: (1) recognizing prevailing ideas that polarize perception of a problem, (2) searching for distinctive ways of looking at things, (3) relaxing from inflexible hegemony of thinking, and (4) use of opportunity to promote other ideas.

De Bono (1967) also suggested that "Lateral thinking seems associated with the Gestalt theory of Wertheimer and is applicable to the concept of creativity" (p.18). Wertheimer (2013) asserted that the problem cannot be dissected into parts to be analyzed in isolation. Rather, the problem should be addressed as a whole, including in the context of its environment. As argued by Wertheimer (2013):

> The whole is not a sum of its parts, or more than the sum of its parts, but something entirely different. It is not determined by its parts. Rather, it determines each of its parts and the nature of each of those parts. (p. 114)

It appears what Wertheimer referred to was the concept of *insight*. Wertheimer (2013) discovered that one who attains insight understands the complete situation in a new way, a way which includes understanding of logical relationships or perceptions of the connections between means and ends.

Adult Learning Theory

The theory of andragogy was developed by Knowles (1973) into a theory of adult learning. Andragogy describes the education of adults. It emphasizes that instruction for adults must concentrate more on the process and less on the content being taught (Knowles, 1980). Knowles (1973) asserted that adults require certain conditions to learn. Knowles (1973) also

contended that andragogy is based on five essential assumptions about the features of adults: (1) Adults need to know why they need to learn something, (2) adults need to learn experientially, (3) adults approach learning as problem-solving, (4) adults learn best when the topic is of immediate value, and (5) as a person matures, motivation to learn comes from within the learner (Knowles, 1984, p 34).

Collaborative, Solutions-Based, Team Learning Theory

Team learning theory benefits from elements of organizational learning theory much in the inverse manner of amassing theories of individual learning theory. The value of team or collaborative shared learning is the enhanced capacity for problem solving as a result of access to diverse, interdisciplinary expertise. In their book entitled *The Case for Inter-professional Collaboration*, Meads and Ashcroft (2005) described "Collaboration is a word increasingly used widely as an alternative to partnership or joint working … defined as a process of conscious interaction between the parties to achieve a common goal" (p. 19). Hargadon and Bechky (2006) offered a collective creativity paradigm that explained how problem solving is initiated with the individual problem solver and transitions to group interaction. Their findings suggested that while occasional solutions may very well come about from individual insight, most are the result of collaborative efforts.

A prerequisite for team learning is the latitude to engage in open dialogue. Senge (2006), in his book, *The Fifth Discipline*, described what he called a learning organization. Learning organizations are groups whose members continuously collaborate to create the product they wish to see (Beckman & Barry, 2007). Consistent with Senge's learning organization description, teams function on the premise that the team is the most important unit in the organization (Huffman & Jacobson, 2003). Team members should be aware the team is

comprised of "multiple viewpoints, multiple value systems, multiple ways of operating, multiple assessments of responsibility and authority, and the like" (Feltovich, Hoffman, Woods, & Roesler, 2004, p. 92).

Loop Learning Theory

Loop learning is aimed at creating an adaption in understanding one's context or point of view (Argyris, 1993). Loop learning compels learning organizations (Senge, 2006) to understand the relationship between problems and solutions. Loop learning also forces the learning organization to understand how previous actions led to the current condition and is the instrument learning organizations use to enable them to ascertain and assess organizational theories of action (Argyris & Schön, 1995). Argyris and Schön (1995) described two forms of organizational learning**,** whereby learning represents the discovery and resolution of error. When the error discovered and resolved allows the organization to continue and achieve its current objectives, that error-and-resolution method is *single-loop* learning. *Double-loop* learning occurs when error is discovered and resolved in such a manner that requires the organization to change to its fundamental standards, policies, and objectives (Argyris & Schön, 1995). Argyris and Schön (1995) suggested most organizations participate in single loop learning whereby outcomes are pursued and objectives associated with desired outcomes. Double loop learning requires organizations to focus on desired outcomes, but moreover is accountable for double-checking whether the outcomes themselves should be desired.

Design Thinking; a Synthesis of Theories

Research conducted by Lawson (2006) suggests that scientists problem-solve by analysis, whereas designers solve problems by synthesis. Design thinking, then, can be thought of as a synthesis of many theories. Kolko (2010) described this synthesis as an "abductive,

sensemaking process of manipulating, organizing, pruning, and filtering data in the context of a design problem, in an effort to produce information and knowledge" (p. 3). Kolko (2010) offered a technique for giving structure to the synthesis process: "Reframing, concept mapping, and insight combination—emphasizes prioritizing, judging, and forging connections. These qualities are derived directly from the logical processes of abduction and the cognitive psychology theory of sensemaking" (p. 10). Brown and Wyatt (2010) explained design thinking as a methodology to problem solving that aids interdisciplinary team members to create a "vibrant interaction environment that promotes iterative learning cycles driven by rapid conceptual prototyping" (Leifer & Steinert, 2011, p. 151).

The literature review led to developing a theoretical framework for this study illustrated in Figure 1, located at the beginning of this literature review. Design thinking is the integration of several theories that suggest the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners. The review of the literature presented a variety of theories for this phenomenon; all have the same goal in mind, which is to close the problem-framing gap in problem solving, especially in the area of complex problems. The literature review focused on the challenges, processes and methodologies of solving complex, ill-structured problems. It explored approaches of military planners which encourage thought, innovation, and reactivity as well as the importance of design thinking to provide sufficient details for successful military operation planning. The literature examined various learning theories and how design thinking brings planning (theory) into action (practice).

Opposing View

Enthusiasm for design thinking is not without critics. Some critics dismiss design thinking as a fad due to a weak theoretical foundation (Johansson Sköldberg, Woodilla, &

Cetinkaya, 2013; Jahnke, 2009, 2013; Rylander, 2009). A review of the literature revealed a number of prominent writers in military studies who have voiced concern with the concept of design thinking. Aside from a number of authors who expressed disappointment with design thinking because it lacked an "actual, repeatable process" (Newman, 2011, p. 44), the most vocal opposition comes from Vego (2009) who dismissed design thinking when he asserted, "This new concept rests on dubious theoretical foundations" (p. 69). Vego (2009) accused advocates of design thinking with presenting a variety of often contradictory definitions. Additionally, he argued that while design thinking is described as a cognitive activity derived from "the creative vision, experience, intuition, and judgment of commanders to provide relevant work for the development of detailed operational plans" others argue that design thinking is a "precursor to operational planning and at other times that it is not" (Vego, 2009, p. 69). Moreover, Vego (2009) criticized proponents of design thinking as those pursuing an endeavor to "rationalize complexity through systemic logic…[with] a method that uses critical learning of a shared appreciation of systemic logic to form hypotheses relevant to unique and highly complex situations that evade easy or commonsense solutions" (Vego, 2009, p. 69).

Vego (2009) proceeded to claim, "Empirical evidence of successful application of … design [thinking]…simply does not exist" (Vego, 2009, p. 75). What is more, he charges that design thinking predestined failure of the Israeli Self Defense Force in the conflict with Lebanon in 2006. Vego (2009) cited credible witnesses in that conflict as having extreme difficulty with the novel lexicon and methodology and who questioned whether those in leadership positions could understand the concept and underlying theories of design thinking. This sentiment was aptly expressed by one leader who said design thinking "was not easy to understand . . . because [it is] not intended for ordinary mortals…and that officers found the entire concept elitist" (p.

75).

Not so much critics of design thinking, Elkus and Burke (2010) presented some reservations with the concept and discussed its shortcomings and associated risks. They acknowledged design thinking endeavors to "spread mental flexibility for the conception of operational frameworks," but is "difficult to necessarily institutionalize such qualities, especially within large industrial bureaucracies" (p. 15). They noted this problem "must be addressed through training, personnel policies, and organizational planning" (p. 16). They further cautioned that there are "substantial risks in the adoption of design that must be addressed" (p. 1). That being so, should design thinking resort to "a checklist approach rather than an iterative approach then it will fail its predicted purpose" (p. 16).

Elkus and Burke (2010) also pointed to the limits of design thinking at lower levels in the military. Since plans are promulgated from higher levels down to those who will ultimately execute them, the vague lexicon of design thinking increases the likelihood for misunderstanding tasks and purposes. Like Vego (2009), Elkus and Burke (2010) used the Israeli Self Defense Force challenges during the conflict with Lebanon in 2006 with "the vague language inherent in Israeli doctrine [design thinking] and plans led to ambiguous and unclear orders" (p. 16). The officer in charge of Israel's Central Command during this conflict was Major General Yair Naveh (2007) who said, "military planners are confined to the shackles of inferiority determined by institutional paradigm, doctrine, and jargon…[they] are cognitively prevented, by the very convenience of institutional interiority…because the shackles of ritual hold them in place" (p. 72). Elkus and Burke (2010) also questiond the level within the military structure at which design thinking is applicable, and asserted it applied at the highest, strategic level. In the end, Elkus and Burke (2010) welcomed design thinking with the caveat that the concept only dealt

with one component of a larger complex problem and suggested the intention of implementing strategic objectives is insufficient "to merely visualize the problem more creatively … that design thinking needs to be more firmly linked to the politics that determine the war's aim" (p. 19).

Whereas Elkus and Burke (2010) cautioned about shortcomings and risks with design thinking, Martin (2012) insisted the current paradigms in the military are "incompatible with the concept" and are "dead on arrival" (p. 4). He declared design is a way of thinking based on the premise that in uncertain situations some other epistemology is required; one that permits various theories to arise in any given situation. According to Martin (2012), "the military is stuck on attempting to force design [thinking] principles into our current epistemology, a wholly impossible mission" (p. 1).

Martin (2012) posited the military must: (1) be an establishment that rewards results, requires institutional integrity and accepts failure, providing it is constantly learning. He stipulated that because the military is highly bureaucratic, hierarchical, regimented and doctrinal, design thinking is destined to fail; (2) be expected to challenge paradigms; and (3) foster a learning environment (p. 4). In addition to these, Martin (2012) referred to disciplines that Peter Senge (2006) introduced in *The Fifth Discipline* along with the work of Argyris (1993) regarding double-loop learning organizations and added a fourth: learn from experience. He concluded that the military is actually established as anti-design [thinking] and contended "any cause for confusion with design thinking is not because, as many suggest, the concept is obscure, rather design thinking is inherently incompatible with the military establishment" (p. 4). He claimed the organization must evolve from a positivist philosophy pervasive in its doctrine, training, leadership, and education.

Conceptual Model

While acknowledging critics of design thinking, what follows connects the current study to the previously discussed theoretical framework. Conceptual models, also referred to as maps, working assumptions, and at other times conceptual frameworks are used in qualitative research to connect all the relevant information and concepts that can guide action or research (Bertrand, 2006; Dyer, Penny, Haase-Wittler, & Washburn, 2012). According to Cañas, Novak, and González (2004), "Conceptual models assist researchers to link the theoretical framework of the research to the actual research" (p. 1). Similarly, Weaver-Hart (1988) viewed a conceptual model as, "A structure for organizing and supporting ideas; a mechanism for systematically arranging abstractions; sometimes revolutionary or original, and usually rigid" (p. 11). Two types of models commonly used in research are statistical or mathematic models and schematic models (or conceptual maps) (Castro-Palaganas, 2011). Novak and Gowin (1984) explained further that a conceptual model is "a schematic device for representing a set of concept meanings embedded in a framework of propositions" (p. 15).

Conceptual models are important in qualitative inquiry because they serve to provide focus and allow the researcher to see participants' meanings as well as the connections that participants discuss across concepts or bodies of knowledge (Cañas, Novak, & González, 2004). Conceptual models are also useful to researchers because they use symbolic representations of phenomena or conceptual schemes resulting in minimal numbers of words, which tend to be ambiguous, in representing reality (Castro-Palaganas, 2011). According to Bryman (1988), conceptual models link concepts and heuristic methods by providing a set of general indicators for researchers.

Although the conceptual model may become progressively more defined during the

study, “it does not become reified such that it loses contact with the real world” (Bryman, 2012, p. 68). The below illustration, Figure 2, is considered a working conceptual model. Bertrand (2006) defined a working model as “a preliminary formulation of a theory or program that is used as an initial guide for thought or action” (p. 49).

Conducting military operations is intrinsically complex, exacerbated by the evolving characteristics of the operating environment which makes understanding the problem and possible solutions a challenge. Traditional detailed planning processes assume military planners understand the problem and possess the wherewithal and experience required (Heaney, 2013) to solve it. This will not always be the case. History has shown that some problems are so unique and complex, resulting in decision makers’ inability to understand. Design thinking is a cognitive process, rooted in experience, intuition, and training (U. S. Army, 2012), which provide decision makers and planners “the intellectual breathing space” (Grigsby, 2011, p. 31) for designing, planning, and executing operations. Therefore, the object of design thinking is to produce a shared understanding of a complex problem before proceeding to use the linear planning process (Banach, 2009; Bell, 2010; Elkus & Burke, 2010; Heaney, 2013)

The Chairman of the Joint Chiefs of Staff (2011) as well as the U. S. Army (2012) and the U. S. Marine Corps (2010) describe planning as a process that is divided into two components: conceptual and detailed. *Marine Corps Doctrine Publication (MCDP) 5, Planning* (2010) defined conceptual planning as “establish[ing] aims, objectives, and intentions and involves developing broad concepts for action” (p. 35). When the problem fails to conform to established patterns, or is beyond the decision maker’s experience, the decision maker is at a disadvantage and typically reverts to planning from habit and heuristics rather than a deep understanding of the problem (Heaney, 2013; Schmitt, 2010). Design thinking, thus, is a

methodology that can help overcome this predicament.

There is no one conclusive paradigm for design thinking. Hekkert and van Dijk (2011) offered a process for industrial design grounded in moving between deconstruction and reconstruction. Brown (2008) presented an iterative process with three interconnected phases (inspiration, ideation, and implementation) which can later be described by smaller-scale steps and reflective questions. Aspelund (2006) presented a seven-step sequential model that separates design thinking from production matters. Another model of design thinking offered by Kembel (2009) is a five-step cyclical representation made up of empathy, problem definition, ideation, prototyping, and testing. Similarly, Fierst, Diefenthaler, and Diefenthaler (2011) explained a five-step process wherein iteration is referred to as the last phase, evolution. A phenomenological viewpoint is taken with Poulsen and Thøgersen (2011) in their study that offered a three-phase design thinking process involving focus, reflection, and reframing. This process model strengthens the sense that problem framing is imperative to design thinking (Dorst, 2011).

Fundamentally, the methodology of design thinking entails open dialogue among the decision maker and military planners. Analyzing guidance from higher headquarters and intelligence reports, the decision maker and planning team begin discourse about characteristics of the operational environment and the nature of the problem(s) to be confronted. The tools needed for conceptual planning are not prescriptive but are purposefully "free form" (Grigsby, 2011, p. 31). The lack of a prescriptive process is purposely meant to encourage critical and creative thought without definitive boundaries in determining "what to do and why" (Heaney, 2013).

The integration of conceptual and detailed planning throughout the planning process is

critical to effective planning (Dorst, 2011; Heaney, 2013; Paparone, 2012). Figure 2 (Mangold, 2011, p. 3), illustrates a methodology of how design thinking can be integrated into a linear problem-solving process, serves as an anchor for the study, and illustrates a holistic perspective of the integration of design thinking into the linear planning process. The model shows a linkage between conceptual and detailed planning, thus underscoring that conceptual and detailed planning components are present during all planning evolutions. In addition, the model addresses the impact of complexity and the commander's experience in solving similar problems. Heaney (2013) wrote, "Complexity and familiarity regulate the relationship between conceptual and detailed planning and affect the way planners work through the planning process" (p.3).

The conceptual framework of design thinking is built from four elements: understanding of the strategic direction; understanding the operating environment; defining the problem, and; developing an operational approach. The problem is that while the current linear planning process provides a way to conduct detailed planning to confront simple and well-defined problems, it is found lacking in solving complex, unfamiliar, and ill-defined problems (Dorst, 2011; Heaney, 2013; Paparone, 2012).

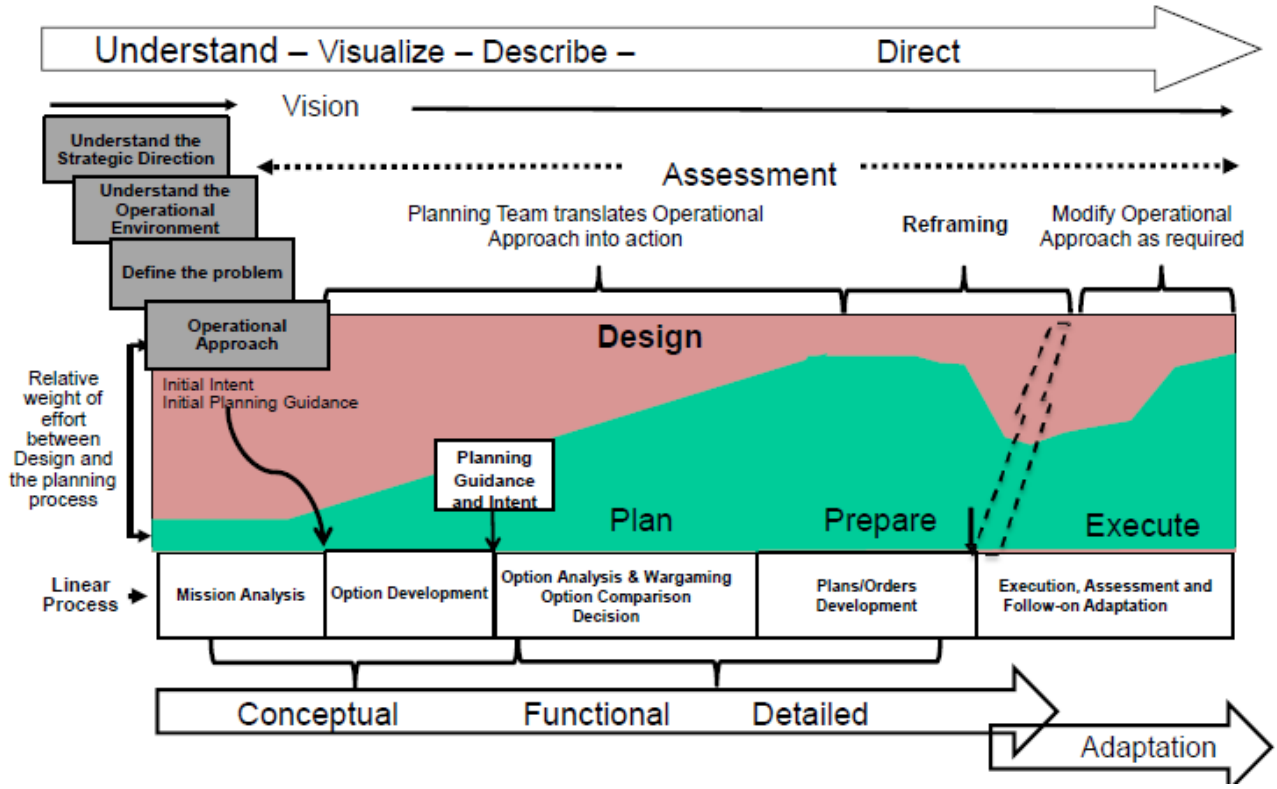

Figure 2. Conceptual Model: Integrating design thinking with the planning process (Mangold, 2011; Rudesheim, 2011)

Design methodology can help decision makers better understand the operating environment and provide ways to discern the true nature of the problem to be solved. Only then can decision makers provide the planning guidance required to develop feasible approaches to complex, unfamiliar problems. A unique perspective in considering the utility of design thinking is to view it "permeating the problem-solving process and serves as the foundation for operational command and control, providing considerable perspective that heightens the commander's understanding and visualization" (Mangold, 2013c, p. 2). If addressed effectively, the execution of operations will lead to mission accomplishment with the least expenditure of resources.

According to Army doctrine (2012), "Effective planning employs both conceptual and detailed planning. The focus of conceptual planning is *problem setting* while the focus of

detailed planning is *problem solving"* (p. 6). The interface between conceptual and detailed planning is subtle and even underappreciated when the problem is well understood (Heaney, 2013, p. 3). When a problem is simple and defined, planners can quickly and instinctively employ heuristics in conceptual problem solving in order to ascertain and propose solutions. However, when faced with complex, unfamiliar problems, like those during Operations Odyssey Dawn (Libya 2011) and Tomodachi (Japan 2011), and more recently combating Islamic State of Iraq and the Levant, decision makers and their staffs should take the time to consciously apply the conceptual planning methodology known as design thinking to assist in better understanding of the operating environment and discern the essence of the problem to be solved (Dorst, 2011; Heaney, 2013; Paparone, 2012).

Military doctrine uses slightly different language among branches of the military regarding design thinking. Yet, all the services agree that the object of design thinking is to identify the underlying problem in complex, unfamiliar situations (Chairman, 2011). An examination of design thinking language from joint and military service doctrine divides design thinking into four related cognitive activities (U. S. Army, 2012; Heaney, 2013) and adds a fifth activity: Reframing:

1. Understanding the strategic direction,
2. Understanding the operating environment,
3. Defining the problem,
4. Establishing an operational approach, and
5. Reframing.

When employed together, they lead to an actionable operational approach that provides guidance for detailed planning and execution (Eikmeier, 2010).

Understand Strategic Direction

At the outset of conceptual planning, the starting point is to consider the overarching strategic and operational direction. Understanding the strategic and operational direction is insight "can be gleaned from an analysis of all available guidance to include written directives, oral instructions from higher headquarters, security cooperation guidance, and higher headquarters orders or estimates" (Chairman, 2011, pp. III-7). Analysis of the strategic direction should yield a deeper understanding of the desired strategic and military end states.

Understand Operating Environment

Joint Publication (JP) 5-0, *Joint Operation Planning*, defined the operating environment as "the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander" (Chairman, 2011, p. III-8). Discourse begins among the decision maker and planners to assimilate the multiplicity of factors to form a holistic picture of the interactively complex environment (Perez, 2011). Understanding the operating environment should result in a newly developed appreciation for the actors, relationships, challenges, tensions, competitions, and opportunities which, when identified, may be acted upon to create the desired effect (Heaney, 2013). Freidman (2000) explained the "Big Idea" in *The Lexus and the Olive Tree*: "if you can't see the world, and you can't see the interactions that are shaping the world, you surely cannot strategize about the world" (p. 232). The current state of the affairs in the operational environment and how the environment should look when operations conclude must be articulated before an approach to solving the problem can be visualized (Mangold, 2013a).

Define Problem

Essential to problem solving is defining the problem (Chairman, 2011). Although it might seem simple, the purpose of design thinking is to effectively ascertain the nature and cause of complex, ill-defined problems. The understanding gleaned renders the problem less complex and may guide planners to a resolution of those features in the current environment that heretofore impeded achieving the desired end state (Chairman, 2011). Per Army doctrine (2012) "A concise problem statement clearly defines the problem or problem set to be solved" (p. 3). At this point, design thinking helps to lead to plans which can achieve the desired end state.

Develop Operational Approach

The operational approach is a description of the decision maker's visualization of the broad actions that must be taken explaining how the operation will transform current conditions into the desired conditions at its conclusion (Chairman, 2011; Heaney, 2013; Mangold, 2013b). The operational approach can be found as a "consistent theme in recent military theory and doctrine … an emphasis on the visualization of the problem prior to (and concurrent with) planning" (Elkus & Burke, 2010, p. 1). As indicated earlier, conducting an in-depth analysis of the operating environment and the nature of the problem assists in identifying what must be affected to transform the current situation to the sought-after end state (Eikmeier, 2010). According to Paparone (2001),

> Visualization, a related concept to heuristics, is a decision-maker's ability to picture what lies ahead. Good decision makers, like good chess players, think downward to envision second- and third-order effects of decisions and develop branches and sequels to current or planned operations. (p. 49)

Understanding the operating environment and nature of the problem enhances the ability to

visualize and conceive how the problem can be resolved. Once the operational approach is decided upon, planners can begin using the planning process in a linear manner. The decision maker and staff should "continually review, update, and modify the approach as the operational environment, end states, or the problem change" (Mangold, 2013c, p. 2).

Key documents are produced by the planners as a result of using the design thinking methodology. Heaney (2013) proposed that documents consist of: (a) fundamental features of the operating environment; (b) disparity concerning current and desired end state conditions; (c) a clear and succinct problem statement, application of the concept(s) of lines of operation or effort to explain operational approach; and (d) initial intent and planning guidance to be used by planners to proceed with detailed planning (Eikmeier, 2010). The result of effectively using the design thinking methodology is the operational approach as it synthesizes all the discussions, narratives, and models into concise summation for planning (Banach & Ryan, 2009; Heaney, 2013; Zweibelson, 2011).

Reframe

The enduring aspect of design thinking is reframing, which is defined as "a continuous process of refining and assessing the deductions and decisions made from the application of design methodology during conceptual planning, through detailed planning and execution" (U. S. Army, 2012, p. 12). Paton and Dorst (2011) articulated how framing can be grasped as a kind of abductive reasoning since it entails developing hypotheses that explain circumstances surrounding the study.

The cognitive activity of reframing when using the design thinking methodology is intended for planners to reexamine decisions previously made throughout conceptual planning, during detailed planning and again in execution, because when analyzing complex, unfamiliar

problems this keeps conceptual planning from going into an endless planning loop for fear of missing critical information (Heaney, 2013). An essential component of periodically reframing the problem over time is to recognize that the features of the operating environment are continuously changing and are likely to adapt in complex, ill-defined problems (Mangold, 2013c; Paparone, 2012; Rutledge, 2009). As a result, Heaney, (2013) aptly pointed out that "reframing's recurring nature acknowledges that decision makers cannot afford to think endlessly about the problem, quoting Voltaire, (1772) in *La Bequeule, Conte Moral*, that in conceptual planning, 'the better is the enemy of the good'" (p. 2).

Summary

A synthesis of the literature indicates that material regarding design thinking is not new. The volume has, in fact, grown in the last decade, particularly regarding business and organizational development. Much of the material focuses on design thinking as a means to close the problem-framing gap in problem solving, especially in complex problems. Exhaustive critical research reveals that the literature remains at the theoretical level with prolific discussion of the esoteric lexicon. What is absent is research advancing the subject of design thinking from theory to practice.

Source for Theoretical Framework

Although some critics may dismiss design thinking due to a weak theoretical foundation (Johansson Sköldberg et al., 2013; Jahnke, 2009, 2013; Rylander, 2009), the source for building a theoretical framework of design thinking was the literature review. The framework is grounded in theory from many elements of various theories such as bounded rationality, complexity, systems, and planning theories. The review of the literature addressed each of these theories separately and concluded with a synthesis of the various theories, thereby introducing

design thinking. Finally, a conceptual framework was presented that illustrated a methodology of how design thinking can be integrated into a linear problem-solving process.

The literature review focused on the challenges, processes, and methodologies of solving complex, ill-structured problems. It explored approaches of military planners, which encourage thought, innovation and creativity as well as the importance of design thinking to provide sufficient guidelines for successful military operation planning. Additionally, the material examined the variety of theories of how design thinking could advance planning (theory) into action (practice). Critical examination also found several theories that would suggest the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners. Finally, the review presented a variety of theories for this phenomenon; yet, all have the same goal in mind, which is to close the problem-framing gap in problem solving, especially in complex problems.

Gap in the Research

Discovered through the research, material regarding design thinking is abundant, but remains at the theoretical level. There has been no research of advancing the subject of design from theory to practice using collaborative, team-based learning to achieve organizational learning to solve complex problems. Where material regarding practical application is available, it is anecdotal and based on historical examples to demonstrate how design thinking *could* have been applied in a particular circumstance. No literature explores the intrinsic value of a design-thinking-led problem-solving education. Therefore, this study addressed this gap and adds to the body of knowledge concerning the value of design thinking education.

Significance of the Study

The significance of the study is that it may have a positive influence on the military

leadership community by providing insight on how important it is to target the right problems to solve and develop viable options to address those problems. Findings from this study may also have an impact on other areas of the military such as doctrine, leadership, organization, and education and training. Moreover, because solving complex, ill-structured problems is not limited to the military, other organizational entities could benefit from an improved problem solving process. A comprehensive problem-solving process could be applicable to the whole-of-nation whereby the ultimate objective is for all U.S. government agencies to plan and conduct operations from a shared perspective (Gockel, 2008). These arenas encompass government and public policy, education, health care, and socio-economic matters, and so on (Burnham, 2009). Similarly, Hobday et al. (2012) asserted that "Design thinking goes beyond the technical and business domain to broader social, policy, and economic applications. Its main contribution is to offer new opportunities for problem solving and solution generation through a collective social approach to wicked problems" (p. 28).

The previous material has been a comprehensive review of the literature relevant to the study of design thinking and presented the rationale for the problem pertinent to this study, while demonstrating the need for additional research. This review expanded upon the introduction and background information offered in Chapter One. This chapter contains theories relevant to design thinking, a brief overview of the problem, and contemporary discourse relevant to design thinking.

Chapter Three discusses the methodology used to advance the literature from the theoretical to practical application. There the case study answers one primary research question and four sub-questions: (a) How can military planners better address complex, ill-structured problems?; (b) What methods do military planners use to confront complex, ill-structured

problems?; (c) How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning?; and (d) How can the current problem solving process be improved?

CHAPTER THREE: METHODOLOGY

Introduction

This research explored a novel approach to military transformation, a prototype of more than just another problem-solving process, but one that offers a methodology that recognizes the reality of the current and future operational environment. The operational environment is characterized by uncertainty and complexity. This study observed military student-planners' experience with design thinking and how they integrated that methodology into the existing planning process. The study focused specifically on the people, processes, and products that make up that experience. This chapter describes the methods that were implemented to accomplish this purpose, to include a description of the design, setting, case, participant-selection procedures, my role as the researcher, data collection and analysis procedural actions that were taken to increase trustworthiness. Methods to ensure all participants were treated in an ethical manner are also addressed. Findings from this study suggest an improved problem-solving process to inform military educational leaders and practitioners.

Research Design

This chapter presents this study's "strategies . . . [and] flexibility of design" (Marshall & Rossman, 2010, p. 51) in its methodology. It examines a practical theoretical research tradition, explains the rationale for the research design followed by the dissertation's approach. Overall, this chapter offers an approach for conducting a qualitative case study for exploration into intrinsic value of the phenomenon of design-thinking-led problem-solving education for collaborative learning of a team of military student-planners. I reveal that approach with participant data in Chapter Four.

Merriam (2009) defined research methods as "a systematic process by which we know

more about something than we did before engaging in the process" (p. 5). Creswell (1998) noted that "Biography, phenomenology, grounded theory, ethnography, and case study" methods comprise the qualitative research tradition (p. 65). A qualitative study was selected for this study because I was interested in "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 14). Said another way, Ary (2006) posited that a qualitative study should be chosen when the study seeks to understand human and social behavior not from the outsider's view, but from the insider's view, specifically, as it is lived by participants in a particular social setting.

A case study method was used in this research with the case defined as an interdisciplinary team of military student-planners. The case-study methodology is defined as a methodology, or research design (Bassey, 1999; Feagin, Orum, & Sjoberg, 1991; Merriam, 1998; Yin, 2009). According to VanWynsberghe and Khan (2007), the case study method is a "transparadigmatic and transdisciplinary heuristic that involves the careful delineation of the phenomena for which evidence is being collected, meaning the case study is appropriate irrespective of the researcher's paradigm or disciplinary emphasis" (p. 1).

The case study method to research has been examined at length by three leading researchers, specifically, Yin (2009), Merriam (1998, 1999, 2009), and Stake (1995, 2008). The viewpoints of these renowned writers are in harmony concerning the essence of case study. It is their philosophical points of view that distinguish them. Rolfe (2006) stated "the quantitative-qualitative dichotomy is in fact a continuum" (p. 304). If this is so, I place Yin on the right and Stake on the left with Merriam positioned in the middle of the continuum. Yin appears decidedly methodical and logical, as contrasted by Stake who creates meaning; whereas Merriam evokes a balanced, practical technique.

Because my interests lie in the area of leadership in higher education, I was predisposed toward the writing of Sharan Merriam due to her practical research in applying the case study strategy in education. I also used the work of Robert Yin as a source due to his experience as a consultant in policy exploration as well as his methodical approach to research. Lastly, I relied on the work of Robert Stake because his research interests in the complexity and personal experience in the phenomenon regarding program evaluation and because of his belief that case study is very much an interpretive endeavor.

Yin (2009) likened the case study design to telling a story concerning something distinctive or thought-provoking, and noted that these stories can be about individuals, organizations, processes, programs, neighborhoods, institutions, and even events. According to Yin (2009), the case study method permits the researcher to conduct studies from simple involvement to more complex interventions and provides for the deconstruction and the subsequent reconstruction of various phenomena. Given the nature of the phenomenon and the case, this is an appropriate approach to the current study because, in addition to what is being studied (i.e., the case), case study research encompasses the logic of the research design, the data collection techniques, and the approach taken toward data analysis as it occurs in a real-life context (Yin, 2009).

According to Stake, the case study design was also chosen because "case-study knowledge resonates with our own experience because it is more vivid, concrete, and sensory than abstract" (as cited in Merriam, 2009, p. 44). This research is well-suited for the case study approach because, according to Yin (2009), a case-study design should be applied when the emphasis of the study is to undertake "how" and "why" questions, and when the researcher cannot control activities of participants as well as when the researcher desires to reveal

contextual conditions because they are understood to be of interest to the phenomenon under study, or boundaries are not clear between the phenomenon and context.

It should be noted that this study might also be characterized as phenomenological due to its emphasis upon interpretation of meaning from the perspective of the humans and their interactions under study (Merriam, 2002; Stake, 1995). Merriam (1998) specified that case-study design "is employed to gain an in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation." (p.19) Since the focus of this study was on the methodology employed by an interdisciplinary team of military student-planners in the context of using design thinking to solve complex, ill-defined problems, case study was an excellent research design.

The case study option is also well-suited to this study because, according to Creswell (2013), "Case study research is a qualitative approach in which the investigator explores a real-life, contemporary bounded system … over time, through detailed, in-depth data collection" (p. 97) and "seeks to provide an in-depth understanding of the case" (p. 100). The current case in this study is a bounded system (Stake, 1995; Merriam, 1998) with a limited context (an interdisciplinary team of military student-planners). Yin (2009) defined this bounded, descriptive, clinical method of investigation as a research tool that can "represent a significant contribution to knowledge and theory building" and that "such a study can even help to refocus future investigations in an entire field" (p. 47). The boundaries in this case were limited to a single group of student-planners at a military service college.

There are various types of case studies. Yin (2003) categorized three types based on the purpose and potential implications of the research: exploratory, explanatory and descriptive.

What Leedy (1997) referred to as evaluative, Yin (2003) named as an exploratory case study. Exploratory case studies are undertaken to define questions and propositions for follow-on studies. Whereas explanatory case studies are conducted in order to present information showing causal relationships, descriptive case studies are performed to provide a comprehensive description of a phenomenon. This may be considered an exploratory (or evaluative) case study because it searched for trends in the data and designed a model to understand this data.

Stake (1995, 2006) further made a distinction between instrumental and intrinsic case studies, with the former a study in which the case is used to study a larger topic and the latter being a study in which the case itself is the focus. The type of case study chosen can be considered an instrumental case study because an instrumental case study best supports the purpose of the study, which is to explore the value of the phenomenon of design-thinking-led problem-solving education for collaborative learning of military student-planners within its natural setting. According to Stake (1995), an instrumental case study is used to gain insight into a particular phenomenon wherever an explicit expectation exists that learning can be used to generalize or to develop theory. In this single case study, there is a theory that is being explored and experienced.

Yin (2003) then classified six variants of structure by which case studies may be classified (p. 138). These are linear analysis, comparative, chronological, theory-building, suspense and un-sequenced. This report may be characterized as having the theory-building structure. This variant of a case study structure is appropriate because each section of the report that follows explains a different element of the design theory being exhibited. Furthermore, Eisenhardt (1989), asserted this type and variant of case study is,

Particularly well suited to new research areas or research areas for which existing theory

> seems inadequate. This type of work is highly complementary to incremental theory building from normal science research. The former is useful in early stages of research on a topic or when a fresh perspective is needed, while the latter is useful in later stages of knowledge. (pp. 548-549)

Yin (2003) also described case studies as either embedded or holistic studies based on the unit(s) of analysis. Whereas holistic studies research the case as one single unit, embedded studies isolate multiple sub-units. Consequently, this is a holistic study with only one unit of analysis that focuses exclusively on the intrinsic value of design thinking within an interdisciplinary team composed of military student-planners.

Regarding a researcher's philosophical approach to research, Bryman (2012) contended that all methodology is grounded upon some philosophical point of view or theoretical conception. Bryman (2012) referred to a paradigm as "a cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done, how results should be interpreted" (p. 630). Bogdan and Biklen (2007) defined paradigm as "a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research" (p. 22). According to Bogdan and Biklen (2007), Mackenzie and Knipe (2006), and Mertens (2005), the paradigm influences the way knowledge is studied and interpreted. The selection of paradigm establishes the purpose, method, end state, motivation and expectations for the research. Otherwise, there is no basis for later choices regarding methodology, methods, literature or research design (Mackenzie & Knipe, 2006).

Lincoln and Guba (1985) distinguished three major paradigms: positivism, post-positivism, and constructivism. Critical theory and participatory paradigms were later added. Like both Yin (2003) and Stake (1995), I approached the case study from a constructivist-

interpretive paradigm and applied descriptive interpretation and thematic clustering from the participants' commentary and analysis of the data to synthesize corresponding patterns (Stake, 1995). The constructivist paradigm has origins in Vygotsky's social-constructivism whereby an individual's beliefs and reality are constructed based on his or her own world experiences (Vygotsky, 1986). Constructivists assert that truth is relative and that reality depends on one's perspective. The constructivist "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity" (Miller & Crabtree, 1999, p. 10). The constructivist approach to research pursues the objective of "understanding the world of human experience" (Cohen & Manion, 1994, p. 36), proposing "reality is socially constructed" (Mertens, 2005, p. 12); whereas, "pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object" (Baxter & Jack, 2008, p. 545). As a constructivist, I appreciate there are multiple realities through which one makes sense of the world. Because my view of reality is from my collective experiences, the experience of this research was an evolution of understanding, which used an interpretive unbiased view while setting aside my own preconceptions and prejudgments to uncover the essence of the researched case phenomenon (Creswell, 2007; Stake, 1985; Yin, 2003, 2009).

Propositions

Yin (2003) suggested propositions are helpful because they can assist in guiding a case, thereby heightening expectations the researcher can limit the scope of the study and increase the likelihood of completing the endeavor. Yin (2003) posited that propositions may be derived from the literature, experience, theories, and generalizations where the case study is intended to "confirm, challenge, or extend the theory" (p 40). Yin (2003) also suggested propositions are essential elements in case study research because they bring about the development of a

conceptual framework that will guide the research.

What Yin (2003) called propositions, Stake (1995) referred to as issues. According to Stake (1995), "issues are not simple and clean, but intricately wired to political, social, historical, and especially personal contexts . . . important in studying cases" (p. 17). The propositions/issues that guided this research are:

1. Without a design-led educational experience, military planners have difficulty in understanding the strategic direction in confronting complex, ill-structured problems.
2. Without a design-led educational experience, military planners have difficulty in understanding the operating environment in confronting complex, ill-structured problems.
3. Without a design-led educational experience, military planners have difficulty in understanding the operational approach in confronting complex, ill-structured problems.

The above propositions are derived from the literature, brought about the conceptual framework, and are intended to confirm theory.

Research Questions

According to Creswell (2007), "Qualitative researchers ask at least one central question and several sub-questions" (p. 141). Central questions are generally broad and serve as the foundation for the development of subsequent questions. Sub-questions are typically narrow and serve as a method to focus interviews, close observations, and document analysis (Creswell, 2007). The questions begin with words such as how or what and use exploratory verbs, such as explore or describe (Creswell, 2007). General questions "allow the participants to explain their ideas" (p. 141). Creswell (2007) additionally splits sub-questions into issue-oriented and

procedure-oriented sub-questions. Whereas issue-oriented sub-questions are theoretical and designed to separate the central question into subtopics and issues, procedure-oriented sub-questions are process-related and meet my requirement for information relative to the intent of the research (Creswell, 2007). Purposeful studies establish a snapshot of the case described in the voice of the participants from open-ended questions and revealed by the data from the case (Rockinson-Szapkiw, Spaulding, & Yocum, 2012). Carlgren (2013) also indicated the importance of a priori specification or definition of the research questions, yet they should be regarded as tentative. The advice of Carlgren (2013) followed that of Halvorsen (1992) who advocated initial research questions are not required to be exceedingly specific given that the objective is to expound a holistic and insightful interpretation. In the present case, I begin with a broad inquiry, then develop themes and refine research questions as insights emerge. Accordingly, the central research question, issue and procedure-oriented sub-questions highlighted below guided the study.

Central Question

How can military planners be better prepared to solve complex, ill-structured problems through design thinking?

This primary question was central to the research study, as the answer offers the potential to inform military educators how they can provide relevant and rigorous planning instruction to student-planners (Banach, 2009; Bousquet, 2009; Conklin, 2008; Di Russo, 2013; Jablonsky, 2010; Leifer & Steinert, 2011; Rutledge, 2009; Schmitt, 2010).

Issue-Oriented Sub-questions

1. How can military planners receive comprehensive planning guidance needed to address complex, ill-structured problems? The answer to this question has the potential to inform

military leaders as to how they can provide essential planning guidance and transfer knowledge to the collective planning team members (Akin, 2009; Banach, 2009; Bousquet, 2009; Conklin, 2008; Cross, 2011; Di Russo, 2013; Eikmeier, 2010; Jablonsky, 2010; Jensen, 2009; Leifer & Steinert, 2011; Rutledge, 2009; Schmitt, 2010; Zweibelson, 2011).

2. What methods do military planners currently use to confront complex, ill-structured problems? This question is important because the answer serves as a driving function to critically examine the process used by planners to solve problems (Di Russo, 2013; Dorst, 2011; Eikmeier, 2010; Jablonsky, 2010; Rutledge, 2009; Schmitt, 2010; Zweibelson, 2011).

Procedural Oriented Sub-questions

3. How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning? Understanding how and in what ways military planners collaborate is helpful in developing and delivering future professional military education (Burnham, 2009; Grigsby, 2011; Heaney, 2013; Kem, 2009; Machin, etal, 2009; Mangold, 2011, 2013c; Norton, 2012; Paparone, 2012; Scott, 2011; Teal, 2010; Tuckman, 2009).
4. How can the current problem solving process be improved? Understanding how the problem solving process can be improved is essential to curriculum (program improvement) development and discovery of effective teaching methods (Banach, 2009; Berger, 2009; Brown, 2009; Brown & Wyatt, 2010; Hart, 2010; Heaney, 2013; Kimbell, 2010, 2011; Knowles, 2011; Utting, 2009).

The above questions serve as a method to focus data collection and analysis.

Participants

Qualitative research typically utilizes purposeful sampling with variations in order to garner the most information-rich cases (Patton, 2002). Participants in the proposed study were homogeneous, selected by purposeful sampling. According to Patton (1990), purposeful sampling is popular in qualitative research and proposes 16 techniques. The homogeneous type of purposeful sampling is most appropriate in this study because I was interested in maintaining focus, reducing variation, and simplifying analysis (Patton, 2002).

Homogeneous sampling, as opposed to maximum variation sampling, entails selecting individuals, groups, and settings because they all share similar characteristics (Onwuegbuzie, Jiao, & Bostick, 2004). Participants in this study were selected due to membership in a subgroup or unit that has specific characteristics. This is appropriate because as Creswell (2003) asserted, "the idea behind qualitative research is to purposefully select participants that will help the researcher to understand the research question" (p. 185).

The 15 participants were all U.S. Navy commissioned officers, whose average age is 33 with an average of 11 years in military service. They have experienced the process and development of the theory that might help explain practice or provide a framework for future study. The limited number of participants is supported by Seidman (2006) who established two criteria for limiting the number of participants: sufficiency and saturation. Sufficiency comprises the number and characteristics of participants necessary to represent those in the population, whereas saturation indicates the juncture at which the researcher learns nothing new from data collection (Seidman, 2006). Seidman (2006) also acknowledged that five to 25 participants is appropriate.

The small number of participants did not minimize the contributions based on the key

characteristics of the case study. According to Merriam (2009), "The single most defining characteristic of case study research lies in eliminating the object of study, the case . . . a single entity, a unit around which there is boundaries" (p. 27). The case then, "could be a group or single person who is a case example of some phenomenon, a program, a group, an institution, a community, or a specific policy" (p. 40). The unit of analysis—or case—for the study consisted of a single team comprised of interdisciplinary military student-planners. This is quite appropriate because as Creswell (2013) stated, researchers develop "case studies of individuals who represent a composite picture rather than an individual picture" (p. 174). Discussed next is a brief description of the site of the study.

Site

The site is a graduate-level senior military service college located on a military base in New England. It is just one of numerous military education and training institutions collocated on the base. The total military and civilian population on the base is approximately 10,000. Total number of military students at the institution is approximately 840. Enrollment in the program under study is 15 students. The rationale for the selection of this site is that a case study seeks to understand the nature of the phenomenon in its natural setting (Creswell, 2007).

Procedures

The overall procedures for this study are influenced by a comprehensive case study method of data collection. The qualitative process of interviewing provides a practical tool to reach understanding of participants' experience of using design thinking to solve complex, ill-structured problems. Before any data collection could begin, approval from the U.S. Navy's Institutional Review Board was obtained followed by approval from the institution where the study was conducted (see Appendices A and B, respectively). Finally, permission from Liberty

University‘s Institutional Review Board was obtained (see Appendix C). Information about the study was provided prior to initial contact with participants via an email. The participants who agreed to participate in this research study signed an informed consent form (see Appendix D). Dates for interviews were determined through verbal communication with the study participants. Data collection began following receipt of the signed consent forms. Common themes and patterns began to emerge during the interviews and coding began during data collection. The data needed to be organized so that open coding could begin and the search for meaning ensued through recognition of common themes and patterns (Stake, 2008).

Personal Biography

Peshkin (1988) conveys the importance of being aware of one’s subjective nature and how this subjective nature may affect research. For that reason, being aware is better than assuming one can purge oneself from subjectivity. Eisner (1998) hypothesized that because no two people share exact life experiences, how people act and react in a situation, “and how we interpret what we see, will bear our own signature. This unique signature is not a liability but a way of providing individual insight into a situation” (p. 34). As a realist, my role required me to maintain objectivity and disclose a methodological account in a transparent manner and one that is consistent with case study methodology (Ballinger, 2006). Being cognizant of my subjective nature involves being attentive of the attributes that enriched my study along with the viewpoints I hold about professional military training, education, and planning that could distort my analysis of the data if I were otherwise unaware of them.

My personal experience comprises 20 years of active military service which began when I graduated from Temple University and was commissioned a U.S. Marine Corps officer in 1985. I was designated a joint specialty officer and had joint assignments with the U.S. Pacific

Command during which I served as Coalition Logistics Plans Officer, Chief Strategic Mobility Officer, and Chief Logistics Planner. I also served on the Deployable Joint Task Force Augmentation Cell (DJTFAC) where I was responsible for logistics plans to support crisis intervention in the western Pacific region. My other joint assignments were with Strategic Operations, Multi-National Forces-Iraq and Operations Officer for Civil-Military Operations in the U.S. Embassy, Baghdad.

I hold a Master's of Science degree in Systems and Business Management from Chapman University (1993) and a Master's of Arts degree in National Security and Strategic Studies from the Naval War College (2000). I completed Marine Corps Amphibious Warfare School and the Marine Corps Command and Staff College and later attended the Joint Forces Staff College. I am currently an Associate Professor of Maritime Operations serving as a course director at the U.S. Naval War College.

The primary instrument used for data collection in qualitative research is the researcher, commonly collecting data during direct observations or interviews (Ary, Jacobs, Razavieh, & Sorensen, 2006). Stake (1995) likened the case study researcher's chief role to that of interpreter. As the human instrument (Lincoln & Guba, 1985) in this study, I understood the importance of disclosing my personal experiences as a former U.S. Marine, military planner, educator, and educational administrator. The significance of my role as the human researcher comes from these four roles. In each of these roles, it is important to understand the epistemology supporting the study.

Epistemological assumptions based on personal experience as a Marine, military planner, educator, and educational administrator may be present. As a realist, I followed criteria espoused by Lincoln and Guba (1985) and was charged to be objective and ensure a "transparent

methodological account" (Ballinger, 2006, p. 18). As stated by Ary, Jacobs, Razavieh, and Sorensen (2006), research subjects may be influenced through actions of the researcher during the course of data collection or by their participation in the study itself. As the human collection instrument in this study, my role during individual and focus group interviews was to "listen, prompt when necessary, and encourage subjects to expand and elaborate on their recollections of experiences" (Ary et al., 2006, p. 473). It was necessary to act with skills of an effective investigator; such skills associated with valid and reliable research are essential to collecting data that support the purpose of the study (Yin, 2009). I had interview discussions recorded and arranged for an unbiased third party to review notes and journal entries to further reduce possible research bias.

Data Collection

As stated by Merriam (1998), the case study does not impose explicit methods of data collection, yet "focuses on holistic description and explanation" (p. 29). Case studies may well use multiple methods of data collection and do not depend on a single technique (Ary et al., 2006). Interviewing, observation, review of documents and artifacts, and other methods may be used (Ary et al., 2006). The absolute is that whatever procedures are used, each are concerned with a single phenomenon or entity and make every attempt to collect information that can lead to understanding the study (Ary et al., 2006). Data for this case study research were collected through the use of multiple data sources, an approach to ensure triangulation by enhancing data credibility (Patton, 2002; Stake 1995; Yin, 2009).

Data collection needs to be systematic and timeframes for completing all components of the data collection must be considered (Stake, 1995). Three data collection procedures were used in this qualitative case study: observations, interviews, and document collection (Creswell,

2007; Yin, 2009). Sources of data also originated from a review of documents such as reflection and group products as well as researcher field notes.

The interviews were convened in the student workspaces. The research questions, purpose of the study, and underlying theory drove all open-ended questions for the participants. The interview questions were firmly supported in the literature. I also audio recorded the interviews. Using these multiple forms of data collection allows for the triangulation of the data (Yin, 2009). Methods chosen provided comprehensive understanding of the effectiveness of applying design thinking as a useful approach in solving complex, ill-structured problems. I served as a human instrument and non-participant observer. Data were collected until theoretical saturation was achieved.

Interviews

One-on-one interviews were conducted in this study. Bogdan and Biklen (2007) defined an interview as, "a purposeful conversation, usually between two people but sometimes involving more, that is directed by one in order to get information from the other" (p. 103). Interviews are used to collect data on subjects' opinions, beliefs, and feelings about the circumstances in their own words (Ary et al., 2006). According to Rubin and Rubin (2005), "qualitative interviewing is a way of finding out what others feel and think about their worlds. Through qualitative interviews you can understand experiences and reconstruct events in which you did not participate" (p. 1). Seidman (2006) stated the principal method a researcher has to examine experiences of another in an educational setting is through the interview process. "Interviewing is necessary," states Merriam (2009), "because researchers cannot always observe behavior, feelings, or how people interpret the world" (p. 88). Merriam (2009) also noted that sometimes interviewing is the only way to get data. According to Seidman (2006), interviewing

"provides access to the context of people's behavior and thereby provides a way for researchers to understand the meaning of that behavior . . . [and] allows us to put behavior in context and provides access to understanding their action" (p. 10). In education, "interviewing is probably the most common form of data collection in qualitative studies" (Merriam, 2009, p. 86). This study heavily collects data from individual interviews.

Within qualitative research, the interview is sometimes referred to as a "conversation with a purpose" and is less structured than interviews conducted in quantitative research (Ary et al., 2006, p. 480). The primary justification for conducting individual interviews was to collect data that listens to the voice of military student-planners and their experience in using design thinking. According to Bogdan and Biklen (2007), qualitative interviewing serves a dual purpose of being used for both data collection and to complement observations and other means of document analysis.

Interviews are intended to gather overall concepts to serve as a comprehensive examination of these concepts with the interdisciplinary team of military student-planners as a collective unit of analysis. Interviews are used in qualitative research to further examine topics and allow the researcher to ask participants to explain their answers, give examples, and describe their experiences (Rubin & Rubin, 2005). Because design thinking is grounded in the theories of design, systems, and lateral thinking, it was essential to gain a firm understanding of the participants' assessment of the intrinsic value of design thinking.

The organization of the interview used a methodology that enabled an understanding of the participants' experience and the significance of their experience to emerge (Seidman, 2006). This approach is supported by Merriam (2009) who contends the most widespread practice of interview in qualitative inquiry is dialogue "in which one person elicits information from

another" (p. 88). Furthermore, Merriam asserts, "interviewing is the best technique to use when conducting intensive case studies of a few selected individuals" (p. 88).

Interviews took place until data saturation was reached. Saturation is described by Bogden and Biklen (2007) as "the point of data collection where the information you get becomes redundant" (p. 69). It was important to protect the identities of the participants to assure confidentiality (Stake, 1995). The review of literature was used to prepare the questions for the interviews to make certain the topic and questions were connected. Moustakas (1994) suggested that anchoring qualitative studies in literature would allow the researcher to determine what is being researched and assist in crafting interview questions.

According to Kline (2008), "The development of appropriate interview questions is crucial to obtaining credible data, especially during interviews" (p. 214). Additionally, Kline (2008) contended researchers' assumptions, biases, and limitations should be disclosed in the methodology. Accordingly, the interviews consisted of 15 questions (Table 1) which were articulated as such to collect credible data. Other interview questions addressed participant's experiences with military problem solving. Questions were reviewed by the dissertation chair and committee members. Revisions were incorporated and preliminarily tried, also known as piloted, by two recent graduates from the planning course to ensure their validity, relevancy, congruency, and clarity of instruction.

Results of pilot testing and comments were used to modify questions prior to being given to participants. Information collected from the interviews addressed all research questions. I used interviews with each of the participants in order to gather data relevant to opinions and confidence about their level of expertise in design-thinking problem solving. Necessary precautions were taken to make certain the interview questions were relevant to the study. The

organization of the interviews was open-ended. As Merriam (2009) pointed out, “less structured formats assume that individual respondents define the world in unique ways. . . This format allows the researcher to respond . . . to the emerging worldview of the respondent, and to new ideas on the topic” (p. 90).

Table 1

Standardized Open-Ended Interview Questions

Questions
1. What role does design thinking play in successful problem solving?
2. How does design thinking vary among individual planners comprising the interdisciplinary planning team?
3. To what degree does design thinking influence the planners during the problem solving process?
4. What characteristics do teams who effectively solve complex problems display?
5. How does knowledge of design thinking affect the activities of problem solving teams?
6. How does design thinking affect the subsequent development activities including concept generation, concept selection and system and detailed problem solving?
7. What is the interaction between framing and course of action selection?
8. How do problem-solving teams settle upon a suitable frame for their complex problem?
9. How does design thinking change over time (if it does) from an initial vision or proposal to a final shared view?
10. What role does iteration play in coming to a final framing?
11. How are the different frames or perspectives of individual planners exchanged within a team setting?
12. Describe any differences between doctrine, what is taught and what is experienced.
13. Describe any tools that could support problem-solving teams to better understand and apply the problem-solving process.
14. What are the obstacles or impediments of fully implementing an integration of design thinking into the linear problem-solving process?
15. If deemed valuable, in what ways can design thinking be improved upon to incorporate into the military problem-solving process?

Each interview was audio-recorded and coded by the researcher. Each participant was provided with a transcription of the highlights of interview with the removal of pragmatic sociolinguistic markers such as of "Uh," and "Um." In the end, the audio-recording of the interview provided rich context that was not able to be gleaned from written transcripts.

Document Collection

Qualitative research depends on field work (interviewing, non-structured observation, and document analysis) as the principal means of collecting data (Ary et al., 2006). Document collection and analysis is a research method applied to written or visual resources for the purpose of classifying specified characteristics (Ary et al., 2006). Various documents were collected and analyzed to advance an understanding of military student-planners' design thinking educational experience such as course and session syllabus, faculty guides, instructional materials pertaining to design thinking, and student collaborative material and products (see Appendix E). It was important to review these documents in order to ascertain participants' understanding relevant to rigor of analysis and synthesis of the problem they were presented. These documents were viewed in student work areas.

I also generated "corroborated and augmented evidence from other sources" such as participant interviews and observations (Yin, 2009, p. 103). As expected, these documents provided a rich source of information. Reflection products were also analyzed. These consisted of a variety of notes, papers, discussion, and presentations. Finally, the researcher interviewed several participants, providing opportunity for them to share thoughts on documents.

Observations

Observation is the straightforward procedure of data collection in a qualitative study (Ary et al., 2006). I conducted observations of the interdisciplinary team of military student-planners

in order to gain an understanding of the process applied as they proceeded to confront and solve complex, ill-structured problems. I used an observation protocol worksheet. Appendix F pertains. The observations were recorded in field notes and were descriptive as well as reflective in nature. Observations were conducted in such a manner as to ensure information could be evaluated in context, and I, as the observer, could remain apart from the teaching environment to reduce reflexivity which could lessen the accuracy of observations (Yin, 2009). Classroom observations were used to collect data for this study. Narrative observations took place while students proceed to solve complex, ill-structured problems. A homogenous sampling technique was utilized. The observations took place at three separate times.

Researcher Field Notes

In similar fashion that health care professionals maintain active journals or records that account for interaction with patients, qualitative researchers keep field notes and documents on their research (Gilgun, Sherman, & Reid, 1994; Marlow, 1993). According to Kawulich (2005), "field notes are the primary way of capturing the data collected from participant observations" (p. 10). Similarly, according to Ary et al. (2006), field notes are the most common data collection strategy used in research to provide a record of what is going on during an observation.

According to DeWalt and DeWalt (2002), field notes may provide a true account of what was observed and are the result of the observation process. They also point out that observations do not become data until they are documented into field notes. Thus, I used field notes as a data collection and data analysis method. For this, I maintained two separate notebooks to record field notes. One was used to recount/document interactions and activities of the group. The other was used for questions.

Data Analysis

Perhaps the most essential step of the research process is data analysis (Onwuegbuzie, Leech, & Collins, 2012). Per Schwandt's (2007) writing, "To analyze means to break down a whole into its components or constituent parts. Through assembly of the parts, one comes to understand the integrity of the whole" (p. 6). Bogdan and Biklen (2007) explained data analysis as, "working with the data, organizing them, breaking them into manageable units, coding them, synthesizing them, and searching for patterns" (p. 159). Other prominent qualitative researchers agree that data analysis involves: (a) preparing and organizing data; (b) condensing data into themes, categories, clusters, etc.; and (c) characterizing that data to ascertain the essence of the phenomenon (Creswell, 2013; Moustakas, 1994; Seidman, 2006; Stake, 1995; van Maanen, 1996; Yin, 2003). Merriam (1998) commented that "historically, data analysis in qualitative research has been something like a mysterious metamorphosis. The investigator retreated with the data, applied his or her analytic powers, and emerged butterfly-like with 'findings'" (p. 156). While the process is indeed intuitive, Merriam (1998) insisted the data need to be systematically recorded and managed, and suggested researchers utilize Yin's (2003, 2009) data- base and Patton's (1990) case report of data as useful techniques in organizing evidence (see Appendices G through J).

I analyzed this case study data by following Stake's (1995) case study analysis approach as to when analysis occurs. In accordance with Stake (1995), there is no specific moment when analysis should commence, thus analysis starts at the beginning of data collection and uses direct interpretation to extract meaning. Additionally, Creswell (2007) advised, "The processes of data collection, data analysis, and report writing are not distinct steps in the process–they are integrated" (p. 182). A set of steps was taken to delve into the data and seek to gain

understanding of the observations that I made by watching and thinking deeply. I recognize this process is purely subjective.

I used case issues (Stake, 1995), also known as propositions (Yin, 2003) from the beginning and throughout the case during analysis. In this manner, the analysis process remained focused; thereby avoiding veering outside the scope of the research questions (Stake, 1995; Yin, 2003). Following Yin's guidance (2003), accepting and rejecting propositions (issues) increased confidence in the case results.

Because there is a paucity of previous knowledge and experience in the phenomenon under the current study, I incorporated what Lauri and Kyngas (2005) called inductive content analysis, whereby analysis moves from specific details contained in the data and emerges as general themes (Chin & Kramer, 1999) by way of distilling data through constant recoding (Glaser & Strauss, 1967). Complementing these approaches is akin to what Ary et al. (2006) and Merriam (2009) called the constant comparative method. This method is described by Ary et al. (2006) as, "a method of analyzing qualitative data that combines inductive category coding and simultaneous comparison of such units of meaning" (p. 630). Throughout the process I attempted to interpret the phenomenon being studied and pursued understanding of relationships between all the data assembled from various data sources (Ary et al., 2007).

Although the constant comparison method is typically associated with grounded theory research, a review of analysis methods reveals evidence using the constant comparative analysis method outside of grounded theory research. O'Connor, Netting, and Thomas (2008) specified,

> It must be clear that constant comparison, the data analysis method, does not in and of itself constitute a grounded theory design. Nor does the process of constant comparison ensure the grounding of data, whether "grounding" is used in a positivistic or interpretive

> sense. Simply put, constant comparison assures that all data are systematically compared to all other data in the data set. This assures that all data produced will be analyzed rather than potentially disregarded on thematic grounds. It is the time and the process of this constant comparison that determine whether the analysis is deductive and will produce a testable theory or whether the analysis is inductive and will build a theory for a particular context. (p. 41)

Accordingly, various research designs utilize this method in data analysis. Therefore, the use of constant comparison method was appropriate for the current study.

Merriam (1998) described data analysis as an activity of shifting backward and forward among description and interpretation by way of inductive and deductive reasoning, and between data and concepts. The constant comparison method assigns codes that reveal the conceptual relationships (Merriam, 1998). Memo writing was used throughout the coding to assist in exploring the codes and further conceptualization (Creswell, 2007). As Maxwell (2005) asserted, memos can "convert thought into a form that allows examination and further manipulation" (p. 11).

Data analysis began with my recording all of the collected data. The coding process followed Strauss and Corbin's (1998) suggested types of coding: open coding, axial coding, and description making, whereby more focus was applied to design thinking, the problem-solving process and collaborative learning. Open coding allows for the text to be opened up and meaning to be explored through the identification of important themes or patterns (Creswell, 2007). For data collection and analysis, I used Microsoft Word as a data collection and analysis tool. Creswell (2007) cited this as an appropriate tool, stating that "new forms of qualitative data continually emerge in the literature," and that one tool to capture and analyze data is "journaling

in narrative story writing, using text from e-mail messages, and observing through examining videotapes and photographs" (p. 129).

Open Coding

As stated by Strauss (1987), "Any researcher who wishes to become proficient at doing qualitative analysis must learn to code well and easily. The excellence of the research rests in large part on the excellence of the coding" (p. 27). Just as data analysis is the most essential step of the research process, the coding and recoding process is fundamental in qualitative analysis and encompasses classification of themes for refinement (Ary et al., 2006). Often referred to as inductive coding, open coding was the primary method used in assembling data in inductive content analysis. Open coding occurred while I considered the data and discovered major themes and categories as opposed to a priori codes, which are encoded in advance of data collection (Elo & Kyngas, 2008).

Developing a coding system involved searching the data for patterns, topics, and themes that emerged, and used words and phrases to represent them. Rossman and Rallis (2003) explained the difference between a category and a theme: "think of a category as a word or phrase describing some segment of your data that is explicit, whereas a theme is a phrase or sentence describing more subtle and tacit processes" (p. 282). This study examined themes.

Auerbach and Silverstein's (2003) *Qualitative Data: an Introduction to Coding and Analysis*, along with Saldana's (2013) *The Coding Manual for Qualitative Researchers* recommend the coding process for this type of study. Auerbach and Silverstein (2003) described coding as a process "used to organize texts from transcripts while discovering patterns within that organizational structure" (p. 31). Similarly, Saldana (2013) described a code as "most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or

evocative attribute for a portion of language-based or visual data" (p.3). Coding is central in qualitative analysis because research themes emerge from the data.

Merriam (2009) likened these themes to codes that can be "single words, letters, numbers, phrases, colors, or combinations of these" (p. 173). Merriam (2009) described open coding as a process of composing categories by analyzing the transcripts and formulating notes beside the data. According to him, "This process of making notations next to bits of data that strike you as potentially relevant for answering your research questions is also called *coding"* (p. 178). Codes were identified and used to build themes. The number of themes depended on data collection, but Merriam (2009) advised "the fewer the themes, the greater the level of abstraction, and the greater ease with which you can communicate your findings to others" (p. 187).

Axial Coding

After open coding, when data were broken into segments and categories formed, axial coding was used to rebuild the relationships between categories (Strauss & Corbin, 1998). Axial coding looks for causal condition, context, intervening, conditions, strategies, and consequences. The researcher then conducted selective coding and produced corresponding categories to developed propositions. Next, codes were combined to broader categories or themes. Intrinsic to this method is the constant comparison of segments of data, categories, and so forth. Throughout the analysis—open analysis, open coding, axial coding and selective coding—there was a return to the data to ground the theoretical ideas.

Researcher Reflection (Journal)

I was mindful to ensure what Koch and Harrington (1998) described as constant self-assessment and evaluation to be aware of any bias or assumptions and be prepared to explain

how my own experience may have influenced the research process. Specifically, I engaged in systematic epistemic reflexivity. Coghlan and Brannick (2005) described epistemic reflexivity as the "constant analysis of your lived experience as well as your own theoretical and methodological presuppositions" (p. 62). According to Ary et al. (2006) reflexivity is defined as "the use of self-reflection to recognize one's own biases and to actively seek them out" (p. 507). Ryan (2005) wrote that reflexivity "supports critical introspection. To be reflexive can actually nourish reflections as introspection leads to heightened awareness, change, growth, and improvement of self and our profession" (p. 2). Reflective journaling served as a link which joined data reduction with the writing process in order to discover theories and connections (Creswell, 2007).

Reflective journaling furnished a nexus connecting the data reduction and the writing process whereby I endeavored to discover theories and connections (Creswell, 2007). Sandelowski and Barroso, (2002) made it clear that reflexivity and researcher reflection are sound indicators within a study, when they said:

> Reflexivity is a hallmark of excellent qualitative research and it entails the ability and willingness of researchers to acknowledge and take account of the many ways they themselves influence research findings and thus what comes to be accepted as knowledge. Reflexivity implies the ability to reflect inward toward oneself as an inquirer; outward to the cultural, historical, linguistic, political, and other forces that shape everything about inquiry; and in between researcher and participant to the social interaction they share. (p. 222)

Several researchers suggested there are a variety of the types of entries which should be entered in journals. Krefting (1991) recommended that journal entries contain:

1. A schedule with activities of the study;
2. An accounting of where decisions and rationale were discussed; and
3. Reflections of researcher's thoughts, feeling, ideas, and frustrations (p. 218).

Thus, this study adheres to the above recommendation but may contain addition entries as well.

After each session of data collection, significant topics were recorded. The core of the process involved constant comparison. Initially, I compared data to other data. Then, I compared data to theory. Coding began from recording notes of this comparison. I then identified categories that were generally equivalent to themes or variables and their sub-categories.

Theoretical Sampling

Fassinger (2005) wrote, "one of the hallmarks of the case study approach is the use of theoretical sampling" (p. 162). Theoretical sampling is explained as the process of continually gathering data through the analysis process with the purpose validating emerging concepts. In the current study, theoretical sampling was used to identify participants and included "repeated examination of data collected for to select instances, scenes, or events" (p. 162). The process used in theoretical sampling involved asking probing questions to participants to provide further information on the problem-solving process that was being observed.

Trustworthiness

In any research study, qualitative or quantitative, the trustworthiness, or validity, of the research findings is an important concern (Creswell, 2007). Silverman (2006) contended that "Validity is another word for truth" (p. 290). Validation in qualitative research is to suggest that researchers employ accepted strategies to document the "accuracy of their studies" (p. 250). Williams and Morrow (2009) declared trustworthiness is a distinguishing aspect of qualitative

research. Establishing trustworthiness of a qualitative research design is essential in its relevance and viability for future research. As such, the qualitative researcher is compelled to "demonstrate that the methods used are reproducible and consistent, that the approach and procedures used were appropriate for the context and can be documented, and that external evidence can be used to test conclusions" (Ary et al., 2006, p. 509). In controlling the trustworthiness of qualitative studies, researchers must consider the data collection, analysis, and interpretation methods used (Guba, 1981).

To address some of the criticism associated with qualitative studies, numerous researchers have searched for methods to assess the rigor of data collection and data analysis (Pidgeon, 1996). Lincoln and Guba (1985) published three imperatives required of researchers: (a) present sufficient detail regarding participants in order for readers to formulate judgments concerning findings of the study; (b) practice assiduous data collection and data analysis methods; and (c) apply methods such as triangulation, audits and reflexive journaling to demonstrate consistency of the data (p. 305).

Trustworthiness has procedures that comprise the degree to which the examination accurately represents the observations of the participants: whether other researchers would reach similar conclusions based on the data; whether the analysis procedure is flexible to account for variations in experiences; and the degree that study elements were sufficiently described to allow for comparison to other populations and study findings. Various frameworks have been developed to evaluate rigor or assess the trustworthiness of qualitative data (Lincoln & Guba, 1985). I followed the guideline by Lincoln and Guba (1985) to strengthen the trustworthiness of this study. They contended a qualitative study's trustworthiness has four elements—credibility, transferability, dependability, and confirmability. This approach is widely written about and

recognized among disciplines, e.g., Krefting (1991), Sandelowski (1993), and Lincoln and Guba (1985).

The credibility of the study was measured through member checks and peer reviews. Participants were given interview transcripts and the research report in order to confirm or refute my findings. In addition, credibility was reinforced by sustained engagement and observation as well as triangulation of data. Additionally, Patton (1990) asserted that the credentials and experiences of the researcher enhance credibility of a qualitative study. Because of my extensive experience, interest, and education as a military planner, I deemed the findings of this study are congruent with reality, and therefore, credible (Merriam, 1998).

Regarding transferability, Merriam (1998) specified it is the degree to which findings of one study can be applied to other situations. Ary et al. (2006) stated that transferability is "the degree to which the findings of a qualitative study can be applied or generalized to other contexts or to other groups" (p. 507). Lincoln and Guba (1985) indicated the utmost significant attribute of transferability is the commitment the researcher has in articulating circumstances or events that model the setting within which the phenomenon occurred, thus presenting contextual material for the reader to transfer results. Transferability of the findings was increased through thick, rich data collected during the interviews, observations, and document collection. Thick, rich data requires precise and comprehensive descriptions of the setting, participant synopsis, and the data collection methodology and analysis (Lincoln & Guba, 1985). Rich data was derived from substantive comments from the participants to include how they experienced the phenomena. Using open coding, these comments were coded into themes. However, since this inquiry studied military student-planners in an educational environment, transferability for this research study is only limited to military personnel.

Dependability represents the prospect to reproduce the research with the same framework, methods, and participants, and achieve the same results (Creswell, 2007). Lincoln and Guba (1985) reasoned that by establishing credibility, dependability of a research study is more assured. In order to attain dependability of this research study, I provided an extensive and detailed procedure of the methods undertaken that provided a comprehensible account of the research conducted. The dependability of the findings was substantiated through an audit trail process to ensure the information was organized in such a way that is backed by the data.

In qualitative research, confirmability corroborates that the findings of the study are the outcome of the experience and ideas of the participants in a study, and not of the researcher (Merriam, 1998). Lincoln and Guba (1985) suggested and were later affirmed by Creswell (2007) that the resilience of a qualitative study is supported by demonstrating that the study is free of researcher bias. Confirmability of the study was increased by affirmation of my beliefs and assumptions and through the use of diagrams to demonstrate the audit trail (Lincoln & Guba, 1985; Krefting, 1991). Koch (2006) recommended using an audit trail to permit the reader to follow events, influences, and actions of the researcher. Additionally, an audit trail can represent a method of ensuring quality in qualitative research (Akkerman, Admiraal, & Simons, 2012). Rice and Ezzy (2000) affirmed that "maintaining and reporting an audit trail of methodological and analytic decisions allows others to assess the significance of the research" (p. 30). In order to increase the trustworthiness of this research, I produced an audit trail of the data collection and analysis procedures. Individual participant interviews, and observations were methodically preserved. My log of the timeline and basis for data collection was documented. A third-party auditor appraised the audit trail during the study and indicated to me what additional documentation was required. Throughout data collection and the analysis process, the following

were used to establish methodological rigor: (a) triangulation; (b) peer reviews; (c) member checks; (d) reflective journaling; and (e) thick, rich descriptions.

Triangulation

The most common strategy to ensure internal validity is data triangulation that Merriam (2009) describes as "the most well-known strategy to shore up internal validity of a study" (p. 215). Triangulation describes the process of comparing results of data collection from different sources to validate findings. Gall et al. (2007) affirmed that qualitative researchers are encouraged to "vary the methods used to generate findings and see if they are corroborated across the variants" (p. 475). In this manner I, in effect, substantiated the collection and analysis that the study comprises.

During this research study, I followed recommendations from Lincoln and Guba (1985) and Stake (1995) who suggested using multiple data sources in order to ensure congruence regarding themes, thus resulting in better understanding the phenomenon. As Lincoln and Guba (1985) pointed out, "Steps should be taken to validate each against at least one other source… no single item of information . . . should ever be given serious consideration unless it can be triangulated" (p. 283). Accordingly, this research contained multiple data sources.

Regarding internal validity, Creswell (2007) stated, "In triangulation, researchers make use of multiple and different sources, methods … to provide corroborating evidence" (p. 251). Triangulation is a technique used to increase the trustworthiness of qualitative research (Lincoln & Guba, 1985). Similarly, Ary, Jacobs, Razavieh, and Sorensen (2006) agree, "the use of multiple sources of data, multiple observers, and/or multiple methods is referred to as triangulation" (p. 505). Various resources were used in this research to gain a better understanding of the phenomenon under study and to raise the level of credibility and

dependability of the data collection. What follows is a discussion of the process for collections.

Three primary data collection procedures were used in this qualitative case study. Interviews, document collection, and observation along with researcher field notes were the means used for collecting data. Because this case study explored intrinsic value of design-thinking-led problem-solving education for collaborative learning of military student-planners, the use of multiple participants included comparing their experience. Convergence of information acquired during participant interviews were examined in order to ascertain the fidelity of sources and is expected to aid in developing greater understanding of the experience (Merriam, 1998; Leech, 2007).

Peer Review

According to Ary et al. (2006), the resultant findings from data collection and analysis needed to be substantiated by others to inject credibility to the findings of the research. The process of confirmation is universally established in qualitative research as peer review, or peer debriefing. Accordingly, peer review was used as a method to add credibility to the study.

Various researchers attempted to articulate functions of a peer review. Lincoln and Guba (1985) proposed that a good peer review: (a) maintains researcher impartiality; (b) offers opportunity to assess assumptions and hypotheses; (c) affords opportunity for the researcher to collect own thoughts; and (d) allows a period to further synthesize the data. Shenton (2004) added that consultations such as peer reviews "provide a sounding board for the investigator to test his or her developing ideas interpretations, and probing from others may help the researcher to recognize his or her own biases and preferences" (p. 67). Lincoln and Guba (1985) went one step further and likened the peer reviewer as a "devil's advocate." They recognized a peer reviewer adds credibility to the study by furthering to "explore aspects of the inquiry that might

otherwise remain only implicit within the inquirer's mind" (p. 308).

During this process I made all elements of the research available to a colleague/peer who was not connected with the study to discuss nuances that may have otherwise been overlooked (Lincoln & Guba, 1985). I also discussed interpretations and conclusions with impartial peers. These peers critically challenged the research in order to provide solid evidence for any interpretations or conclusions.

Member Checks

In order to ensure clarity, feedback, otherwise known as member checks or reliability checks, were provided to participants during the course of data analysis. Aptly pointed out by Ary et al. (2006), member checks ask the question: "Do the people who were studied agree with what you have said about them?" (p. 506). In so doing, I generated a sense of trust with those involved in the research. This was accomplished by making contact with participants during the data-analysis procedure to ensure clarity of interview responses and interpretation of observed behaviors. I shared information gathered in order to further the search for explanation of the phenomenon.

The participants were then offered the opportunity to review and clarify my interpretation and provide direct clarification of the matter under study. Maxwell (2005) commented that member checking, or soliciting feedback from participants, is the "single most important way of ruling out the possibility of misinterpretation of the meaning of what they say and the perspective they have on what is going on" (p. 94). According to Lincoln and Guba's (1985) writings, reliability checks are "the most critical technique for establishing credibility" (p. 314). Concomitantly, Stake (2008) affirmed, "Member checking is a vital technique for field researchers. Thus, after gathering data and drafting a report, the researcher asks the main actor

or interviewee to read it for accuracy and possible misinterpretations" (p. 37). Adhering to this advice rules out the possibility of misinterpretation.

I made use of a peer reviewer to substantiate that the study has been thorough and complete. Additionally, participants were sent a list of main ideas or themes that I interpreted during the study. Participants were asked to review these documents to ascertain whether I accurately captured the participants' experiences. Here again, participants were invited to view and comment as desired.

Ethical Considerations

Kimmel (1996) saw ethical problems as both personal and professional. Ethical considerations that could have arisen during this study were matters of privacy, data storage, and confidentiality. Each of these issues remained under close scrutiny so as to ensure there were no violations of ethical protocol at any time. Permission from the Institutional Review Board (IRB) at the college under this study was the authority that permitted the researcher to gain access to students and data.

The researcher collected a number of student products, which were produced by an interdisciplinary team. Students who chose to participate in the study comprised one interdisciplinary team. Documents were collected and analyzed to advance an understanding of military student-planners' design-thinking educational experience. It was important to review these documents in order to ascertain participants' understanding relevant to rigor of analysis and synthesis of the problem. The documents that consisted of notes, papers, discussion, sketches, and presentations were viewed in student work areas. Individual identities of who contributed to the group project were known only because they comprised the single unit of analysis, which was a group, better known as a planning team of military student-planners. Still, none of the

student-produced products contained individual identifying information in any form.

Individual interviews were also used to collect data on participants' opinions, beliefs, and feelings about their experience in their own words. The one-on-one interviews provided access to the context of behavior and thereby provided a way for me to understand the meaning of that behavior and to put it in context. The primary justification for conducting individual interviews was to collect data that reveal the opinions and listens to the voice of military student-planners and their experience in using design thinking. The interviews were intended to gather overall concepts and served as a comprehensive examination of these concepts with the interdisciplinary team of military student-planners as a collective unit of analysis. Because design thinking is grounded in the theories of design, systems, and lateral thinking, it was essential to gain a firm understanding of participants' assessment of the intrinsic value of design thinking.

The individual interviews were convened because the research topic is rather new and one for which little information is available. Therefore, informed consent was obtained for transparency and to make certain participants were informed that the interview sessions were to be audio-recorded. To finish, I transcribed highlights of the audio recordings, with the narratives examined for patterns and themes.

Stake (2003) stressed the honored position of the case study researcher. He said, "Qualitative researchers are guests in the private spaces of the world. Their manners should be good and their code of ethics strict" (p154). He proceeded to insist that researchers go further than basic ethics requirements and use caution to minimize risk. I maintained participant confidentiality by using pseudonyms and kept data secured at all times throughout the study. The storing of data was password protected for electronic files. I stored all hard copies of data in a locked filing cabinet to which only I had access. A coded sheet associating participants' true

identities with their assigned pseudonyms was stored separately from the rest of the data at my residence in a locked desk drawer, accessible only by me. All research-related data will remain securely stored for a minimum period of three years after the end date of the study, as required by federal regulations. After the mandatory storage time has elapsed, I will erase all digital files and burn all other material.

Because of extensive personal experiences with the phenomenon under study, I might develop a perception of bias given the extent of personal experiences. Bracketing was used to set aside those personal experiences and focus on the case unit of analysis. Finally, I was aware of the possibility that an even more professional and open relationship might develop with a number of participants. Heeding the advice from Ary et al. (2006), who explained, "some researchers say they obtain their best data at this point [when participants forget research is ongoing]," I remained vigilant to mitigate any negative implication from this potential ethical problem while reaping the positive affect in data collection and during member checks.

On a final note, participation in the research was completely voluntary. No one whom I directly supervise participated in the study. Participants signed a letter of informed consent that detailed the nature of the study. There were minimal potential issues with results of study impact on curriculum, faculty workload, or accreditation, and no issues regarding influence.

Summary

This chapter presented the methodology for the current study and explained the suitability of the case study design, the participants, and the study site. The steps for data collection and research question were also addressed as was the analysis method. Also presented was a discussion regarding rigor and ethical implications for the study.

The reader may note that elements of the research methodology follow more than one

prominent qualitative researcher's approach. Rationale for this rather unconventional manner of using multiple approaches lends greater trustworthiness to the study. This study heavily employed the approaches from three prominent qualitative researchers, Merriam (1998), Yin (2003, 2009), and Stake (1995, 2003, 2008).

Sharan Merriam's body of work was used because this is a case study in education and she has conducted extensive research on applying case study methods in education. In addition, because he is an authority in policy research and renowned research methodologist, the work of Robert Yin was used as well. Finally, Robert Stake's work was also drawn upon due to his experience with program evaluation along with his stance of case study being very much an interpretive undertaking.

I synthesized substantive input from each participant into one generalization, wrote a description, and welcomed participants to add subject matter. Descriptive interpretation was then used to create corresponding themes. The resultant revealed four themes that I presented as findings of this study in Chapter Four. Next, findings are interpreted in Chapter Five where conclusions of this research are presented. Implications for the professional military education continuum and implications for the further research are also discussed in Chapter Five.

CHAPTER FOUR: FINDINGS

Introduction

The purpose of Chapter Four is to report the data analysis and research results as it pertains to themes that were discovered. The chapter begins with a restatement of the problem and purpose of this case study research. The chapter is organized around explaining the findings for this case study which are merged to produce common themes and answer the research questions. The report of data includes observation results, document analysis results, and individual interview results that include participants' input regarding the four themes that emerged from analysis of the data. A summary of findings concludes the chapter.

Restatement of the Problem and Purpose

The literature review revealed a problem: The current problem-solving process used by the military is inadequate to address today's complex issues. Mid-career advanced military education may not be developing the necessary skills required for staff officers to keep pace in their ability to advise decision makers about operational courses of action against adept, agile adversaries. Integrating design thinking into the planning process encourages a more complete understanding of the problem confronted, the operating environment, and the purpose of an operation.

The purpose of this qualitative single, instrumental, theory-building researcher case study was to explore and discover the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners at a senior military service college. The rationale for conducting this study is to influence the military leadership community by providing insight on how important it is to use a disciplined design methodology to identify and target the right problems and broad solutions before developing viable detailed

options for the employment of large military forces. Literature regarding design thinking is not new. In fact, the subject has gained momentum in the last decade particularly regarding business and organizational development. Current literature is focusing on design thinking as a means to close the problem-framing gap in problem solving, especially in the area of complex problems. However, existing literature remains at the theoretical level, impaired by prolific esoteric lexicon, with no research dedicated to advancing the subject of design thinking from theory to practice. The results are described by the use of themes, which emerged when data sources were triangulated. The data sources included the interviews, observations, and documents. This information was then used to structure the research questions and to guide the study.

Description of Participants

Participants in this study were homogeneous and selected by purposeful sampling. Homogeneous sampling, as opposed to maximum variation sampling, entails selecting individuals, groups, and settings because they all share similar characteristics (Onwuegbuzie et al., 2004). Participants in this study were selected due to membership in a subgroup or unit that has specific characteristics. This is appropriate because as Creswell (2003) aptly pointed out, "the idea behind qualitative research is to purposefully select participants that will help the researcher to understand the research question" (p. 185).

The 15 participants were all U.S. Navy commissioned officers, whose average age was 33 with an average of 11 years in military service. Though the participants represented different races, socio-economic background, religious affiliations, etc. that might otherwise render them heterogeneous, they shared specific characteristics relevant to the scope of this study. For example, participants shared common professional training experiences and level of education. The participants also proclaimed allegiance to the same organizational goals, ethics, and

leadership as well as were inculcated in the culture of the U.S. Navy as a profession. Lastly, each participant, though representing a variety of military specialties, such as aviation, law, and surface warfare, were attending the same course on their journey to taking on planning responsibilities at their next duty assignment. They have experienced the process and development of the theory that might help explain practice or provide a framework for future study. Accordingly, participants were deemed homogenous.

The small number of participants did not minimize the contributions based on the key characteristics of the case study. This is supported by Merriam's (2009) findings: "The single most defining characteristic of case study research lies in eliminating the object of study, the case . . . a single entity, a unit around which there is boundaries" (p. 27). The case then, "could be a group or single person who is a case example of some phenomenon, a program, a group, an institution, a community, or a specific policy" (p. 40). Hence, the unit of analysis—or case—for the study consisted of a single team comprised of interdisciplinary military student-planners.

Report of the Data

The research findings this chapter reports are based on analysis of the following data sources: Observations, semi-structured interviews, and documents which includes discourse.

Observation Results

Two sets of observations were conducted of students performing a practical application exercise using design thinking. Observations began as the student-planners were concluding week 2 of the 11-week planning course. They had been introduced to the military planning topics such as operational art, the Navy planning process, operational functions such as intelligence, logistics, command and control, etc., as well as becoming familiar with operational factors analysis covering time, space, and force. They had become familiar with the operational

variables in a complex joint, coalition, multi-national maritime scenario. Operational variables describe the foundation and features of an enemy or ally state (U. S. Army War College, 2011) in the operational environment. These variables consider dynamic political, military, economic, social, infrastructure, information, physical environment, and time implications that affect the operating environment. The students referred to these variables which formed the acronym PMESII-PT. Military doctrine utilize the PMESII-PT acronym to assess the state's strengths and weaknesses, as well as help estimate what effect actions will have on states across these variables (Chairman, 2011). The acronynm PMESII-PT appeared to have served as an effective mnemonic device and prompt for the students to conduct analysis of the operating environment. The student-planners had also conducted analysis to determine the enemy's center of gravity, the aspects of the enemy's system giving the strength, will, and freedom to act.

An introductory lesson in "Design" (thinking) was observed. Following the lesson, the instructor systematically led the students through a design methodology using a complex maritime scenario, henceforth referred to as Scenario 'A'. The group organized themselves to learn during the conduct of a planning simulation. One participant was designated to sketch highlights of the group discussion on a large white board for all members to see and reflect upon. Another student was designated to record the context under which discussions took place. The instructor would ask prompting questions to stimulate discussion and the sharing of ideas. The students were observed brainstorming ideas while they refrained from judging. Collectively, the students appeared to have a very supportive group dynamic, one with openness to unanticipated comments, and where the group members contributed and built upon other's input. During the period between the first and second set of observations, the students proceeded through the steps of the detailed planning process that follows the design step.

The second set of observations began in week 6 and into week 7 over a two and a half day period during the 11-week course. By this time the student-planners had completed detailed planning for Scenario 'A' in response to the initial design thinking exercise, and were presented with another scenario, henceforth referred to as Scenario 'B.' As in the first observation, students had become familiar with the operational variables in this different complex maritime scenario and determined the enemy's center of gravity. Unlike the first scenario, whereby the faculty member led the students through a design methodology, this iteration had the faculty member merely facilitating student-led discourse. The students again organized themselves to learn in order to understand the problem as presented in the scenario. One student was assigned as the group lead, responsible for leading the group discussions, serving as the group spokesperson, and adjudicating group conflict to allow the design process to proceed through the steps. Another student was designated as a recorder to capture the discussions in context while another student was designated to visually display sketches and models. Meanwhile, the faculty member took on the role of the decision-maker, known as the "Commander."

Although the students were halfway through finishing the 11-week course and had become more comfortable in group discussions, there seemed to be a greater sense of urgency to come to shared understanding of the complexity of the problem before them rather than simply performing impassively in their roles in the planning simulation. In other words, students were treating the simulation as if it was real. Over a period of time, the students proceeded to simply discuss the problem openly and without structure. It was clear this period of discussion was very valuable to reinforce the positive effect of group dynamics. After some discussion, the designated group lead referred back to the original lesson on Design and the group's shared experience with design thinking from Scenario 'A.' As the students proceeded with the iterative

activities that constitute a design methodology, they sought to understand answers to four broad questions:

1. What is the operational direction (what requirements and authorities are delegated to me)?
2. What is the context (also known as operational environment) in which the operation will be conducted?
3. What problem is the operation intended to solve?
4. What broad, general approach for the operation could solve the problem?

It is worthy to note some students remarked that some of what they accomplished while applying the design methodology is also done during the normal course of applying the linear planning process. Moreover, they asserted they would not be in a leadership position anytime soon that would help them understand such broad questions such as they encountered in this practical exercise. The faculty member confirmed that some activities of the design methodology do, in fact, parallel the linear process, such as the "Joint Intelligence Preparation of the Operational Environment" and "mission analysis." However, the faculty member presented a convincing argument that senior decision makers are very often unfamiliar with design as a methodology and will require the assistance of a facilitator to guide senior leaders through a process to answer the broad, conceptual questions before them. Further, the instructor explained how decision makers very often need assistance with sense-making, visualizing, describing and translating the conceptual aspect of planning in the form of guidance, intent, and direction to subordinates who will be doing detailed planning. The faculty member further described the relationship between conceptual (what and why) and deliberate planning (how). This point clearly resonated with the students when they appeared to realize by virtue of their attendance in

this course, they will likely be the very same individuals decision makers will actively seek for such assistance. In time, given the military promote-from-within human resource management process, some of these students may become senior decision makers relying on this exposure to design methodologies.

The students resumed to reflect upon these four questions in an iterative and recursive manner. Meaning, that as one question was answered, new questions were generated, and in some cases questions already asked were asked yet again in order to gain deeper understanding. One student stated, the "purpose of the dialogue is to explain an operational approach that can be translated into an executable plan, or used to modify an existing plan, and can be used to help determine when adaptation to the plan is appropriate."

In order to better understand the broad questions, the students were presented with expectations on what they will deliver by using the design methodology. The students were to articulate a narrative of the current state of affairs as well as a narrative of the desired state. The students were to then synthesize and articulate a problem statement and visually explain an overall approach to confront the problem. Finally, students were to articulate the proposed commander's intent that included a statement that explained the operation's overarching purpose, method, and end state as well as risk analysis. Students also proposed initial planning guidance to the cross-functional teams that go about translating the conceptual level input into the detailed level of planning. Together, these design products were to constitute what the faculty member referred to as the "Commander's Design Concept." Toward producing these products, the students turned to using the design methodology: (a) Understand the operational direction; (b) Understand the environment; (c) Understand the problem; and (d) Develop an approach.

With regard to students proceeding to understand and articulate the problem, they were

observed examining the symptoms, underlying tensions, and the root causes of tensions and conflict in the operational environment. From this perspective, the group was observed discussing distillation of the fundamental problem toward achieving clarity and considering how to solve the problem. Considerable discussion ensued with the group keenly vigilant of the difference between solving a problem right and solving the right problem. The group was aware of the need to identify the right problem to solve. Toward this end, the group asked a series of questions such as, "What needs to change and what doesn't need to change?" and "What are the opportunities and threats?" and "How do we go from the existing conditions to the desired conditions?" The group then returned to discussion about tensions and risk. Examples of probing questions were "What tensions exist between the current and desired conditions?" and "What tensions exist between our desired conditions and adversaries' desired conditions?" as well as "What are the risks in going to the desired conditions?" Next, the group referred back to the lesson on design. The students recalled the various tasks in problem framing. The recorder illustrated the tasks on a whiteboard and the fellow students proceeded in discussion in order to articulate a concise statement in response to each tasking. The group then articulated their response regarding the operational context, synthesis of the strategic direction, trends, and voids in knowledge, differences, and assumptions. At this point it appeared the group reached a point of saturation and turned to discussing how to present their understanding of the problem. Since the discussions were visually recorded, the group seemed to easily develop a single graphic illustration of the problem called the "Problem Frame." This along with a concise problem statement demonstrated their understanding of the problem.

With regard to students proceeding to develop an overall approach toward addressing the problem, students were observed using their shared understanding of the strategic and

operational direction along with their understanding of the operational environment and concise definition of the problem. Toward that end, the group proceeded to discuss ways to visualize actions that would produce desired conditions. Once again, the group referred to the lesson on design. The group recalled that an operational approach consisted of a broad conceptualization of general actions and the nature and interaction of stakeholders. The group applied a technique to guide this discussion through use of a model or rubric with the acronym "RPC," which prompted the group to determine what combination of elements in the environment needed to be *removed*, those elements that needed to be *provided*, and what behavior or conditions needed to be *changed*. The group then proceeded to discuss these in terms of meeting several objectives toward reaching the desired state of affairs. Much discussion ensued when the group was sometimes observed discussing options rather than remaining on the task at hand which was to come to a shared understanding. The faculty intervened to remind the group that they were not to develop options to solve the problem at this point. Rather, they need to understand and describe what combination of actions would achieve the desired state of affairs. The faculty reminded the students that options on how to employ those actions would come later during the detailed planning process and that design was intended to achieve shared understanding. Toward this end, the group illustrated tasks that were needed to be executed using the RPC model. The end result was a narrative of nine tasks to achieving three objectives. This illustration was a single, concise graphic, titled, "Operational Approach."

Document Collection Results

Qualitative researchers regularly utilize the study of documents to aid in their understanding of a phenomenon (Ary et al., 2006). I included document analysis in the data used to explain the findings of this study. The current study collected data from a variety of

documents. According to Merriam (2009), documents can be considered whether they are visual, written, digital, or physical material that can be examined in relation to a study. In this study, documents that were collected related to the interdisciplinary group of student-planners collaborating to proceed through problem framing using the methodology of design thinking. Documents included the course syllabus as well as session syllabus for design thinking. Documents also included material needed to support students' understanding regarding the background for the scenario in order for the students to continue with the practical application exercise for Scenario 'A.' These documents were background material to provide sufficient detail regarding context of a particular complex problem. Documents also included sketches and drawings, charts and mind maps. Finally, student-produced briefings, sketches, narratives, both printed material and electronic material used in a collaborative information environment with open access to the researcher. These documents were obtained both from shared files and in class. The final documents included in my analysis were ones produced by the group of student planners. Document review reflects that course supporting documents were very clear, comprehensive, yet concise. All documents aligned with the course and lesson syllabus.

It should be noted that some details in the documents used and developed by students contained material of a sensitive nature regarding contemporary geo-political considerations. As such, viewing the documents was only permitted in the class spaces. This was deemed as having no consequence to this study because I was allowed to take notes authorized under the supervision of the course director.

While conducting document analysis of group products, many indicators, or sub-themes emerged. The group demonstrated the essential goal of understanding the procedural mechanics and conceptual elements of leveraging the operational direction, operational environment,

defining the problem, and developed an operational approach paradigm of "Design." While going through the design methodology, the group collaborated and organized among themselves. They engaged in lively and recursive dialogue and communicated conceptual and contextual thoughts and made use of the physical workspaces to analyze and explain topics by using storyboards and graffiti walls. They also recorded discussions by drawings and sketches to illustrate consensus behaviors and shared understanding. These sketches, mind-maps, and drawings included matters such as distinguishing characteristics between the current state of affairs and identifying those traits which were sought after in the future state. The group also illustrated those elements that needed to be changed, provided, or removed to make the difference in the environment. The fact the group was comprised of an interdisciplinary group was also made evident by the varied expertise that contributed to shared understanding through discourse. Analysis of the documents indicated that group learning and shared understanding occurred iteratively and through synthesis and discourse. Lastly, the group was required to demonstrate their understanding by transferring their shared knowledge and understanding to a wider audience. They used a combination of formal briefings to role-playing faculty, explanations, discussions, and followed through with a question-answer period.

Interview Results

One-on-one interviews were administered to eight participants. The purpose of the interviews was to hold a purposeful conversation to explore the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners. The interviews were used to collect data on opinions, beliefs, and feelings about the circumstances in their own words. According to Rubin and Rubin (2005), "Qualitative interviewing is a way of finding out what others feel and think about their worlds. Through

qualitative interviews you can understand experiences and reconstruct events in which you did not participate" (p. 1). Also, "Qualitative interviewing serves a dual purpose," asserted Bogdan and Biklen (2007), "of being used for both data collection and to complement observations and other means of document analysis" (p. 58).

Interviews took place until data saturation was reached, which as Bogden and Biklen (2007) point out is "the point of data collection where the information you get becomes redundant" (p. 69). The interviews consisted of 15 questions. A brief discussion took place to ensure that each participant comprehended the purpose of the research and the interview process. The organization of the interviews was open-ended. This is supported by Merriam (2009) who pointed out, "less structured formats assume that individual respondents define the world in unique ways. . . This format allows the researcher to respond . . . to the emerging worldview of the respondent, and to new ideas on the topic (p. 90)."

Each interview lasted no longer than 75 minutes and was audio-recorded, transcribed with the use of Dragon software, read, and coded. Interviewees contributed differing amounts and qualities of information. During in-depth interviews, study participants described their perceptions and experiences with design thinking and discussed their use of findings to improve the planning process.

Question 1: What role does design thinking play in successful problem solving?

The participants all described design thinking in various ways to address complex problems. One participant, Michael, responded during the individual interview, "I am really not sure that design thinking is actually meant to solve problems as much as it helps us target and solve the right problem." Another participant, Sara, commented, "I have to wonder if design thinking is nothing more than analysis of the mission, except used by senior leaders." When

prompted whether senior leaders understood the design thinking methodology, Sara responded that,

> the decision makers would probably look for assistance in facilitating the methodology, even by such junior staff officers. But now that I think about it, design thinking, is really thinking at a higher level and helps leaders to synthesize all the variables and gain insight to better understand the problem to be solved and visualize how to solve it.

All participants noted the importance of reflecting on dialogue and challenging assumptions. Kevin said, "You have to question each other and reflect on how one knows anything about what has caused this situation. Sometimes, we discovered that what we thought were absolute facts turned out to be assumptions and were not quite accurate." When prompted to address how this was important, the participant replied that "by challenging assumptions, we were better able to target the right problem to solve." The participants all described design thinking in various ways to synthesize, understand and visualize complex problems.

Question 2: How does design thinking vary among individual planners comprising the interdisciplinary planning team? The participants all described their experience with design thinking as a way to discover different aspects of the problem to be solved and indicated the importance of acknowledging biases. One participant, Brian, responded during the individual interview,

> For the past 10 years, I have been looking at problems from perspective of what my particular job is in the Navy. As an aviator, I never realized that other peoples' experiences and jobs in the Navy influenced how they might think about problems. I discovered that there was not so much a right perspective but various legitimate perspectives.

Amanda commented,

> I admit it. Our group is comprised of many different job experiences as well as other background such as coming from different parts of the country, different colleges, etc. I believe this interdisciplinary group, as you call it, was extremely valuable for the group to arrive at some shared understanding.

All participants noted the importance of such diversity in worldviews as essential to productive brainstorming. David offered, "Having such a mix of personalities, job specialties, etc., helped me understand how people look at problems and determine what needs to be changed, or made different in the environment to bring about a desired end state." The participants described their experience as a way to view a problem from various perspectives.

Question 3: To what degree does design thinking influence the planners during the problem solving process? All the participants described how design thinking and the group's discourse led them to be able to succinctly describe the problem presented. Amanda responded during the individual interview,

> At first, I felt the methodology was too regimented or prescribed. Later, I realized, the manner in which we used the methodology was simply a tool for facilitating the group process and encouraging dialogue so that we could all come to some sort of shared understanding.

Mark commented,

> I think the methodology helped us come to realize the many variables that come into play that contribute to a problem, or conflict. I would also add that when realizing the many variables involved, the methodology also encouraged discussion as we used the group process.

Kalan recognized how the methodology forced the group not to leap ahead to come up with viable solutions, rather to try to first understand the problem in context. This participant remarked,

> At first, I thought we could come up with options to solve the problem. I soon realized that some likely options might actually make matters worse. Later, I realized how important it was to come to the groups' shared understanding of the problem before trying to solve the problem.

All the participants described in a variety of ways how design thinking and the group's discourse helped describe the problem presented and facilitate the group process and encouraged dialogue.

Question 4: What characteristics do teams who effectively solve complex problems display? Each participant described, to one extent or another, the importance of effective group dynamics. Sara responded during the individual interview that "It is important for members to leave one's egos at the door." When asked to elaborate, she explained that "it is not only important to maintain an open and fair mind, but not take remarks from others personally. And because we are united in purpose, to be cooperative and supportive." Sara went on to remark that, "It was great to see that many different viewpoints contributed to our understanding of the problem." Michael commented, "For our group to understand the problem, we had to freely communicate our ideas and feel as we were all contributing to the collaborative effort." Each participant described, to one extent or another, the importance of effective group dynamics.

Question 5: How does knowledge of design thinking affect the activities of problem solving teams? The responses to this question followed in similar fashion as the previous question. The respondents described that knowing discourse was encouraged and that a shared understanding of the problem was the goal and affected the group dynamic in a positive manner.

Brian responded during the individual interview, "that because we engaged in open dialogue, it was natural to gain insight into the variables that were the underlying cause to the problem." Responses to this question generally referred to unity of purpose and how various perspectives contributed to understanding the problem.

Question 6: How does design thinking affect the subsequent development activities including concept generation, concept selection and detailed problem solving? This question was met with some degree of bewilderment by all participants because concept generation, concept selection, and detailed problem solving extended outside the scope of their design thinking experience. Once I realized this I stopped asking this question. However, a few of the participants offered an explanation. David responded during the individual interview, "I can see how coming to some shared understanding of the problem, once we go about developing ways of solving the problem we could refer back to our work in design thinking." Mark commented, "I imagine using our work will be essential when we have to come up with ways to actually solving the problem." Mark went on to elaborate that, "having feedback throughout detailed planning will be essential." Though this question could not be fully explored, most participants commented about how shared understanding of the problem was essential to move forward with planning.

Question 7: What is the interaction between framing and course of action selection? Similar to the previous question, this question was soon determined to be irrelevant in this case. It was not relevant because this question, too, was outside the scope of the students' design thinking experience. Had this study included actual problem solving, instead of first achieving understanding, it would be most relevant. One of the first participants to be interviewed, though, offered that, "going forward, it will be important to acknowledge our individual biases so that we

do not become personally attached to a particular course of action."

Question 8. How do problem-solving teams settle upon a suitable frame for their complex problem? Because the group was not at the point in the course where they were to propose ways to solve the problem, I rephrased the question to omit the term "problem solving." Having rephrased the question made it germane to the students' purpose of collaborating. Amanda responded that, "it's difficult to say precisely how and when we settled upon our shared understanding of the problem." She went on to say, "I suppose it was when we realized and were able to articulate our understanding on what need to be changed, provided, or removed to bring about favorable conditions." Kevin commented:

> I would have to say that because we kept asking ourselves questions and that those questions raised more questions, it was a reasoning manner we arrived at our understanding of the present conditions and the conditions we were looking for at the end state.

Responses to this question varied as well, but most remarked that the point they were able to articulate understanding on what need to be changed, provided, or removed to bring about favorable conditions is when they realized they could frame the problem.

Question 9: How does design thinking change over time (if it does) from an initial vision or proposal to a final shared view? The participants' responses varied. However, most participants made reference to the effect that the methodology, itself, did not change. Rather, their understanding of the concept and insight gained from design thinking became more sophisticated as did their ability to recognize limitations, or obstacles that impeded change in the environment. Kalan responded:

> My sense of insight, regarding the problem, seemed to expand as we went through the

> design thinking methodology. As I look back at the exercise, I gain an appreciation for how to think about problems. As a matter of fact, I believe I may be able to use the methodology alone, to some extent, when thinking about world affairs.

The participants' responses varied, but most made reference to understanding of the problem and insight gained from design thinking.

Question 10: What role does iteration play in coming to a final framing? Most participants described the relationship of feedback and problem framing. Mark responded, "As a computer science major, I would say that iteration is similar to recursion in computer code." Asked to elaborate, he explained that, "it's like when a computer is programmed to continuously loop back to find out if answers to various queries yield the same results. That's what our group did. Each iteration wound up generating even more questions." I asked how this practice contributed to problem framing. Mark explained that, "looping back helped us validate or invalidate assumptions and challenged previously held biases." Brian simply commented, "Using the iterative approach helped us build upon our understanding of the problem and what conditions needed to be changed." Kevin commented, "I can now see the relationship between reflection and iteration." When asked to elaborate, he responded that, "we kept going back over what we previously discussed and thought about what was agreed upon only to find ourselves modifying our understanding of the problem." Most participants described the relationship of feedback and problem framing as well as that of reflection and iteration. The notion of recursive thinking was also discussed by three participants.

Question 11: How are the different frames or perspectives of individual planners exchanged within a team setting? The participants all described the role open dialogue played in exchanging perspectives as well as the role of leadership. David responded, "It was important

to maintain open dialogue to share ideas and perspectives. The diversity of the group also ensured we were made aware of how each other saw the problem." Kalan commented, "It was important that someone was designated the leader of the group in order to keep the group on task and not wander off." When prompted to add to their statement, Kalan explained that "it was also necessary for us to remember to be unified in purpose and to support the designated leader." The topic of leadership came up often. Most participants also described the role open dialogue played in sharing various perspectives.

Question 12: Describe any differences between doctrine, what is taught, and what is experienced. Most participants described that there was value in doctrine but that doctrine has its limitations. Sara responded, "It appears that doctrine is not consistent. Also, doctrine only explains what design thinking is, not how to use it." When asked to explain further, she remarked that, "It is one thing to say what a concept is. It's an entirely another matter to be given a methodology, or technique on how to use it." When asked if their design thinking experience provided some useful techniques she responded that, "Much of this exercise used techniques that are not doctrinal. Rather, we used some techniques offered by the instructor." When asked to give an example on one technique she replied, "Using the rubric of 'RPC' to determine the difference and impediments to changing the environment." When asked to explain the rubric, she responded that,

> "RPC" stood for what needed to be removed, provided, and/or changed in the environment to bring about favorable conditions. That is just one example I can think of at this point. However, I believe that much of what we experienced was by using techniques that went beyond what doctrine offers.

Most participants described value in doctrine but that doctrine has its limitations.

Question 13: Describe any tools that could support problem-solving teams to better understand and apply the problem-solving process. Once again, I discovered the question needed to be rephrased because, as written, it extended beyond the scope of the group's design thinking experience. Accordingly, I replaced the term, "problem-solving" with "design thinking." Most participants referred to some physical tools such as graphic displays, maps, charts, and data obtained from intelligence sources. However, Michael responded that mind-mapping and sketches were useful in explaining ideas and thought processes within and among the group. Michael said, "I found that sketches and diagrams helped keep track of ground already covered and that we kept referring back to the illustrations as a frame of reference." Amanda commented, "The graffiti walls helped me reflect back upon to ensure we kept challenging assumptions." Mark commented that, "drawing on the board helped me visualize where we were going and aided in my understanding as well as kept us on task." Most participants referred to some physical tools such as graphic displays, maps, charts, mind-mapping, and sketches that were useful for collaborative learning.

Question 14: What are the obstacles or impediments of fully implementing an integration of design thinking into the linear problem-solving process? The participants described to one extent or another that senior leaders will likely impede fully integrating design thinking into the linear problem-solving process. When asked to explain, Kevin said that, "Senior leaders, if they even appreciate design thinking, may resort to using design thinking as the detailed planning process." When asked to elaborate, he responded that "I can see that senior leaders could become frustrated with just thinking about problems and want to jump to solving the problem." Kevin went on to say, "Now I understand more fully that it is important to isolate the problem before going about solving just any old problem." Brian commented, "I think some

of the terminology used in design thinking is a little too lofty to be fully implemented in the military." When asked to further explain he commented:

> Well, take the term design thinking. For years the military has used what we call elements of operational design to think about the elements of the environment. It's confusing how we seem to use these terms interchangeably. Additionally, doctrine indicates that there is to be a special 'design team.' How do we have separate group of people designing and another group actually doing the detailed planning? Somehow the two must be linked. I question whether we can do that.

Amanda commented, "Military leadership is more inclined to 'do' than 'think.'" The participants all described the biggest obstacle to fully implementing an integration of design thinking into the linear problem-solving process will be senior leaders.

Question 15: If deemed valuable, in what ways can design thinking be improved upon to incorporate into the military problem-solving process? Similar to responses from the previous question, most participants pointed toward education of senior leaders in design thinking as the best way to incorporate design thinking into the military problem-solving process. Kevin responded that, "Yes. I can see the value in incorporating design thinking into the military problem-solving process, but I think that some techniques for using it should be incorporated in our doctrine." David commented, "If some of the vocabulary were to be made more simple or plain instead of, well, 'esoteric' or conceptual, it would be better received in the military." Michael commented, "I think the idea of feedback or looping as well as facilitating the methodology could be emphasized more." Most participants indicated that education of senior leaders in design thinking as the best way to incorporate design thinking into the military problem-solving process.

The interview questions were crafted to answer the primary research question as well as the four sub-questions guiding this study. Interview questions established rapport and put the participants at ease. Specific interview questions supported one or more of the research questions. Open-ended questions provided thick descriptive data, and participants' quotes communicated their personal stories. Recording similar statements and phrases allowed for an analysis of the interview questions to occur. Emerging themes were noted and categorized according to the data collected and attributed to the participants who provided that data.

While concluding the individual interviews and beginning thematic coding, it was discovered that the information gathered and assessed contained rich themes and were consistent with the problem statement. It became clear conducting a focus group, as originally planned for in the research proposal, would yield no further data. This observation was confirmed because the very same participants who conducted the individual interviews would have comprised the focus group. I consulted with my dissertation committee who endorsed my recommendation. I retained the notion of conducting a focus group as a recommendation for future research. The rationale for retaining that instrument in the study's methodology was to indicate that the focus group is still deemed viable but that the composition of the focus group should not be from those who participate in the individual interviews. Alternatively, the use of the focus group would be more useful with a study oriented toward a target group regarding organizational learning, etc. The above results were used to arrive at findings that follow.

Study Findings

This study explored the intrinsic value of a design thinking-led problem solving education for collaborative learning of military student-planners at a senior military service college. The coding worksheets and data analysis form, located in Appendices G and H, present

themes drawn from each key data point for the research questions. The findings were arrived at by iterative and continuous analysis, which examined related sub-themes revealed by the instrument (see Appendix I). Because analysis of the data was subjective, interpretive bias was minimized by presenting various explanations to data where appropriate. This case study focused on one bounded system, an interdisciplinary group of military student-planners. This led to a holistic approach, whereby data from multiple sources were drawn together.

Auerbach and Silverstein (2003), along with Saldana (2013) described coding as a process applied to discover patterns. Merriam (2009) likened themes to codes that can be "single words, letters, numbers, phrases, colors, or combinations of these" (p. 173). Merriam (2009) described open coding as a process of composing categories by analyzing the transcripts and formulating notes beside the data. Codes were identified and used to build themes. The number of themes depended on data collection, but Merriam (2009) advised "the fewer the categories, the greater the level of abstraction, and the greater ease with which you can communicate your findings to others" (p. 187). The coding process followed Strauss and Corbin's (1998) three suggested types of coding: open coding, axial coding, and description making whereby more focus was applied to design thinking, the problem-solving process, and collaborative learning. Just as data analysis proved to be the most essential step of the research process, the coding and recoding process proved to be fundamental in analysis and encompassed classification of themes for refinement.

Often referred to as inductive coding, open coding was the primary method used in assembling data in inductive content analysis. Open coding permitted the results to be opened up and meaning to be explored through the identification of important themes or patterns (Creswell, 2007). After open coding, when data were broken into segments and categories formed, axial

coding was used to rebuild the relationships between categories (Strauss & Corbin, 1998). Axial coding looks for causal condition, context, intervening, conditions, strategies, and consequences. Next, codes were combined to form broader themes. Fundamental to this method is the constant comparison of segments of data, categories and so forth. Throughout the analysis—open analysis, open coding, axial coding and selective coding—the data were consulted to ground the themes. The initial lists of coded phrases or themes were recorded on a large whiteboard to track and analyze how the themes emerged. This list generated 108 elements. Next, commonality among the themes was examined using open coding. At this point, 82 re-emerging elements were discovered (see Appendix G). Through axial coding, the elements and phrases were next grouped, thereby reducing the number to 10 themes (see Appendix H and I. Upon further critical analysis of the data, three themes emerged which clearly characterized design thinking.

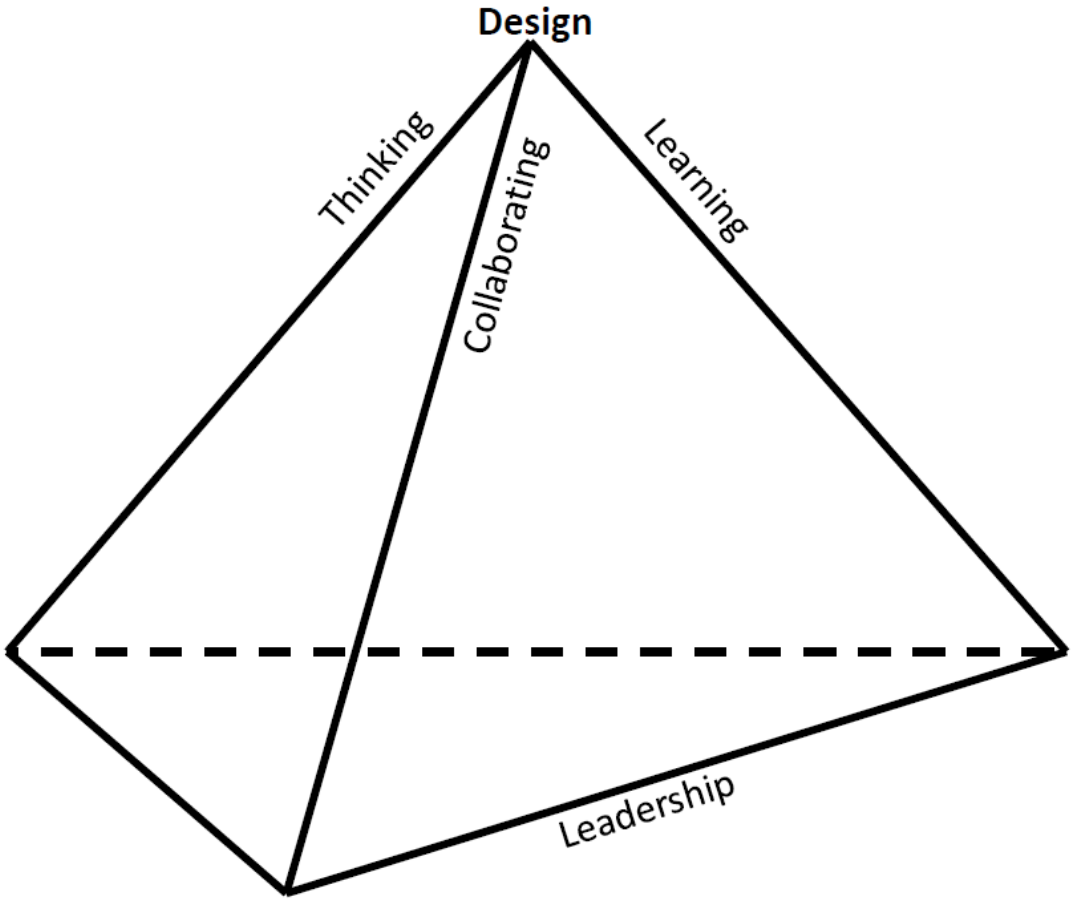

Figure 3. Themes

The three main themes that emerged are: (a) Design as collaborating; (b) Design as thinking; and (c) Design as learning. In reviewing the information further, it became clear that each of the three themes shared a foundational theme of leadership. Accordingly, a fourth theme emerged that thematically bounded the findings: (d) Design as leadership. While the themes are represented as being discrete, all four themes are interconnected through the literature and synthesis of the experiences of the participants. What follows is a presentation of each theme as well as the associated key words, phrases and concepts of each theme. Henceforth, these phrases, words, and concepts are referred to as "elements," that were revealed through data analysis. The rationale behind choosing a triangular shape to illustrate each theme will be discussed in Chapter Five.

Theme 1: Design as Leadership

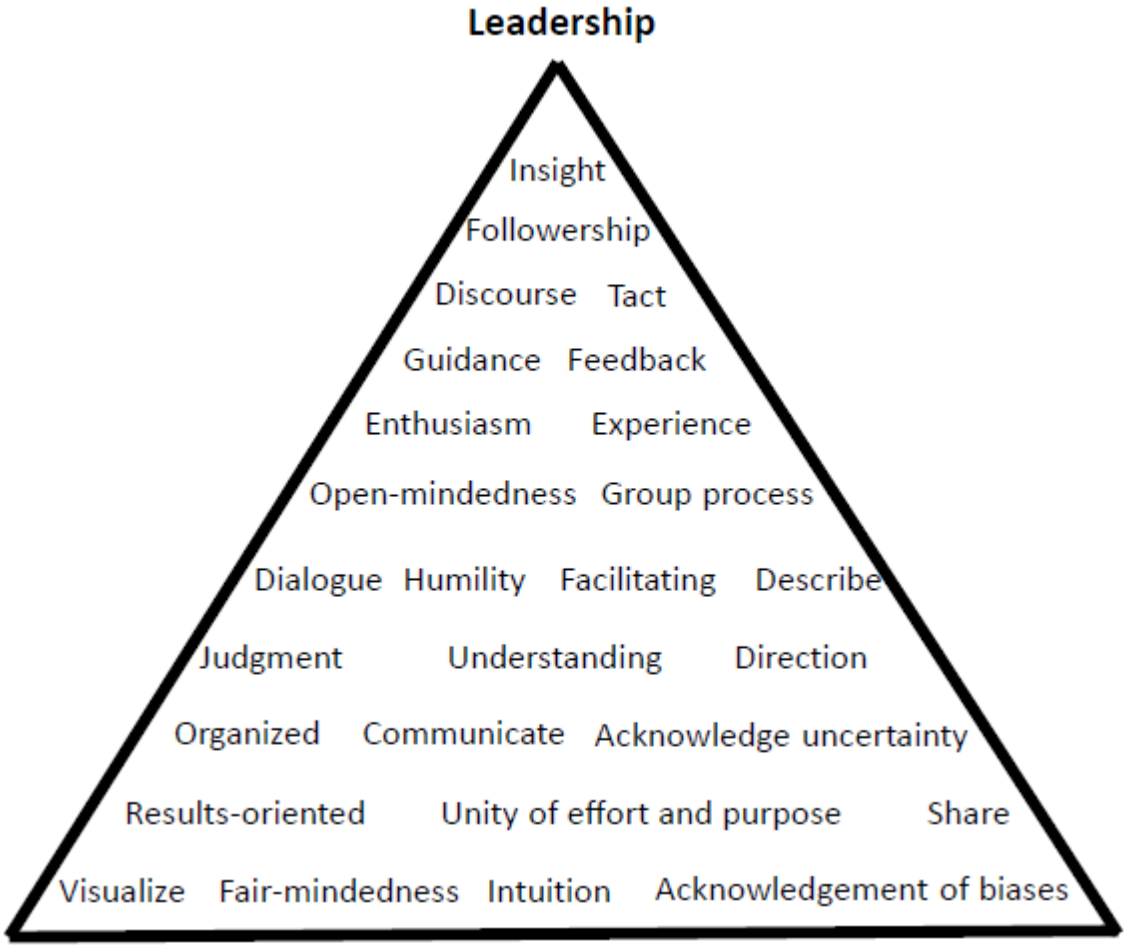

Figure 4. Theme one: Design as Leadership

The thematic code of leadership is the foundational theme, however, it was not discovered until it was discovered that the three basic themes were grounded in the common theme of leadership. During the observation periods I observed the members of the group exhibiting many traits of leadership. Although a leader of the group was designated, all members were observed, at one point or another, demonstrating various traits of leadership. Specifically regarding the group's membership, one of the striking examples of leadership was their seemingly unconditional support being in a subordinate role. Other than being aware of a designated leader who provided guidance and facilitated the methodology, it was apparent theirs

was a team effort. Other leadership traits exhibited throughout the group were open and fair mindedness, and all members seemed genuinely interested in others' viewpoints and ideas.

While conducting the individual interviews Kevin remarked that "collaboration requires disciplined leaders." He continued, "Even as members and peers, our leadership responsibilities continued. When told to lead, you lead and facilitate shared understanding. If you are not the designated leader, you need to act accordingly and support the designated leader." Sara remarked that "it was important to acknowledge uncertainty and put aside my bias."

While analyzing documents, which included discourse as well, various traits of leadership were present. Participants were able to assess the current situation, describe complicated concepts they visualized, developed an operational approach, and organize their briefings to share with the faculty who played the role of higher headquarters. As indicated earlier, the theme of leadership ran through each of the separate themes.

Theme 2: Design as Thinking

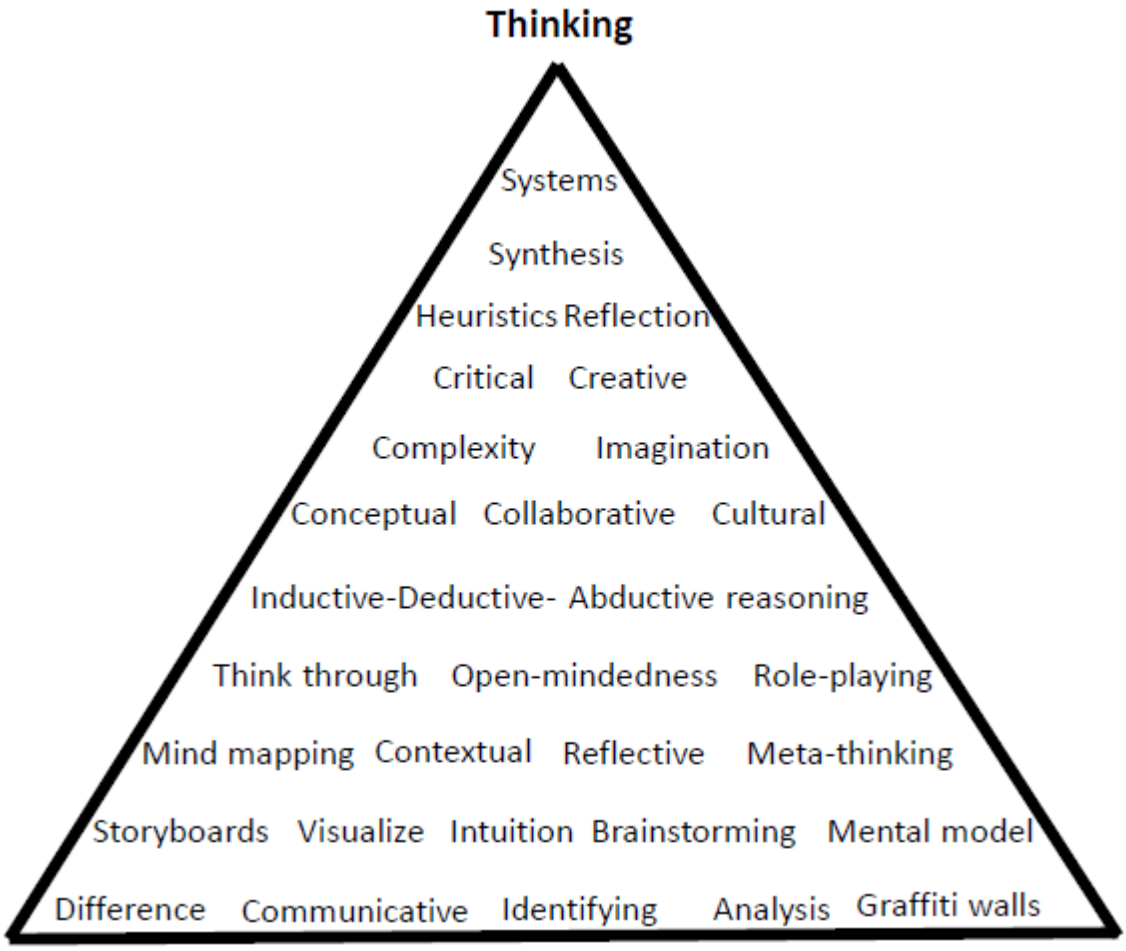

Figure 5. Theme two: Design as Thinking

The thematic code of design as thinking was discovered throughout analysis of each of the collection instruments. During the observation periods, one of the more prominent features where thinking occurred was during the group interpreting what was referred to as a vision and determining the difference between the current state of affairs and the desired future conditions. The leader of the group referred back to the part of the lesson that suggested the use of a technique to guide the group as they considered what needed to be changed, removed, and/or provided in the environment to achieve the desired conditions of the future state of affairs. The group used a systems or nodal analysis in order to frame their thoughts. Also observed are

characteristics of critical as well as creative thinking.

While conducting the individual interviews it became apparent that various types of logical reasoning were used. Beyond deductive and inductive reasoning, the group employed a higher level of thinking: abduction. Kaylan remarked that "we concluded there was no single solution to the problem but there were many wrong approaches." Michael commented "while we had to conduct extensive analysis of the systems and sub-systems that comprise the environment, we had to balance that analysis with intuition." David explained "we found ourselves looking for indications of things in the environment that didn't seem to fit and challenge assumptions." As expected, given the problem presented in the situation was complex, several facets of the system present competing avenues of progress rather than single points-of-solution. Confronted with the ambiguity, student planners gravitated to employ more than one to one deductions to gain shared understanding.

While analyzing documents, which included discourse, the manner in which the group thought about the complex problem was an evolutionary process toward attaining understanding. As the group proceeded with the design thinking methodology their reasoning extended beyond mere critical thinking. The final product demonstrated creative thinking and synthesis. The theme of leadership again was demonstrated through the briefing that the group leader presented. When challenged on certain aspects of the proposed operational approach, such as undesired secondary effects of some proposed actions, the leader was able to articulate the group's understanding and synthesis of the problem. The illustrations that supported the briefing also demonstrated reasoning and understanding of the operational direction, the environment, the problem as well as how to measure the effects of proposed actions.

Theme 3: Design as Learning

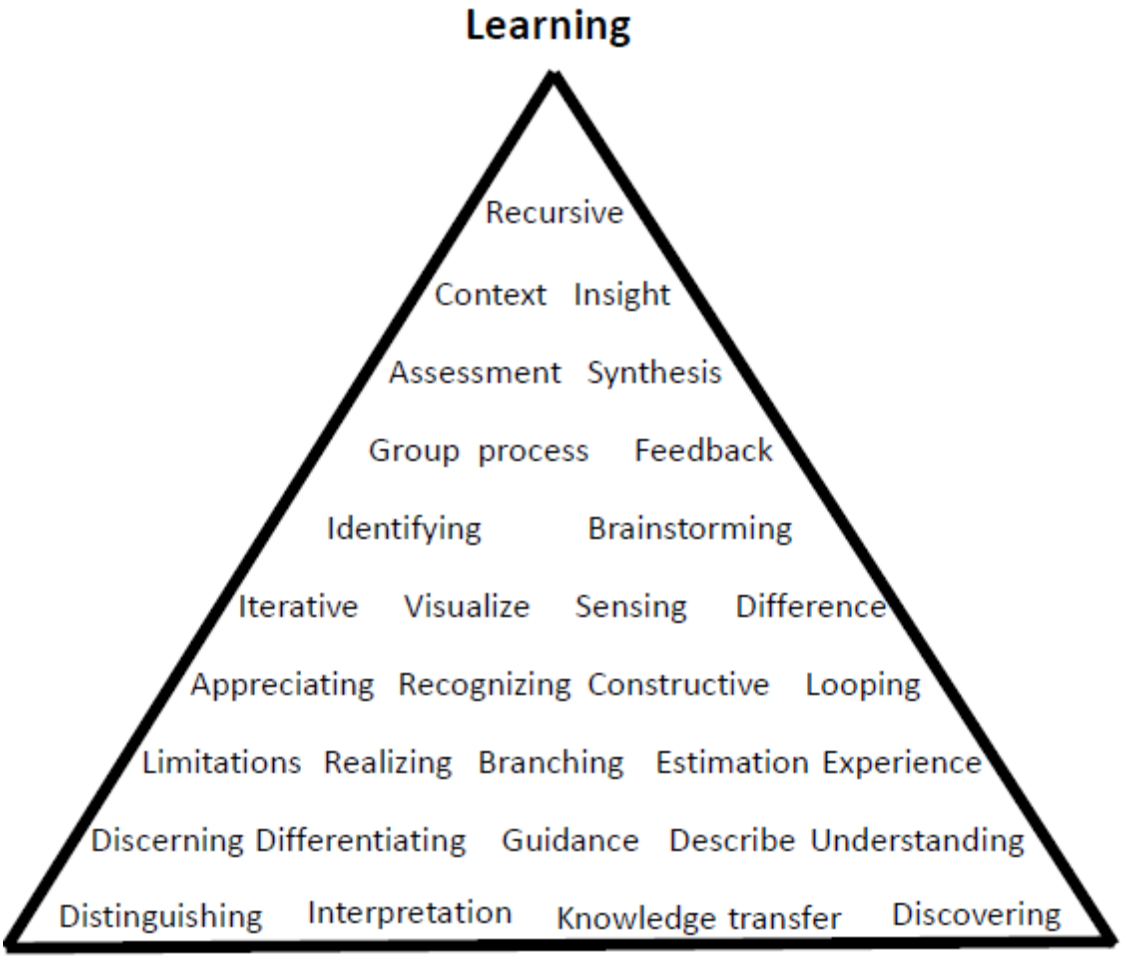

Figure 6. Theme three: Design as Learning

The thematic code of design as learning is a theme discovered primarily through observations and interviews, and to a lesser extent, through document analysis. During the observation periods, the group was witnessed discussing the overall design thinking methodology. It was clear that some members required remedial attention to certain aspects of the methodology while others needed to openly discuss the methodology and listen to feedback to first gain understanding of the methodology. Once it appeared every member learned and understood the methodology and what was expected of the group, the group was seen coming together for team learning in order to gain shared understanding of the problem they were

presented to solve and learn together the context of the problem. In order to understand the context and nature of the problem, the students discussed the operational direction and operational environment. To gain insight on the environment, the group performed a nodal or otherwise known as systems analysis of the environment commensurate with the direction they had ascertained. After a considerable time, discourse, and application of design methodology it appeared as though there was a transition from analysis to synthesis. After much discussion, everyone in the group appeared to understand the operating environment and the strategic direction. Because they shared an understanding of the operational direction and the operational environment, they appeared more confident to frame the problem. Once it appeared the students understood the operational environment and the strategic and operational direction, the group next turned to framing the problem. To initiate problem framing, the designated group leader was prompted by the faculty to assess the current situation and discover the difference between that and the desired future situation, referred to as the "desired end state," utilizing the rubric of provide, change, remove, or "RPC." The group was observed using this in an iterative and recursive manner. It is worthy to mention that nowhere in the literature was reference made to previous use of this technique to facilitate learning. To the best of my knowledge, this technique was one conceived by the faculty member. In any event, the technique appeared to be effective for learning. Again, the theme of leadership ran through the theme of learning too. It became evident early on in the observations that team learning requires that someone play the role of leader or facilitator in order to move discussions along, assess the group's learning, and evaluate shared understanding. The students were obviously absorbed in the exercise, but they were also engrossed in learning the process. Leadership was also displayed by each member in the group, as when the need arose, each filled the role of an emergent leader who encouraged each other

toward individual learning as well.

While conducting the individual interviews it was often remarked that learning involves leadership in the social sense because of the demonstrated traits of leadership such as critical, creative, and contextual thinking, etc., as well as self-discipline that enabled learning. This is particularly noteworthy since the interdisciplinary group was formed of peers and was rather informal. Amanda remarked that,

> most, if not all, members of the group displayed various examples of leadership. For example, not only the group leader, but peers as well encouraged me to share my perspectives with the group and were supportive. Not only did I sense that I was a contributing member and who helped the group learn from my experience and perspective, but I also learned about leadership from one of my peers.

Also discovered during the individual interviews was the value of peer and leader feedback which facilitated learning. Kaylan, when asked, "What characteristics do teams who effectively solve complex problems display?" responded,

> one of the common characteristics I experienced was coming to understand the problem and through synthesis by understanding and through the use of feedback. I believe our members, by being so supportive of each other greatly helped my ability to learn about solving the right problem with various methods.

I asked if those were "characteristics of leadership?" To which Kaylan responded, "Yes. Absolutely, I never thought of it in terms of leadership but that is exactly what it was…leadership." Also discovered during the individual interviews was how visualizing also contributed to learning. Amanda remarked that "visualizing the desired future state helped me learn and finally understand what obstacles or impediments were preventing the environment to

change from the way things are in the scenario." Mark said that "although I felt like I learned from the process of using design (thinking), it wasn't until I visualized the desired end state and walked it through, visually, on what was preventing solution to the problem."

Numerous and varied documents were analyzed pertaining to this particular portion of the overall planners course. Documents that supported the course included the course and session syllabus. Other material included documents that were needed to provide context and support students' understanding regarding the setting for the scenario in order for the students to continue with the practical application exercise for Scenario 'A'. Documents also included sketches and drawings, including charts and mind maps. The most relevant data germane to this study came from group-produced briefings, sketches, narratives both printed material and electronic material used in a collaborative information environment. It was clear that openly displayed sketches facilitated learning. The documents, particularly those generated by the group facilitated assessment of the problem and helped identify the numerous variables affecting the environment and recognize, distinguish, and learn what variables needed to be changed to bring about favorable conditions as well as what obstacles needed to be affected that would have otherwise prevented change. Additionally, these documents aided in the groups' estimation of the environment and ability to interpret the context of the problem, as well as visualize not only the methodology but also the desired state of affairs.

Theme 4: Design as Collaborating

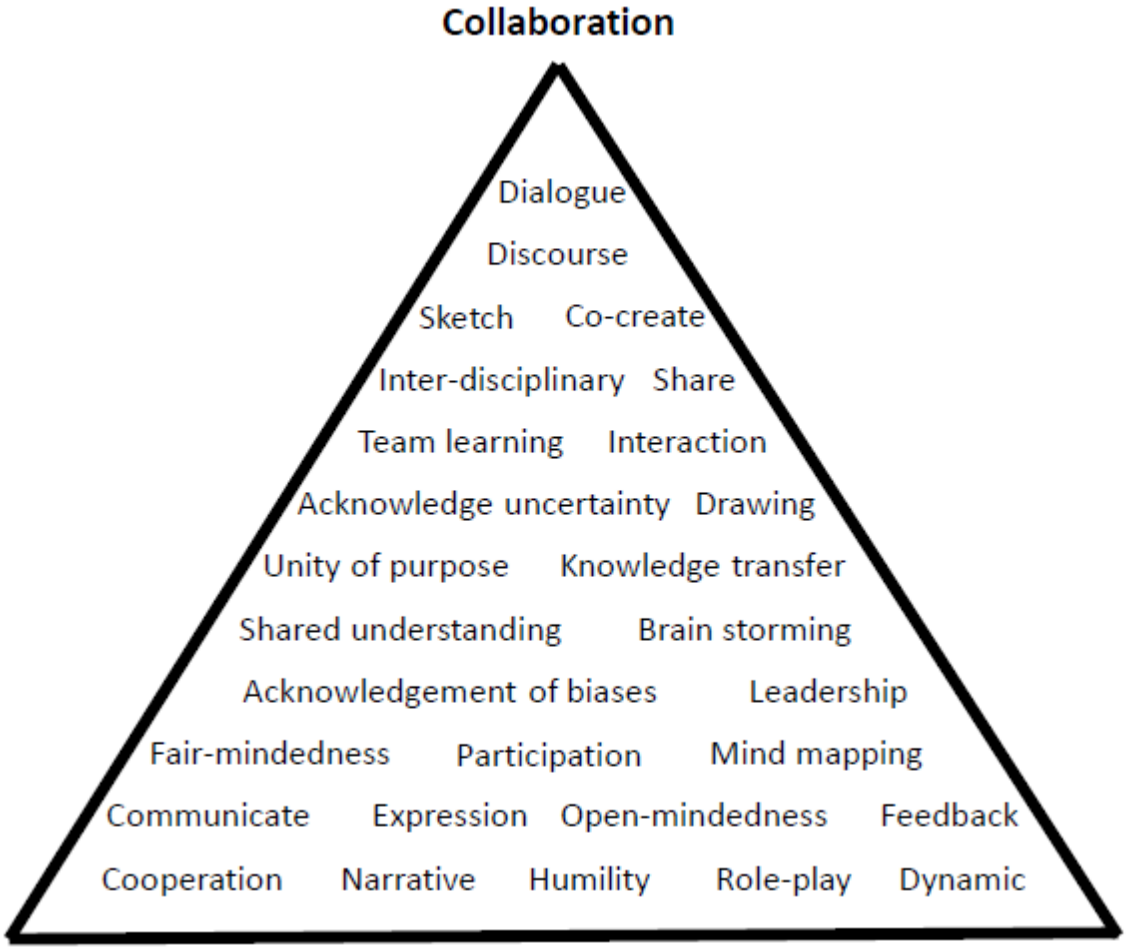

Figure 7. Theme four: Design as Collaborating

The thematic code of design as collaborating was discovered during data collection. While the group was rather homogenous in terms of age, military affiliation, education level, etc., they actually comprised characteristics of an interdisciplinary group. Just as the military in general is comprised of a population of many job specialties, so too was this group of participants. The experience, aptitude, and expertise among the participants varied. For example, one participant had many years of service but little experience with problem-solving. Yet, another participant who had far fewer years in the service had considerable experience with collaborating to solve problems. The group was also diverse regarding the variety of job

specialties of its members. Some participants were surface warfare officers, while two others were logistics officers. Still, another was a tactical fighter pilot. The diversity among the group regarding experience, aptitude, and expertise turned out to be a valuable characteristic that enhanced and facilitated group learning and shared understanding.

During the observation period, student-planners were observed exhibiting the value of collaborating to solve a complex problem. Heard more than once by more than one participant was how great it was to hear others' perspectives on how to view the nature of the problem. One student remarked, "I never looked at a problem from the perspective of anything other than surface warfare." Later, another student remarked, "Before, I never thought that there was a process for intelligence gathering." Also noted was that the group dynamics encouraged open and fair-mindedness. If anyone had a dominant personality, it either went unobserved, did not exist, or was suppressed for the good of the group. This fair-mindedness also seemed to encourage introspection of conduct and discourse. I observed participants contemplating before commenting. Each member was courteous and was given opportunities to contribute and comment. As the collaborative group continued using design thinking, it became evident that the process was rather recursive (recursive meaning that as a topic was discussed, questions were asked). Other questions were subsequently built upon previously answered questions. I also observed that questions which were already answered were asked again, prompting dialogue that diverged from previous discussion. This process was repeatedly applied to gain shared understanding.

While conducting the individual interviews, it was often remarked that collaboration involves leadership in the social sense, particularly since the interdisciplinary group was formed of peers and was rather informal. Nonetheless, one participant was designated the lead member

who was responsible for the group's progress and was the group spokesman. The other group members also exhibited emergent leadership. David remarked that "collaboration requires disciplined leaders." He continued, "Even as members and peers, our leadership responsibilities continued. When told to lead, you lead and facilitate shared understanding. If you are not the designated leader, act accordingly and support the designated leader." As indicated earlier, the theme of leadership and understanding ran through each of the separate themes. In like manner, three participants indicated that for collaboration all members had to share a hard working ethic. Perhaps this may be attributed to the fact that leadership responsibilities were rotated among the students throughout the course. In any event, the group dynamic trait was mentioned a number of times during the individual interviews as well as observed during group activities. Mark commented "Everyone must go 'all-in' because you don't want to be the one who lets down the others. So, you must take on a personal responsibility….be accountable."

While analyzing documents, discourse, and decision making tools, it became clear openly displayed sketches, drawing, and other illustrations facilitated and prompted collaboration. It was clear that collaboration was required to produce documents that displayed shared understanding among the group. Moreover, these documents were necessary to not only record discourse of the design-thinking experience, but to also convey to those outside the design team; those not involved in the exercise, a shared understanding of the problem and articulation of a general approach toward confronting the problem. The collaborative document that served to convey this shared understanding was called the "Commander's Design Concept." Additionally, in producing documents, participants indicated that for effective collaboration all members had to share a hard working ethic, cooperate, and share a unity of purpose.

Presentation of Results by Research Question

Central to the study was the question: How can military planners be better prepared to solve complex, ill-structured problems through design thinking? This primary research question was central to the research study because the answer to this question provides the potential to inform military educators as to how they can provide relevant and rigorous planning instruction to student-planners. Based on the themes that formed through observations, document analysis, and individual interviews, I concluded that when presented with a complex, ill-defined problem and in the absence of receiving comprehensive and specific planning guidance, participants can effectively use design thinking methodology. Beginning with the faculty-led lesson on design thinking and leading the methodology, participants successfully demonstrated leadership throughout the study, collaborated to learn using advanced thinking and reasoning skills to achieve shared understanding. Through mastering the themes discovered in this study and adherence to the methodology of design thinking, military planners will be better prepared to solve complex, ill-structured problems.

In addition to the central question in the study, there are four sub-questions. Central questions are generally broad and serve as the foundation for the development of subsequent questions. Sub-questions are typically narrow and serve as a method to focus interviews, close observations, and document analysis (Creswell, 2007). Creswell divided sub-questions into issue-oriented and procedural-oriented sub-questions. Whereas issue-oriented sub-questions are theoretical and designed to separate the central question into subtopics and issues, procedural-oriented sub-questions are process-related and meet the researcher's requirement for information relative the intent of the research (Creswell, 2007). The central research question, along with issue and procedural oriented sub-questions guided the study.

Issue Oriented Sub-questions

1. How can military planners receive comprehensive planning guidance needed to address complex, ill-structured problems?

The answer to this question offers the potential to inform military leaders as to how they can provide essential planning guidance and transfer knowledge to the collective planning team members. Based on the themes formed through observations, document analysis, and individual interviews, I concluded the methodology of design thinking will greatly facilitate planners' comprehensive understanding of the operational environment, the operational direction, the problem, and developing a general approach to solving complex problems. With this shared understanding, military planners are better equipped to develop, propose, and share commanders' intent and initial guidance so that detailed planning may commence. Each of the four themes discovered in this study, as well as their respective elements illustrated within the corresponding triangles, apply toward answering this first issue-oriented sub-question.

Theme 1: Leadership. Leadership was discovered as the foundational theme of design thinking from which the other themes were grounded. This study viewed leadership from a wider perspective. Whether characteristics, traits, and/or position, leadership was found to be catalyst for design thinking. The elements of leadership as depicted in Figure 4 were found through each of the research instruments. This study concludes that leadership is required for effective design thinking. Design methodology requires someone who is results-oriented and with enthusiasm to take charge in order to facilitate and lead the group process. Additionally, the methodology not only encourages open dialogue, this study found that dialogue and discourse were essential, as was feedback. The final product of design thinking was to gain insight of the problem as well as come to shared understanding and describe and direct an approach to address

the problem.

Theme 2: Thinking. The theme of "thinking" emerged rather early in the analysis of data. Each of the research instruments revealed that design thinking requires advanced thinking skills. More than mere analysis, design thinking requires synthesis of the myriad of variables directly and indirectly associated with the problem. In addition to inductive and deductive reasoning, design thinking requires abductive reasoning and ability to sense through intuition or heuristics. Also, in addition to critical thinking, design thinking requires a creative thinking to understand and address complex problems. The use of reflection, brainstorming, storyboards, and mental models were found to be quite useful, particularly regarding the group's understanding of the difference between the current state of affairs, the conditions of the desired state of affairs, as well as identifying what needed to be changed to reach the desired state and actions that might be taken to create that change.

Theme 3: Learning. The theme of design thinking as learning emerged relatively early in data analysis. Presented with a complex, ill-defined problem, it is essential not only that individuals learn, but also that group learning occurs. This requires the group to use advanced learning skills. The advanced learning that design thinking fosters is both recursive and iterative. Recursive learning is similar but more sophisticated than endless loop learning in that branching points lead to synthesis and shared understanding. Undergoing recursive and iterative learning requires discussion be recorded, which describes the context of what has been explored. In the absence of receiving clear and comprehensive guidance or insight from higher headquarters and senior leadership, design thinking facilitated group learning to arrive at shared understanding.

Theme 4: Collaborating. The coding process revealed that collaborating is a theme in design thinking. Each of the research instruments shared many of the key words and techniques

for collaborating to address the complex, ill-defined problem. Effective design thinking encourages an interdisciplinary group to use feedback, open dialogue, and discourse to arrive at shared understanding. Additionally, effective design thinking promotes the use of collaborative techniques such as sketches, mind mapping, and drawing. The use of these collaborative tools and discourse facilitated the transfer of knowledge and enabled the group to co-create products necessary to share that knowledge and understanding to those persons outside the group.

2. What methods do military planners use to confront complex, ill-structured problems?

This question is important because the answer serves as a forcing function that critically examines the process used by planners to solve problems. Based on the themes formed through observations, document analysis, and individual interviews, I concluded the methods used in design thinking methodology will greatly facilitate planners' comprehensive understanding of the operational environment, the operational direction, the problem, and developing a general approach to solving complex problems. Each of the four themes discovered in this study apply toward answering this second issue-oriented sub-question.

Theme 1: Leadership. The leadership theme runs throughout design thinking. A group leader needs to be designated in order to facilitate the design thinking methodology, keep the group focused, and remain on task. The group leader must be tactful and an effective communicator that encourages open-mindedness and can effectively facilitate dialogue and discourse. Additionally, the leader must have all products assembled and share with other persons outside the design team to pass on insight gleaned from design thinking. Leadership requires the interdisciplinary group members to acknowledge uncertainty and acknowledge biases. Additionally, all members of the group must demonstrate leadership characteristics. Said another way, when not designated as the group lead, all others should demonstrate leadership in

the form of followership as a method to confront complex, ill-defined problems.

Theme 2: Thinking. Design thinking advances the use of various thinking methods. In order to address complex, ill-defined problems, a higher level of thinking is required. Design thinking offers methods to think through the problem and synthesize and conceptualize the myriad of variables that have caused the problem. Much of this synthesis comes about as a result of reflection, abductive reasoning, critical and creative thinking. Design thinking also promotes the use of various thinking tools. Role-playing and mind-mapping are just some of these tools. Additionally, the display of mental models, concept mapping, and storyboards are also encouraged.

Theme 3: Learning. Learning, as a theme in design thinking, is apparent since the objective of design thinking is to learn in order to arrive at understanding the conditions underlying the problem. In order to address complex, ill-defined problems, military planners must use advanced learning methods. Design thinking offers various methods to assess the current situation and use estimation to comprehend meaning of the myriad of variables that have caused the problem. Effective design thinking promotes recursive and iterative learning and relies on feedback following brainstorming, interpretation, and sensing activities. Military planners also use learning methods such as discerning, differentiating, distinguishing, and visualizing to learn about the difference between the current situation and the desired state of affairs, then learn about viable general approaches to confront the problem by changing elements of the environment.

Theme 4: Collaborating. Design thinking advances the use of various collaborating methods in order to address complex, ill-defined problems. The coding process revealed that collaborating is a theme in design thinking. Each of the research instruments found many of the

key words and methods for collaborating. Effective design thinking encourages an interdisciplinary group to interact and use open dialogue and discourse to arrive at shared understanding. In order for collaboration to be effective, the group must acknowledge uncertainty as well as acknowledge biases. Effective collaboration in design thinking requires participation, cooperation, and communication, a group dynamic that fosters fair and open-mindedness. Additionally, effective design thinking promotes the use of collaborative methods such as role-playing, brainstorming, storyboards, sketches, mind mapping, and drawing.

Procedural Oriented Sub-questions

3. How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning?

Understanding how and in what ways planners collaborate is helpful in developing and delivering future professional military education. It is important to note that while data was collected on how military planners integrate design thinking into problem solving, no data was collected on if, and/or how the methodology was integrated throughout problem solving. The distinction here is that data were collected regarding military student-planners design thinking before they experience the detailed, linear problems solving process. If, and/or how design thinking is integrated throughout the problem-solving process is outside the scope of this research, but should be considered as a topic for future research. In any event, elements in each of the themes of the present study were revealed as findings for this research sub-question.

Theme 1: Leadership. As indicated in the central and issue-oriented questions above, the leadership theme runs throughout design thinking. Procedurally, a group leader needs to be designated in order to facilitate the design thinking methodology. He or she must be organized, keep the group focused, and remain on task. The group should be comprised of interdisciplinary

group members. The leader should establish a group dynamic that encourages open mindedness and facilitates dialogue and discourse. The leader should seek direction in the form of planning guidance from higher headquarters and convey this information to group members. Leadership during design thinking must acknowledge uncertainty and acknowledge biases, as should the members of the group. Design thinking is very much a group process whose objective is to arrive at shared understanding. Leadership is required to facilitate the design thinking methodology and ensure unity of effort and purpose.

Theme 2: Thinking. A number of elements associated with the theme of thinking were revealed in how planners proceed to integrate design thinking into the linear problem solving process. Notwithstanding that thinking itself is a process, design thinking requires advanced thinking skills and the ability to visualize the environment in context. However, the process toward advanced thinking cannot bypass the fundamentals of thinking. Higher order skills include such levels as critical, systems, analysis, creative, visual, synthesis, and meta-thinking.

Theme 3: Learning. A number of elements associated with the theme of learning were revealed in how planners proceed to integrate design thinking into the linear problem solving process. In similar fashion as the theme of thinking, learning too is a process and requires higher levels of learning. However, the process toward higher learning cannot circumvent the fundamentals of learning. Higher learning skills include iterative and recursive learning and relies on some operational experience and awareness of limitations. Design thinking also enables learning to be shared through the transfer of knowledge.

Theme 4: Collaborating. Procedurally, a group of interdisciplinary planners assemble together to address complex, ill-defined problems. The group collaborates with a unity of purpose and must first acknowledge uncertainty and acknowledge biases. Next, the group

dynamic must foster open and fair-mindedness and facilitate dialogue and discourse and through team learning.

4. How can the current problem-solving process be improved?

Understanding how the problem-solving process can be improved is essential to curriculum development and discovery of effective teaching methods. It is worthy to note again this study was limited to design thinking and its integration into the linear problem-solving process, not throughout that process. However, based on the themes and their separate elements that formed through observations, document analysis, and individual interviews, I concluded the current linear problem solving process can be improved by integrating design thinking.

Theme 1: Leadership. Procedurally, design thinking encourages senior leaders to become more involved in the entire planning process, share their experiences with insight, and discern through judgment. The interdisciplinary group requires intervention at key periods throughout the problem solving process. Generally, senior leaders have a wealth of experience and are privy to communications with peers that need to be relayed to subordinates in the form of guidance and feedback. Regarding the interdisciplinary group leader, one should be designated who will quickly organize its members to first learn. Procedurally, the leaders should next establish a group dynamic that encourages open mindedness and facilitate dialogue and discourse as well as seek insight from higher headquarters and communicate knowledge and understanding to group members. The group leader should then encourage the group to acknowledge uncertainty and biases. Design thinking is very much a group process, requiring discourse among the members, whose objective is to arrive at shared understanding. Leadership is required to facilitate the design thinking methodology and ensure unity of effort and purpose.

Theme 2: Thinking. Procedurally, the methodology of design thinking promotes a

higher level of thinking. A number of elements associated with the theme of thinking were revealed in how planners undergo collaborative design thinking and proceed with the linear problem solving process. Some of the additional cognitive processing from design thinking are analysis, systems thinking, imagination, and creative thinking. Once those thinking skills were used among the inter-disciplinary group, even higher level skills were utilized, including reflection, abductive reasoning, and synthesis.

Theme 3: Learning. Procedurally, the methodology of design thinking promotes a higher level and perspective of learning. Various forms of learning were used to improve the current problem solving process with collaborative design thinking. Techniques such as contextual, recursive learning, sensing, and iteration facilitated the inter-disciplinary group to identify, assess, recognize differences, and comprehend complexities of the problem. Other learning practices that would also improve the linear problem solving process include estimation, interpretation, and discernment.

Theme 4: Collaborating. Much of what the design thinking offers is already practiced in the current linear planning process, particularly regarding collaboration. In fact, collaborating with an interdisciplinary group is highly recommended. However, the design thinking methodology offers ways to improve collaboration, thereby improving the linear problem solving process. Procedurally, the group of interdisciplinary planners must first acknowledge uncertainty and acknowledge biases. Next, the group dynamic must foster open and fair-mindedness and facilitate dialogue and discourse through team learning. The end result of collaborating through team learning is shared understanding and knowledge transfer.

Summary

The purpose of this chapter was to report the data analysis and research results as it

pertains to themes that were discovered. The chapter began with a restatement of the problem and purpose of this case study research, and explained the findings for this case study. The findings were merged to produce common themes and answer research questions. The report of data included observation results, document analysis results, and individual interview results that included participants' input regarding the four themes that emerged from analysis of the data. In Chapter Five, those findings are interpreted and conclusions of this research are presented. Implications for the professional military education continuum and implications for the further research are also discussed in Chapter Five.

CHAPTER FIVE: DISCUSSION

Introduction

Chapter Five begins with a summary of the findings that were presented in Chapter Four followed by a discussion of the findings of the current study relative the literature and theoretical framework. Next, there is a discussion of the implications of those findings considering the relevant body of literature. Afterward, study limitations and recommendations are presented. The chapter culminates with the finale of the manuscript.

Summary of Findings

Central to the study was the question: How can military planners be better prepared to solve complex, ill-structured problems through design thinking? This question is important because the answer has the potential to inform military educators as to how they can provide relevant and rigorous instruction to student-planners. Based on the themes formed through observations, document analysis and individual interviews, I concluded that when presented with a complex, ill-defined problem in the absence of receiving comprehensive and specific planning guidance, participants effectively collaborated and used the design thinking methodology. Beginning with the faculty-led lesson on design thinking and through the practical application exercise, the participants successfully demonstrated leadership throughout the study, collaborated to learn using advanced thinking and reasoning skills to achieve shared understanding. These four themes were inextricably joined. Leadership was determined to be the foundational theme upon which the others were built. Thinking, collaborating, and learning completed the design thinking framework. Through mastering the themes discovered in this study and strict adherence to the methodology of design thinking, military planners will be better prepared to address problems.

Discussion of Findings

The review of literature offered a solid foundation and framework of the theories behind design thinking. From this knowledge, research questions were created. Throughout the development of this qualitative case study, the central research question, along with issue and procedural oriented sub-questions, guided the study. The central research question was: How can military planners be better prepared to confront problems through design thinking? The issue and procedural oriented sub-questions were:

1. How can military planners receive comprehensive planning guidance?
2. What methods do military planners use?
3. How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning?
4. How can the current problem-solving process be improved?

The four main themes that emerged are: (a) Design as collaborating, (b) Design as thinking, (c) Design as learning, and (d) Design as leadership. While the themes were reported as being discrete, all four themes are interconnected through the literature and synthesis of the experiences of the participants.

On the whole, findings of this research confirm the literature. Integrating design thinking into the linear planning process encourages a more complete understanding of the problem confronted, the operating environment, and the purpose of an operation (Brown & Wyatt, 2010; de Czege, 2009; Eikmeier, 2010; Hobday, et al., 2012; Kem, 2009; Schmitt, 2010; U. S. Army, 2012; U. S. Army War College, 2011). A synthesis of the literature indicated that material regarding design thinking is not new. The volume has, in fact, grown in the last decade, particularly regarding business and organizational development (R. S. Wurman, personal

communications, 29 August, 2014). Much of the material focused on design thinking as a means to close the problem-framing gap in problem solving, especially in complex problems. Exhaustive critical research revealed that the literature remains at the theoretical level with prolific discussion of the esoteric lexicon. What was absent until the current study is research that advances the subject of design thinking from theory to practice. The study also demonstrated that design thinking is a blend of several theories that suggest the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners. Results of this study suggest implications for positive change in the U.S. military regarding overall professional education with an emphasis on leadership, advanced thinking, learning, and collaboration skills.

Theme 1: Leadership

The findings indicate that leadership was the most prominent theme throughout design thinking and serves as the foundational theme upon which others were built. Effective leadership is characterized by open dialogue, discourse, and understanding. Leadership, combined with experience, provides insight into underlying causes of complex problems and enables leaders to articulate intent and guidance to subordinates. During the observation periods I watched the members of the group exhibiting many traits of effective leadership. Other leadership traits exhibited throughout the group were open and fair- mindedness, and all members seemed genuinely interested in others' viewpoints and ideas.

While conducting the individual interviews it was often remarked that learning involves leadership in the social sense because of the demonstrated traits of leadership such as critical, creative, and contextual thinking, etc., as well as self-discipline, peer and leader feedback that enabled learning. This finding mirrored prior research that suggested the design methodology

can help leaders better understand the operating environment and provide ways to discern the true nature of the problem to be solved (Dorst, 2011; Heaney, 2013; Paparone, 2012). Only then can decision makers provide the planning guidance required to develop feasible approaches to complex, unfamiliar problems.

This study highlights the crucial role of leadership and is in agreement with the literature regarding the importance of leaders to articulate essential guidance and transfer knowledge to the collective planning team members (Akin, 2009; Banach, 2009; Bousquet, 2009; Conklin, 2008; Di Russo, 2013; Dorst, 2011; Eikmeier, 2010; Jablonsky, 2010; Jensen, 2009; Lawson, 2006; Leifer & Steinert, 2011; Rutledge, 2009; Schmitt, 2010; Wertheimer, 2013; Zweibelson, 2011). The design thinking methodology provides many leadership tools to confront complex, ill-defined problems. Findings of this study suggest that military educators emphasize effective leadership development at every opportunity and at every level.

Theme 2: Thinking

The findings indicate that higher levels of thinking are facilitated by the design thinking methodology and that advanced thinking skills are required to confront complex, ill-defined problems. Advanced thinking is characterized by abductive reasoning, lateral thinking, synthesis, and understanding. Higher-level thinking enables military planners to better think through the underlying complexities of ill-defined problems and develop ways to confront them. A number of elements associated with the theme of thinking were revealed in this study. One of the more prominent features where advanced thinking occurred was in the group interpreting what was referred to as a vision and determining the difference between the current state of affairs and the desired future conditions. Moreover, beyond deductive and inductive reasoning, the group employed a higher level of thinking: abduction. This supports Kolko (2010) who

described this synthesis as an "abductive, sense-making process of manipulating, organizing, pruning, and filtering data in the context of a design problem, in an effort to produce information and knowledge" (p. 3). Some participants remarked there were no single solutions to the problem but there were many wrong approaches. Thagard and Cameron (1997) explained abductive reasoning classically begins with an incomplete set of observations and advances to the likeliest possible explanation. Nigel Cross (2011) referred to this as "constructive thinking" (p. 136). Additionally, Dorst, (2011) contended design thinking is problem framing which can be understood as a manner of abductive reasoning and an insightful process that raises good questions rather than seeking the right answers Wylant (2008). Also, the participants had to conduct extensive systems or nodal analysis of the systems and sub-systems that comprise the environment while balancing analysis with intuition. Altogether, this finding reflects Kolko (2010) who offered a technique for giving structure to the synthesis process: "Reframing, concept mapping, and insight combination—emphasizes prioritizing, judging, and forging connections. These qualities are derived directly from the logical processes of abduction and the cognitive psychology theory of sensemaking" (p. 10).

Additionally, the study also corroborates the literature in that a prerequisite to applying design thinking is to have a basic understanding of critical and creative thinking in order to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them (U. S. Army, 2010). As the group proceeded with the design thinking methodology their reasoning extended beyond mere critical thinking. The final product demonstrated reflection, creative, lateral thinking, and synthesis. This finding, too, supports Paparone (2001) and Kem, (2009) who asserted that advanced thinking is facilitated by design thinking and overcomes major failings of the current linear planning process whereby planners work "from

the desired end state back to the present is such a pervasive concept that it is both a constant process and generally an accepted 'root metaphor' that defies critical introspection" (Kem, 2009, p. 15). The current study provides insight on advanced thinking as demonstrative of the abductive reasoning model characterized as guessing in contexts of limited information and is in agreement with the literature regarding advanced thinking (Augier, 2001; Branch, 1998; Brown & Wyatt , 2010; Buchanan, Doordan, & Margolin, 2010; Cross, 2011; De Bono, 1967; de Czege, 2011; Elkus & Burke, 2010; Hudson, 1979; Kolko, 2010; Martin, 2012; Mattis, 2009; Newman, 2011; Papanek, 1971; Rittel, 1973; Rowe, 1987; Rudesheim, 2011; Schneider, 1994; Simon, 1945, 1957, 1969; Van Creveld, 1985; Von Bertalanffy, 1950; Wang & Wang, 2011; Williams, 1997; Wylant, 2008). Findings of this study suggest military educators use the design thinking methodology to develop advanced thinking.

Theme 3: Learning

The findings indicate that higher levels of learning are facilitated by the design thinking methodology and that advanced learning ability is required to confront complex, ill-defined problems. The current study reflects the literature in that advanced learning through the design thinking methodology facilitates in creating an adaption in understanding one's context or point of view (Argyris, 1993). Design thinking compels learning organizations (Senge, 2006) to understand the relationship between problems and solutions. Moreover, design thinking also enables the learning organization to understand how previous actions led to the current condition and is the instrument learning organizations use to enable them to ascertain and assess organizational theories of action (Argyris & Schön, 1995).

In order to understand the context and nature of the problem, the participants initiated problem framing by assessing the current situation and discovering the difference between that

and the desired future situation, referred to as the "desired end state." This comports with Paparone (2001), who found that design thinking is "a multi-dimensional undertaking with the decision maker, environment, organization (vertical and horizontal), planning, learning and procedures as its major aspects" (p. 48). The current study also discovered the group used design thinking in an iterative and recursive manner and while they were obviously absorbed in the exercise, they were also engrossed in learning the process.

The current study provides insight on advanced learning and is consistent with the literature (Argyris & Schön, 1995; Beckman & Barry, 2007; Cross, 2011; Knowles, 1973, 1980, 1983; Rowe, 1987; Senge, 1983, 2006). The findings of the current study suggest advanced learning skills, such as those offered by loop learning are aimed at creating an adaption in understanding one's context or point of view (Argyris, 1993). Additionally, these skills compel learning organizations (Senge, 2006) to understand the relationship between problems and solutions. The study also reflects the literature that design thinking facilitates the learning organization to understand how previous actions led to the current condition and is the instrument learning organizations use to enable them to ascertain and assess organizational theories of action (Argyris & Schön, 1995). Findings of this study suggest military educators use the design thinking methodology to develop advanced individual and group learning skills.

Theme 4: Design as Collaborating

The findings indicate the thematic code of design as collaborating extended throughout design thinking. Effective collaboration is characterized by interdisciplinary group membership, discourse, and shared understanding. The findings of this study reflect prior research in that design thinking is foundational for the framework inter-disciplinary teams need to communicate and to coordinate activity (Lindberg et al., 2010). Findings also confirm Brown and Wyatt

(2010) who explained design thinking as a methodology to problem solving that aids interdisciplinary team members to create a "vibrant interaction environment that promotes iterative learning cycles driven by rapid conceptual prototyping" (Leifer & Steinert, 2011, p. 151) and facilitates co-development of solution and problem space (Cross, 2011). Moreover, findings from the current study mirrored those of Hargadon and Bechky (2006) who discovered a collective creativity paradigm that explained how problem solving is initiated with the individual problem solver and transitions to group interaction. Their findings suggested that while occasional solutions may very well come about from individual insight, most are the result of collaborative efforts. These findings along with those of Feltovich, Hoffman, Woods, & Roesler (2004) comport with those of the current study that effective collaborative teams are comprised of "multiple viewpoints, multiple value systems, multiple ways of operating, multiple assessments of responsibility and authority, and the like" (p. 92). Finally, findings of the current study support Senge (2006) who found a prerequisite for team learning is the latitude to engage in open dialogue among the group and that learning teams function on the premise that the team is the most important unit in the organization.

A number of elements associated with the theme of collaboration was revealed in this study. The diversity within the group regarding experience, aptitude, and expertise turned out to be a valuable characteristic that enhanced and facilitated group learning and shared understanding. During the observation period, student-planners were observed exhibiting the value of collaborating to solve a complex problem. Heard more than once by more than one participant was how great it was to hear others' perspectives on how to view the nature of the problem. While analyzing documents, discourse, and decision making tools, it became clear that openly displayed sketches, drawing, and other illustrations facilitated and prompted

collaboration. It was clear that collaboration was required to produce documents that showed shared understanding in the group and to subsequently transfer knowledge to those outside the group. The study is in agreement with the literature regarding the importance of effective collaboration by improving interpersonal, presentational, and communication skills (Argyris & Schön, 1995; Burnham, 2009; Feltovich et al., 2004; Grigsby, 2011; Hargadon & Bechky, 2006; Heaney, 2013; Huffman & Jacobson, 2003; Kem, 2009; Machin et al., 2009; Mangold, 2011, 2013; Meads & Ashcroft, 2005; Norton, 2012; Paparone, 2001, 2012; Scott, 2011; Teal, 2010; Tuckman, 2009). The study also corroborates the concept that design thinking allows teams to develop a mutual understanding due to its strong emphasis on team-based learning regarding both the problem and its potential solutions (Broß, J. 2011). Further, the design thinking methodology provides many collaborating tools to confront complex, ill-defined problems and suggest military educators examine and share effective collaborative practices at every opportunity and at every level.

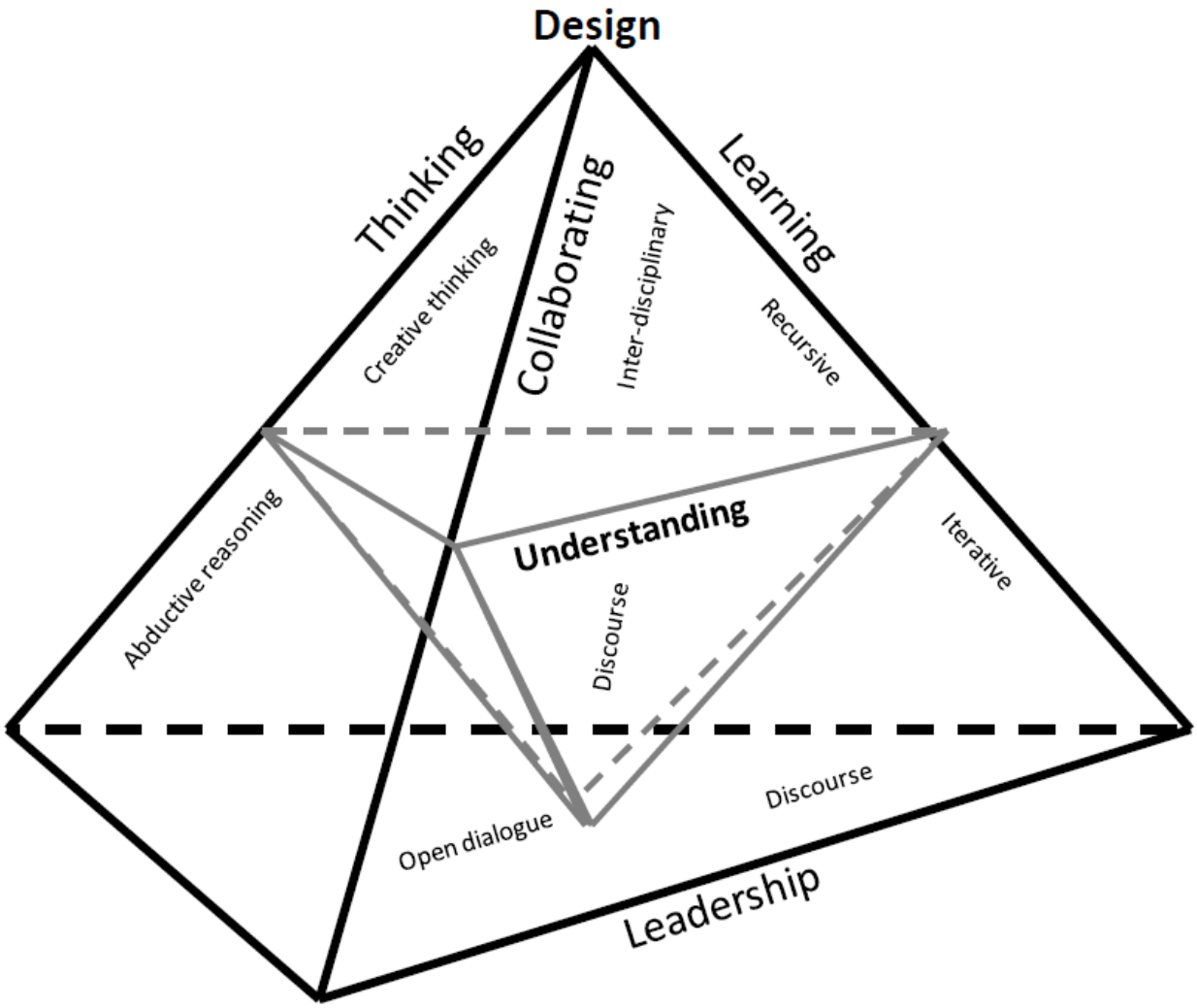

Figure 8. Tetrahedron illustrating themes inextricably joined together

Lastly, findings of meta-interpretation reveal that each theme, when joined together, yields the ultimate goal of design thinking: Understanding. The design thinking methodology provides various leadership, thinking, learning, and collaborating tools to arrive at shared understanding to confront complex, ill-defined problems. The above illustration combines the triangle shape of each theme of the current study. When assembled, the triangles form the design thinking framework of a three-sided pyramid known as tetrahedron. Data for meta-interpretation are presented as a table in Appendix J. The table provides corresponding themes and sub-themes to each research question.

Study Limitations

Limitations are those "boundaries" (Creswell, 2013, p. 102) of the case. These boundaries may be in terms of time, events, and processes. Although qualitative research provides valuable insight into thoughts, perceptions, and processes, they are vulnerable. Various limitations, or weaknesses, are typical of all qualitative research studies. Nevertheless, there are limitations to the current study, in particular that are explained in this section. The current study contained a number of limitations due to some vulnerability that existed with the research duration, researcher bias, and participants. In the current study, knowledge assembled may not generalize to other populations and other settings. Because the findings are unique to one specific site and unit of analysis, rendering transference of findings to other locations and groups is less than viable.

The main limitation to this research related to gathering data about problem solving under the research context. Conducting the interviews was demanding on research resources because some decision processes typically span periods of months or even years. Therefore, this research was obliged to rely on the traces of the completed design-thinking-led problem-solving process in the minds of those people who will use it. Another limitation for this study was researcher bias because I am a faculty member of the academic institution from which the case study population was drawn. For example, I could be viewed as prejudiced regarding the development and delivery of the educational experience. In order to mitigate this risk, I maintained a research journal through the research and analysis stages of the proposed research. To further limit possible research bias, I arranged for an unbiased third party to review notes and journal entries. Another limitation involved the activities and dialogue surrounding the case. Activities and dialogue had the potential to be affected because of awareness of the study. In order to mitigate

this risk, participants were observed in their natural educational environments first and interviewed following completion of observations.

Implications

In this qualitative single instrumental, exploratory, holistic researcher case study, a single bounded unit of analysis was chosen and examined. The purpose of this was to explore a novel approach to military transformation; a prototype of a problem solving methodology that accounts for an inescapable reality in the current and future operational environment: complexity and uncertainty. The overall implication of the current study is that it may have a positive influence on the military leadership community by providing insight on how important it is to target the right problems to solve and develop viable options to address those problems. Accordingly, this research investigated how military planners can be better prepared to solve complex, ill-structured problems through design thinking.

Findings from this study imply opportunities for a positive impact on various areas of the military, such as in leadership, education, and training. Moreover, because solving complex, ill-structured problems is not limited to the military, other social entities could benefit from an improved problem-solving process. A comprehensive problem-solving process could be applicable to the whole of government, whereby the ultimate objective is for all U.S. government agencies to plan and conduct operations from a common perspective (Gockel, 2008) and shared understanding. These arenas encompass government and public policy, education, health care, socio-economic matters, and so on (Burnham, 2009).

Leadership

Leadership and leading are enduring fundamental tenets that are always in demand throughout the military ranks and organizational levels. Implications of the study indicate the

results may have a positive influence on the military leadership community by providing insight on how to target the right problems to solve and develop viable options to address them. Nonetheless, while this study found that design thinking requires leadership skills and talent, it does not imply that leadership should be reserved and exhibited only when confronting complex, ill-structured problems. On the contrary, it is essential that leaders be persistent regarding the elements (or sub-themes) of the leadership theme found in this study. Whether encountering complex, ill-structured problems or conducting routine operations, military leaders should acknowledge their own biases, and encourage open dialogue and discourse. Leaders must also be effective communicators, describe their vision, and share insight as well as provide guidance and feedback.

Although this study found leadership as a foundational theme upon which thinking, collaboration and shared understanding were built, there exists a very real and unexpected leadership implication. The study agrees with Norton, (2012) that while indeed design thinking is focused on solving problems, leadership requires active intervention, not just thinking and understanding. Design thinking is more than just a way of thinking. In order to be effective, it must move from just thinking about problem solving to taking action in addressing problems. In any event, the primary implication of this study is that education in design thinking is also education in leadership, and therefore, an investment.

Thinking

Design thinking is not one way of thinking, but rather it is a blend of different kinds of thinking, built upon induction and problem solving. Advanced thinking skills are continuously in demand in the military. Implications of the study indicate the results may have a positive influence on the military education community by providing advanced thinking skills to target

the right problems to solve and develop viable options to address those problems. The current study confirms the literature and reveals that "understanding complexity requires holistic thinking, and therefore demands the implication of expert disciplines in the process of building design knowledge" (LeBlanc, 2008, p. 1). Nonetheless, while this study found that design thinking requires advanced thinking skills and talent, this does not imply that those skills should be reserved and employed only when confronting complex, ill-structured problems. Rather, skill in the elements (or sub-themes) of thinking are useful whether encountering complex, ill-structured problems or conducting routine operations. Another implication of this study is that education in design thinking is also education in advanced thinking.

Learning

Like advanced thinking, learning skills are continuously in demand in the military. Implications of the study indicate the results may have a positive influence on the military education community by providing advanced learning skills to target the right problems to solve and develop viable options to address those problems. Nonetheless, while this study found that design thinking requires an advanced learning skill, this does not imply that those skills should be reserved and employed only when confronting complex, ill-structured problems. Rather, skill in the elements (or sub-themes) of advanced learning are useful whether encountering complex, ill-structured problems or conducting routine operations. Another implication of this study is that education in design thinking is also education in advanced learning.

Collaboration

Collaboration skills are constantly needed in the military. Implications of the study indicate the results may have a positive influence on the military education community by providing collaborating skills to target the right problems to solve and develop viable options to

address those problems. Nonetheless, while this study found that design thinking requires skills in effective collaboration, this does not imply those skills should be reserved and employed only when confronting complex, ill-structured problems. Instead, skills in the elements (or sub-themes) of effective collaboration are useful whether encountering complex, ill-structured problems or conducting routine operations. The final implication of this study is that education in design thinking is also education in collaboration.

Additionally, the study examined a variety of theories for this phenomenon and found that all have the same goal in mind, which is to close the problem-framing gap in problem solving, especially in the area of complex problems. The study focused on the challenges, processes and methodologies of solving complex, ill-structured problems. It explored approaches of military planners which encourage thought, innovation, and reactivity as well as the importance of leadership, advanced thinking and learning, and collaboration. Finally, the research paves the way for military educators, leaders, and planners to develop four related cognitive activities: (a) Understanding the operational direction, (b) Understanding the operating environment, (c) Defining the problem, and (d) Establishing an operational approach. Developing these cognitive skills will help those in leadership positions target the right problem and more clearly articulate intent and guidance to subordinates.

Recommendations for Future Research

This research study explored the intrinsic value of a design-thinking-led problem-solving education for collaborative learning of military student-planners. Previously, the general lack of literature regarding this topic obscured planners' practices and the potential positive effects of such practices in confronting complex, ill-defined problems. The qualitative case study methodology utilized in this study offered a detailed examination of the experiences of 15

military student-planners.

This study represents a foundation upon which future studies can be conducted. Future studies could build upon what was found and investigate aspects of this phenomenon that could not be covered under this limited study, in order to develop a larger body of research regarding leadership, advanced thinking and learning, as well as collaboration. Accordingly, further research is necessary. First and foremost, limitations of the current study should be considered for future research. The current study contained a number of limitations due to some vulnerability that existed with the research duration, researcher bias, and participants.

The opportunity exists to expand the duration of the current study. The current study limited data collection of design thinking on the front end of the linear problem-solving process. While the scope of the current research examined integration of the design thinking methodology into the linear problem-solving process, future research should consider examining the value of design thinking throughout the problem-solving process to include loop learning, also known as reframing.

Another opportunity exists to address researcher bias of the current study. Because I am a faculty member of the academic institution from which the case study population was drawn, I could be viewed as prejudiced regarding the development and delivery of the educational experience. This limitation offers the opportunity for future research to be conducted by someone entirely disassociated with both curriculum and participants.

Another limitation involved the activities and dialogue surrounding the case. Activities and dialogue of the current study had the potential to be affected because of awareness of the research. This limitation offers the opportunity for future researchers to observe a design thinking exercise in their natural educational environment before it is known that research is

underway.

Another interesting possibility for future research might be to look into each of the separate themes that emerged in the current study. The current study focused on the challenges, processes, and methodologies of solving complex, ill-structured problems. It explored approaches of military planners which encourage thought, innovation, and reactivity as well as the importance of leadership, advanced thinking and learning, and collaboration. Future research might examine implications of leadership, advanced thinking and learning, and collaboration separately in the context of confronting complex, ill-define problems. This research may discover nuances associated with each separate theme of the current study.

An interesting future study could entail a sophisticated examination of how an inter-disciplinary group arrives at co-evolution of problem solution to a complex, ill-defined problem. Specifically, current research offers the opportunity to explore creativity in the design thinking process. Creativity in the design process may be described by the phenomenon of a momentous occurrence; the professed "epiphany," or "creative leap." This research might examine an event as it transpires as abrupt insight.

Opposition

Although findings of this research confirm the vast majority of the literature, this study alone may not be sufficient to sway those who oppose design thinking particularly as it pertains to military decision making and problem solving. Some critics dismiss design thinking as a fad due to a weak theoretical foundation (Johansson Sköldberg, Woodilla, & Cetinkaya, 2013; Jahnke, 2009, 2013; Rylander, 2009, Vego,2009). However, this criticism is clearly refuted by the symbiotic application of a variety of established learning, thinking, and organizational theories that serve as the firm foundation of design thinking.

A prominent writer in military studies, Vego (2009) outright dismissed the concept of design thinking for a number of reasons. Over 5 years have transpired since his writing on the topic and much has since evolved. Perhaps published literature since that time have caused him to rethink his opposition. In either event, findings of this study set aside most, but not all of his criticisms. Where we depart appears to be from a number of his ill-based assertions and a fundamental misunderstanding of the intended use of design thinking. First, Vego (2009) ignored the true origin of design thinking and assigns its founding with the failure when put into practice by the Israel Defense Forces in the Lebanon conflict in July 2006. While the operation may indeed have been a failure, it is injudicious to conclude design thinking caused failure.

The next point whereby Vego (2009) and I depart regards the intended use of design thinking. Vego (2009) assumed that somehow proponents of design thinking were building a case to totally replace the linear problem solving process in favor of the trendy concept of design thinking. Other than online blog posts, the literature revealed no credible source for making such a proposal then or since the time of his writing. The current study, supported by the vast majority of the literature, suggest an integration of design thing into the linear problem solving process.

Aside from criticisms such as the above, much of what Vego (2009) and other critics write are essentially aligned in many ways with the current study. Regardless, addressing each criticism and alignment of the concept of design thinking is outside the scope of this research. Rather, critics should consider the benefits this study found specifically regarding leadership, not just planning.

Barriers

A number of obstacles and elements of risk exist that impede delivering design thinking

education. There are certain actions that may be taken to mitigate risk and address obstacles to fully implementing design thinking education. These actions will be addressed in the recommendations section of this chapter.

Not so much critics of design thinking, Elkus and Burke (2010) presented some reservations with the design thinking concept and discussed its shortcomings and associated risks. They acknowledged design thinking endeavors to "spread mental flexibility for the conception of operational frameworks," but is "difficult to necessarily institutionalize such qualities, especially within large industrial bureaucracies" (p. 15). They noted this problem "must be addressed through training, personnel policies, and organizational planning" (p. 16). They further cautioned that there are "substantial risks in the adoption of design that must be addressed" (p. 1). That being so, should design thinking resort to "a checklist approach rather than an iterative approach then it will fail its predicted purpose" (p. 16).

Another impediment to delivering design thinking education to military planners was presented by Martin (2012) who insisted the current paradigms in the military are "incompatible with the concept" and are "dead on arrival" (p. 4). He declared design is a way of thinking based on the premise that in uncertain situations some other epistemology is required; one that permits various theories to arise in any given situation. According to Martin (2012), "the military is stuck on attempting to force design [thinking] principles into our current epistemology, a wholly impossible mission" (p. 1).

Martin (2012) posited the military must: (1) be an establishment that rewards results, requires institutional integrity and accepts failure, providing it is constantly learning. He stipulated that because the military is highly bureaucratic, hierarchical, regimented and doctrinal, design thinking is destined to fail; (2) be expected to challenge paradigms; and (3) foster a

learning environment (p. 4). In addition to these, Martin (2012) referred to disciplines that Peter Senge (2006) introduced in *The Fifth Discipline* along with the work of Argyris (1993) regarding double-loop learning organizations and added a fourth: learn from experience. He concluded that the military is actually established as anti-design [thinking] and contended "any cause for confusion with design thinking is not because, as many suggest, the concept is obscure, rather design thinking is inherently incompatible with the military establishment" (p. 4). He claimed the organization must evolve from a positivist philosophy pervasive in its doctrine, training, leadership, and education.

Elkus and Burke (2010) also pointed to the limits of design thinking at lower levels in the military. Since plans are promulgated from higher levels down to those who will ultimately execute them, the vague lexicon of design thinking increases the likelihood for misunderstanding tasks and purposes. Like Vego (2009), Elkus and Burke (2010) used the Israeli Self Defense Force challenges during the conflict with Lebanon in 2006 with "the vague language inherent in Israeli doctrine [design thinking] and plans led to ambiguous and unclear orders" (p. 16). The officer in charge of Israel's Central Command during this conflict was Major General Yair Naveh (2007) who said, "military planners are confined to the shackles of inferiority determined by institutional paradigm, doctrine, and jargon…[they] are cognitively prevented, by the very convenience of institutional interiority…because the shackles of ritual hold them in place" (p. 72). Elkus and Burke (2010) also questiond the level within the military structure at which design thinking is applicable, and asserted it applied at the highest, strategic level. In the end, Elkus and Burke (2010) welcomed design thinking with the caveat that the concept only dealt with one component of a larger complex problem and suggested the intention of implementing strategic objectives is insufficient "to merely visualize the problem more creatively … that

design thinking needs to be more firmly linked to the politics that determine the war's aim" (p. 19).

Recommendations

A number of actions are required in order to effectively implement findings of this study. Each action is intended to either mitigate risks or overcome obstacles. First, further discourse regarding design thinking must remove the esoteric lexicon. Though generally well-educated and very professional, the military community is renowned to speak plainly. Using ambiguous and theory-based language advances the notion of elitism and, therefore, risks being promptly dismissed. Napoleon realized the importance of communicating plainly and clearly by having junior enlisted personnel understand written orders for an operation. According to Eikmeier (2010), Napoleon would ask a Corporal if he understood the plan. If the Corporal did not understand the plan, he would have his staff rewrite the plan more clearly.Military doctrine discusses design thinking in terms of a problem solving process with military planners as the audience. Members who can be classified as a planner actually represent a very small part of the military. By deliberately limiting design thinking to military planners, implementing the concept runs the risk of being deemed too exclusive. In order for design thinking to be implemented it cannot be exclusive but must resonate throughout the entire culture. Leadership, on the other hand, is a fundamental quality that is aspired to in all specialties and spans throughout the ranks. Findings of this study reveal that design thinking is founded on leadership. Accordingly, design thinking should not be made an exclusive activity but grounded in leadership training, education, and doctrine.

General Martin Dempsey (2012), Chairman of the Joint Chiefs of Staff, challenged all military personnel, as leaders, to espouse new methods of innovation, adaptability and critical

thinking. The current study suggests such an adaptive approach toward leading. Kienle (2014) asserted that the continuum of leadership development is a "journey and not a destination" (p. 9). He outlined steps that promote assessment, synthesis, reflection, judgment, and creative thinking as an approach to global leadership. Therefore, those in each of the separate branches of the U.S. military who are responsible for leadership development strategy and implementation plans should consider findings of the current study. These findings, along with the methodology Kienle (2014) presented, if incorporated into the continuum of leadership development, offers a fresh approach at integrating the multidimensional aspects of leadership. Lastly, since the ultimate goal of design thinking is understanding, it provides various leadership, thinking, learning, and collaborating tools to arrive at shared understanding. Because shared understanding is sought after in all organizations, design thinking should be explored in terms of business and government leadership.

Conclusion

Conducting military operations is intrinsically complex, exacerbated by the evolving characteristics of the operating environment which makes understanding the problem and possible solutions a challenge. Traditional detailed planning processes assume military planners understand the problem and possess the wherewithal and experience required to solve it. This will not always be the case. Design thinking is a cognitive process, rooted in experience, intuition, and training which provide decision makers and planners "the intellectual breathing space" (Grigsby, 2011, p. 31) for designing, planning, and executing operations. Therefore, the object of design thinking is to produce a shared understanding of a complex problem before proceeding to use the linear planning process.

This qualitative case study was established to explore the intrinsic value of a design-

thinking-led problem-solving education for collaborative learning of military student-planners to solve complex, ill-structured problems. Theorists such as Archer (1979), Buchanan (1992), Cross (2001), and Simon (1969) offered a comprehensive basis for the application of a design-led problem-solving approach. While much has been written on design thinking, material exploring the concept remains stalled at the theoretical level. Indeed, design thinking is theoretical nevertheless, it is also practical. As Kurt Lewin (1952) once asserted "there is nothing more practical than a good theory" (p. 169). Here, he was highlighting the significance of incorporating theory and practice. Heretofore, lacking was any research that applied design thinking theory in a practical, collaborative/team-based learning environment to advance organizational learning.

Chapter One introduced the framework for the current study, gave the reader a general overview of the research, provided the underpinning for the problem that necessitated the research, provided an overview of literature upon which the research was founded, distinguished the importance of the research, and introduced the research by the use of the research questions. This introductory chapter contained numerous subsections: the background of the study, the situation of the researcher, the problem statement, the purpose statement, the significance of the study, research questions, the research plan, and the delimitations and limitations of the study.

Chapter Two provided a comprehensive review of the literature relevant to the study of design thinking and presented the rationale for the problem pertinent to this study, as well as demonstrated the need for the current study. This chapter also provided theories relevant to design thinking, a brief overview of the problem, and contemporary discourse relevant to design thinking. Chapter Two also provided the theoretical framework that guided this study.

Chapter Three provided an account for the methodology of the study. A qualitative

research design was used to conduct this instrumental case study in one specific unit of analysis; an inter-disciplinary group of military student-planners. Chapter Three also included the steps for data collection, and research questions were also addressed was along with the analysis method. Also presented was a discussion regarding rigor and ethical implications for the study.

Chapter Four reported the data analysis and research results as they pertained to themes that were discovered, and explained the findings for this case study which were merged to produce common themes and answer the research questions. The report of data included observation results, document analysis results, and individual interview results containing participants' input regarding the four themes that emerged from analysis of the data. The significant themes that emerged were: (a) leadership, (b) thinking, (c) learning, and (d) collaboration.

The results of this qualitative case study reveal that the themes discovered through this research are joined together by shared understanding. Through mastering the themes discovered in this study, and strict adherence to the methodology of design thinking, military planners will be better prepared to solve complex, ill-structured problems. Accordingly, decision makers would be well served by military planners who have been educated in design thinking. While much has been written on the theory of design thinking, its origin, and where it might be applied, no research has been done that advances the design theory into practice using collaborative, team-based learning to achieve organizational learning to solve complex problems. This study addressed the gap in the literature and added to the body of knowledge concerning the value of design thinking education.

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Appendix A: U.S. Navy Institutional Review Board Approval

Naval Postgraduate School
Human Research Protection Program

19 March 2014

From: Chairman, Naval Postgraduate School (NPS) Institutional Review Board (IRB)
To: Provost, U.S. Naval War College (NWC)

Subj: RECOMMENDATION OF APPROVAL OF NWC.2014.0001-IR-EP7-A

Encl: (1) IRB Protocol
(2) NPS Initial Review Checklist
(3) Sample Approval Template

1. The NPS IRB has recommended approval of NWC.2014.0001-IR-EP7-A titled, "Exploring Intrinsic Value of Educating Military Planners in Design Thinking: A Case Study." The IRB protocol and NPS recommendation for approval is found in enclosures (1-2).

2. The NWC may approve the research for up to 364 days from the date of this recommendation. NWC approval of research must be documented and provided to the NPS IRB. A sample approval template is provided in enclosure (3).

3. The NPS IRB point of contact is the HRPP Specialist Ms. Rikki Nguyen. She may be contacted directly at comm: 2998 or email: _____.

SHATTUCK.LAWRENCE.GEORG.1015756825
Digitally signed by SHATTUCK.LAWRENCE.GEORG.1015756825
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=SHATTUCK.LAWRENCE.GEORG.1015756825
Date: 2014.03.19 14:22:11 -07'00'

Lawrence G. Shattuck, PhD
Chair
Institutional Review Board

Appendix B: Site Approval

DEPARTMENT OF THE NAVY
NAVAL WAR COLLEGE
686 CUSHING RD
NEWPORT RHODE ISLAND 02841-1207

3900
Ser 002
24 Mar 14

From: Provost, Naval War College
To: Professor John Mangold

Subj: APPROVAL OF HUMAN RESEARCH PROJECT ENTITLED "EXPLORING INTRINSIC VALUE OF EDUCATING MILITARY PLANNERS IN DESIGN THINKING: A CASE STUDY"

Ref: (a) 10 U.S.C. § 980
(b) DoD Directive 3216.2
(c) SECNAVINST 3900.39D
(d) NPS IRB ltr of 19 Mar 14

Encl: (1) Approved IRB Protocol

1. In accordance with references (a) through (c), I approve execution of your proposed case study: Exploring Intrinsic Value of Educating Military Planners in Design Thinking (NWC.2014.0001-IR-EP7-A), which was carefully reviewed and approved by the Naval Postgraduate School (NPS) Institutional Review Board (IRB) in reference (d). The approved IRB Protocol is found in enclosure (1). Completion of the CITI Research Ethics Training has been confirmed.

2. This approval expires on 20 March 2015. If additional time is required to complete the research, you must submit a continuing review report for approval by myself and the NPS IRB prior to expiration of this approval. Upon expiration, all research (subject recruitment, data collection, analysis of data containing PII) must cease.

3. You are required to report to me and the NPS IRB any unanticipated problems or serious adverse events within 24 hours of the occurrence.

4. Any proposed changes in IRB approved research must be reviewed and approved by me and the NPS IRB prior to implementation, except where necessary to eliminate apparent immediate hazards to research participants and subjects.

5. As the Principal Investigator it is your responsibility to ensure that the research and the actions of all project

Subj: APPROVAL OF HUMAN RESEARCH PROJECT ENTITLED "EXPLORING INTRINSIC VALUE OF EDUCATING MILITARY PLANNERS IN DESIGN THINKING: A CASE STUDY"

personnel involved in conducting this study will conform with the IRB approved protocol and references (a) through (c).

6. After completing the research, the Principal Investigator will submit to the NPS IRB an End of Experiment Report detailing the conduct of the research and confirming the safeguarding of data and informed consent documents.

7. Please contact CAPT Mark Lyles, DC, USN, at _____ if you have any questions regarding implementation of this guidance.

AMB (ret.) MARY ANN PETERS

Copy to:
Dean, Academics
CAPT Lyles

Appendix C: Liberty University Institutional Review Board Approval

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

March 26, 2014

John P. Mangold
IRB Approval 1762.032614: Exploring Intrinsic Value of Educating Military Planners in Design Thinking: A Case Study

Dear John,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Please retain this letter for your records. Also, if you are conducting research as part of the requirements for a master's thesis or doctoral dissertation, this approval letter should be included as an appendix to your completed thesis or dissertation.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

Fernando Garzon, Psy.D.
Professor, IRB Chair
Counseling

(434) 592-4054

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UNIVERSITY.

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Appendix D: Consent Form

Naval War College

Consent to Participate in Research

Introduction. You are invited to participate in a research study entitled, *exploring the intrinsic value of a design thinking-led problem solving education for collaborative learning of military student planners to solve complex, ill-structured problems*. The purpose of the proposed qualitative single, instrumental, exploratory researcher case study is to explore a novel approach to military transformation; a prototype of a problem solving methodology that accounts for an inescapable reality in the current and future operational environment: complexity and uncertainty. Specifically, this research will explore and discover the intrinsic value of a design thinking-led problem solving education for collaborative learning of military student-planners at a senior military service college.

Design thinking will be used as an essential component supporting a theoretical framework to explore the process of solving complex, ill-structured problems. Fifteen participants from a senior U. S. military service college will be studied using observations, interviews, and sight documents. The data will be analyzed using the systematic, analytic procedures whereby analysis begins as data are collected and more focus will be applied on the problem solving process and collaborative learning. Findings from this study may have a significant impact on other areas of the military such as in doctrine, leadership, organization, and education and training. The study might suggest all military officers be introduced to design thinking and a new problem solving process at the earliest opportunity and throughout the continuum in professional military education. By introducing military officers to supporting concepts and methodology of design thinking, they may be aided in understanding problems and be better equipped to analyze underlying causes of complex, ill-structured problems and synthesize viable options to confront them.

Moreover, since solving complex, ill-structured problems is not limited to the military, other social entities would benefit from an improved problem solving process. A comprehensive problem solving process would be applicable to the whole of government whereby the ultimate objective is for all U.S. government security agencies to plan and conduct operations from a shared perspective. Toward this end, the central research question this study will ask as well as guide the study is: How can military planners be better prepared to solve complex, ill-structured problems through design thinking?

Separately, much has been written on the theories of design thinking, problem solving, program improvement, and collaborative learning. However, no material exists that explores the intrinsic value of a design thinking-led education for military planners in a practical setting. This study will address the gap in the literature and add to the body of knowledge concerning the value of design thinking education.

Procedures. If you agree to be in this study, I would ask you to do the following things:

1. Participate in one-on-one interview where you will be asked 15 questions during a semi-structured interview about your experience using design thinking. Anticipate these to last approximately, but no longer than 60 minutes.

2. As a member of a multi-disciplinary planning team, be willing to be observed while the team proceeds to confront a scenario that present an ill-structured and undefined problem(s). Observations will be conducted periodically throughout the portion of the course that focuses on design thinking. Specific dates, times and duration cannot be projected at this time due to

the nature of this course being objectives-based, not held to a firm schedule. It is anticipated that observations will occur over a three day period for a combined total of 18 hours.

3. Separately, you may be asked to participate in a focus group lasting no longer than 60 minutes.

4. Documents produced by the collective group of participants serve as a main source for collecting data relevant to this study. Such documents include student-produced briefings, sketches, narratives both printed material and electronic material used in a collaborative information environment with open access to the researcher. As a participant in this study you agree to provide these documents.

5. Both interview and field notes will be audio recorded and transcribed by the researcher. Your identity will be protected and your real identity will not be revealed.

Location. The interview and focus group will take place in the student work spaces in Brett Hall, on the Naval Station in Newport, Rhode Island.

Cost. There is no cost to participate in this research study.

Voluntary Nature of the Study. Your participation in this study is strictly voluntary. If you choose to participate you can change your mind at any time and withdraw from the study. You will not be penalized in any way or lose any benefits to which you would otherwise be entitled if you choose not to participate in this study or to withdraw. The alternative to participating in the research is to not participate in the research.

Potential Risks and Discomforts. Risks and Benefits of being in the Study:

This study poses risk which is no greater than during everyday activities. However, risk of breach of confidentiality is present. If you participate, you may withdraw at any time from the study if you should choose to discontinue participation.

Anticipated Benefits. You will not directly benefit from your participation in this research.

Compensation for Participation. No tangible compensation will be given.

Confidentiality & Privacy Act. Any information that is obtained during this study will be kept confidential to the full extent permitted by law. All efforts, within reason, will be made to keep your personal information in your research record confidential but total confidentiality cannot be guaranteed.

The researcher will maintain participant confidentiality by using pseudonyms in all matters of note-taking and discussion. Notes and journals the researcher uses to capture data will be secured at all times throughout the study. The storing of data will be password protected for electronic files. Recordings will be stored digitally in a password protected laptop computer. A coded sheet associating participants' true identity with their assigned pseudonym will be stored separate from the rest of the data at the researcher's residence in a locked desk draw, accessible only by the researcher.

If you consent to be identified by name in this study, any reference to or quote by you will be published in the final research finding only after your review and approval. If you do not agree, then you will be identified broadly by discipline and/or rank, (for example, “fire chief”).

☐ I consent to be identified by name in this research study.

☐ I do not consent to be identified by name in this research study.

Points of Contact. If you have any questions or comments about the research, or you experience an injury or have questions about any discomforts that you experience while taking part in this study please contact the Principal Investigator, John Mangold, (omitted). Questions about your rights as a research subject or any other concerns may be addressed to the Navy Postgraduate School IRB Chair, Dr. Larry Shattuck, (omitted).

Statement of Consent. I have read the information provided above. I have been given the opportunity to ask questions and all the questions have been answered to my satisfaction. I have been provided a copy of this form for my records and I agree to participate in this study. I understand that by agreeing to participate in this research and signing this form, I do not waive any of my legal rights.

_____ _____

Participant's Signature Date

_____ _____

Researcher's Signature Date

IRB Code Numbers: 1762.032614

IRB Expiration Date: 20 March, 2015

Appendix E: Permission to Collect Document Form

Gentlemen:

As you are aware, I am currently in process of conducting a study on exploring the intrinsic value of a design thinking-led problem solving education for collaborative learning of military student planners to solve complex, ill-structured problems. To thoroughly investigate this topic, it is important that I have access to the documents listed below for the time periods listed. Please sign below to indicate your permission in granting my access to these documents.

Thank You,

John P. Mangold

Documents requested for study exploring the intrinsic value of a design thinking-led problem solving education for collaborative learning of military student planners to solve complex, ill-structured problems:

1. Syllabus, Maritime Operational Planners Course
2. Faculty Guides
3. Instructional materials pertaining to design thinking
4. Scenario/vignette
5. Student collaborative material and products

Course director: _____date: _____

Dean: _____ date: _____

Modified from Onwuegbuzie, Leech, & Collins (2010), *Innovative Data Collection*

Strategies in Qualitative Research.

Appendix F: Observation Protocol Worksheet

Activity	Look-for #1	Look-for #2	Look-for #3	Look-for #4
Understand the Operational Direction	□ What is the strategic desired end state to be achieved and the military objectives that support their attainment?	□ What are the strategic objectives – provided or derived?	□ What are the operational objectives – provided or derived?	□ What are the broad conditions that exist after the conclusion of a campaign or operation?
Understand the Operational Environment	□ What are the relevant physical and information factors of all domains?	□ What is the current state?	□ What are the opposing end states	□ What is desired future state?
Define the Problem	□ What are the tensions between current conditions and desired end state?	□ What are the elements within the OE that must change to achieve desired end state?	□ What are the opportunities and threats to achieving the Desired End States?	□ What is the problem to be solved?
Develop an Operational Approach	□ What needs to be removed to transition from the current state to the desired state?	□ What do we need to provide to transition from the current state to the desired state?	□ What needs to change to transition from the current state to the desired state?	□ What actions do we take to produce the conditions that achieve the desired end state?

Intent and Guidance	□ Should describe the OE, define the problem to be solved, describe the operational approach and include his intent.	□ Should include a problem statement: narrative that lists the problem's factors, describes areas of tension, competition, and opportunity.	□ Are areas for action identified that will transform existing conditions toward the desired end state before adversaries begin transform current conditions to their desired end state.	□
Integrate Design Thinking into Linear Process	□ How did planners transition from design (thinking) to planning (doing).	□ Did transition occur based on an iterative common shared understanding of the context, the problem, and initial ideas for problem management or solution?	□ Remained focused on understanding and could not transition?	□ Used design and its products to establish the fundamentals of learning (assessment)?
Reframe	□ How Learning relates to critically thinking about the decisions make throughout the process (reframing questions) to adapt to change. Change brought on by the complex nature of the problem.	□ What's changed? Do they have the right information? What's missing? □ How does the Design team's bias or perspective affect the product? □ Are facts, assumptions, hypothesis still valid or correct?	□ Is the analysis correct? Does it need to change based on new information? □ Are they attacking the root problem or a symptom? □ What actions will produce the effects necessary to change behavior or conditions? (End State)	□ Are the actions having the intended effect? (Measures of Effectiveness) □ What are the possible outcomes or unintended consequences?

Observation Protocol Worksheet adapted from McEwan-Adkins, (2011) *Literacy Look-Fors; A An Observation Protocol Guide*.

Appendix G: Open Coding Worksheet

Abductive
Acknowledgement of biases
Acknowledge uncertainty
Analysis
Appreciating
Assessment
Brainstorming
~~Change~~
Co-create
Collaborative
~~Collective~~
Complexity
Communication
Comprehending
Cooperation
~~Conceive~~
Conceptual
Constructive
Contextual
Creative
Critical
Cultural
~~Depicting~~
Describe
~~Devising~~
Dialogue
Difference
Differentiating
~~Difficulty~~
Direction
Discerning
~~Discrepancy~~
Discourse
Discrimination
Discussion
Distinguishing
Drawing
Enthusiasm
Establishing
~~Estimation~~
~~Exchange~~
Experience
~~Explain~~
~~Explore~~
Expression
Facilitating
Fair-mindedness
Feedback
~~Figure out~~
Followership
Graffiti walls
Group learning
Group learning
Group process
Guidance
Hardworking ethic
Heuristics
Humility
Identifying
~~Illustrate~~
Imagination
Innovative
Insight
Interaction
Inter-disciplinary
Interpretation
~~Intricacy~~
Intuition
Iterative
Judgment
Knowledge transfer
Leadership
Learning
Limitations
Mind mapping
~~Mutual~~
Narrative
Open-mindedness
Organized
Organizing to learn
Participation
~~Productive~~
~~Proficiency~~
~~Provide~~
~~Pull resources~~
Realizing
Recognizing
Recursive
Reflection
~~Remove~~
Results-oriented
Role-playing
Sense making
Sensing
Share
Shared understanding
~~Significant~~
~~Simplifying~~
Sketch
Storyboards
Sustain
~~Synthesis~~
Systems
Tact
Team learning
Thinking
~~Understanding~~
~~Visualize~~

Open Coding Worksheet adapted from Bogdan & Biklen, (2007). Qualitative research for education: An introduction to theories and methods (5th ed.).

Appendix H: Emergent Code Worksheet

Emergent Codes / Key words	Sensing	Think through	Leadership	Understanding	Discourse	Learning	Knowledge transfer	Collaborating	Thinking	Synthesis
Abductive		X		X					X	
Acknowledge biases			X		X			X		
Acknowledge uncertainty	X		X		X			X	X	
Analysis		X	X	X		X		X	X	X
Appreciating	X		X	X	X		X	X	X	
Assessment	X	X	X	X		X	X	X	X	X
Brainstorming		X		X	X	X		X	X	
Co-create			X		X			X		
Collaborative		X	X		X	X	X	X		
Complexity	X		X	X						X
Communication			X		X		X	X		
Comprehending	X	X		X		X	X		X	X
Cooperation			X		X			X		
Conceptual	X		X						X	X
Constructive							X	X		
Contextual		X	X	X						
Creative		X	X					X	X	X

Emergent Codes / Key words	Sensing	Think through	Leadership	Understanding	Discourse	Learning	Knowledge transfer	Collaborating	Thinking	Synthesis
Critical									X	
Cultural		X	X					X		
Describe			X	X	X		X	X		
Dialogue			X		X		X	X		
Difference			X	X		X			X	
Differentiating				X		X				
Direction			X		X		X	X		
Discerning	X			X		X				
Discrimination				X		X				
Discussion			X		X		X	X		
Distinguishing						X				
Drawing					X		X	X		
Enthusiasm			X					X		
Establishing						X				
Experience			X	X	X		X			X
Expression			X		X		X	X		
Facilitating			X			X	X	X		
Fair-mindedness			X					X		
Feedback		X	X	X	X		X	X		
Followership			X		X			X		
Graffiti walls				X	X		X	X		

Emergent Codes / Key words	Sensing	Think through	Leadership	Understanding	Discourse	Learning	Knowledge transfer	Collaborating	Thinking	Synthesis
Group learning		X			X	X	X	X		
Group learning		X			X	X	X	X		
Group process		X		X	X	X		X		
Guidance			X	X			X			
Hardworking ethic			X					X		
Heuristics	X			X						X
Humility			X		X			X		
Identifying						X			X	
Imagination			X					X	X	X
Innovative			X					X	X	
Insight	X		X							X
Interaction					X		X	X		
Inter-disciplinary					X			X		
Interpretation	X			X	X		X	X		
Intuition	X		X						X	X
Iterative						X				
Judgment			X			X		X		
Knowledge transfer				X	X		X	X		

Emergent Codes / Key words	Sensing	Think through	Leadership	Understanding	Discourse	Learning	Knowledge transfer	Collaborating	Thinking	Synthesis
Leadership	X	X	X	X	X	X	X	X	X	X
Learning			X			X	X	X		
Limitations			X		X			X		
Mind mapping					X		X	X		
Narrative			X		X		X	X		
Open-mindedness		X	X		X			X	X	
Organized			X			X		X		
Organizing to learn						X		X		
Participation			X		X		X	X		
Realizing	X			X					X	
Recognizing				X					X	
Recursive						X				X
Reflection			X		X			X	X	X
Results-oriented			X					X		
Role-playing					X			X		
Sense making	X				X				X	
Sensing	X								X	
Share			X		X		X	X		
Shared				X	X		X	X		

Emergent Codes / Key words	Sensing	Think through	Leadership	Understanding	Discourse	Learning	Knowledge transfer	Collaborating	Thinking	Synthesis
understanding										
Sketch					X		X	X		
Storyboards					X		X	X		
Sustain			X					X	X	
Systems		X							X	
Tact			X		X			X		
Team learning		X			X		X	X		
Thinking		X						X	X	

Emergent Code Worksheet adapted from Leech, (2007). An array of qualitative data analysis tools: A call for data analysis triangulation.

Appendix I: Data Analysis Form

This data analysis form includes themes drawn from each key data point for the following research questions.

Research Question #1:
How can military planners better address complex, ill-structured problems? The answer to this question has the potential to inform military leaders as to how they can provide essential planning guidance and transfer knowledge to the collective planning team members?

Interviews:

Leadership:	Guidance	Facilitating	Insight
	Followership	Dialogue	Acknowledgement of biases
	Understanding	Describe	Group process
	Visualize	Heuristics	
Thinking:	Abductive	Reflection	Critical
	Creative	Contextual	Conceptual
	Collaborative	Cultural	Brainstorming
	Difference	Intuition	
Learning:	Recursive	Discerning	Sensing
	Understanding	Brain storming	Comprehending
	Recognizing	Differentiating	Distinguishing
	Identifying	Insight	Limitations
	Visualize	Constructive	
Collaborating:	Dialogue	Leadership	Shared understanding
	Cooperation	Communicate	Brain storming
	Inter-disciplinary	Group learning	Visualize
	Describe	Feedback	

Document Review:

Leadership:	Describe	Dialogue	Feedback
	Understanding	Visualize	Communicate
Thinking:	Conceptual	Collaborative	Storyboards
	Graffiti walls	Learning:	Visualize
	Knowledge transfer	Iterative	
Learning:	Distinguishing	Identifying	Limitations
	Visualize	Difference	
Collaborating:	Sketch	Communicate	Expression

	Synthesis	Leadership	Drawing
	Describe	Narrative	Mind mapping

On-site observations:

Leadership:	Followership	Guidance	Feedback
	Fair-mindedness	Direction	Acknowledgement of biases
	Tact	Results-oriented	Effective communicator
	Organizing to learn	Understanding	Dialogue
	Facilitating	Open-mindedness	Enthusiasm
	Open-mindedness	Insight	Humility
Thinking:	Contextual	Feedback	Abductive reasoning
	Role-playing	Brainstorming	Conceptual
	Collaborative	Cultural	Open-mindedness
	Role-playing	Difference	Concept/mind mapping
	Storyboards		
Learning:	Recursive	Assessment	Difference
	Distinguishing		
Collaborating:	Brainstorming	Leadership	Understanding
	Group learning	Visualize	Describe
	Sense making	Hardworking ethic	Participation
	Narrative	Mind mapping	Acknowledge uncertainty
	Interaction	Hardworking ethic	Acknowledgement of biases
	Feedback	Cooperation	

Research Question #2:
What methods do military planners use to confront complex, ill-structured problems? This question is important because the answer may serve as a driving function to critically examine the process used by planners to solve problems.

Interviews:

Leadership:	Dialogue	Facilitating	Insight
	Guidance	Understanding	Feedback
	Insight	Visualize	Intuition
Thinking:	Reflection	Abductive	Concept/mind mapping
	Iterative	Feedback	
Learning:	Recursive	Synthesis	Visualize
	Sensing	Analysis	Differentiating
	Critical	Creative	Contextual
	Realizing		

Collaborating:	Share	Drawing	Brain storming
	Mind mapping	Understanding	Group learning
	Visualize	Describe	Acknowledge uncertainty
	Acknowledgement of biases		

Document Review:

Leadership:	Feedback	Organized	Effective communicator
	Visualize		
Thinking:	Conceptual	Storyboards	Concept/mind mapping
	Graffiti walls		
Learning:	Recursive	Differentiating	Interative
Collaborating:	Sketch	Graffiti walls	Drawing
	Brainstorming	Leadership	Visualize
	Describe	Narrative	Mind mapping

On-Site Observations:

Leadership:	Visualize	Describe	Group process
	Dialogue	Followership	Guidance
	Feedback	Fair-mindedness	Direction
	Tact	Results-oriented	Acknowledgement of biases
	Organizing to learn	Understanding	Effective communicator
	Facilitating	Open-mindedness	Enthusiasm
	Insight		
Thinking:	Reflection	Abductive reasoning	Brainstorming
	Iterative	Feedback	Concept/mind mapping
Learning:	Recursive	Synthesis	Sensing
	Analysis	Differentiating	Constructive
Collaborating:	Leadership	Discourse	Cooperation
	Shared understanding	Team learning	Inter-disciplinary
	Dialogue	Brainstorming	Group learning
	Visualize	Describe	Sense making
	Narrative	Mind mapping	

Research Question #3:
How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning? Understanding how and in what ways planners collaborate will be helpful in developing and delivering future professional military education.

Interviews:

Leadership:	Visualize	Understanding	Dialogue
	Guidance	Insight	Feedback
Thinking:	Synthesis	Abductive reasoning	Creative
	Contextual	Storyboards	Intuition
Learning:	Recursive	Feedback	Synthesis
	Iterative	Understanding	
Collaborating:	Interaction	Shared understanding	Feedback
	Share	Leadership	Inter-disciplinary
	Discourse	Participation	

Document Review:

Leadership:	Discourse	Describe	Feedback
Thinking:	Difference	Contextual	Concept/mind mapping
	Storyboards		
Learning:	Understanding	Establishing	Distinguishing
	Constructing		
Collaborating:	Discourse	Co-create	Communicate
	Expression	Narrative	

On-Site Observations:

Leadership:	Insight	Guidance	Discourse
	Visualize	Describe	Group process
	Dialogue	Followership	Feedback
	Fair-mindedness	Direction	Tact
	Results-oriented	Endurance	Judgment
	Organizing to learn	Understanding	Effective communication
	Facilitating	Open-mindedness	Enthusiasm
Thinking:	Creative	Difference	Concept/mind mapping
	Contextual	Feedback	Abductive reasoning
	Role-playing	Brainstorming	Conceptual
	Collaborative	Cultural	Open-mindedness
	Storyboards		
Learning:	Interpretation	Experience	Sensing

	Insight		
Collaborating:	Team learning	Leadership	Mind mapping
	Interaction	Visualize	Describe
	Sense making	Feedback	Cooperation

Research Question #4:
How can the current problem solving process be improved upon? Understanding how the problem solving process can be improved is essential to curriculum development and discovery of effective teaching methods.

Interviews:

Leadership:	Visualize	Understanding	Acknowledge uncertainty
	Guidance	Describe	Acknowledgement of biases
Thinking:	Open-mindedness	Collaborative	Creative
Learning:	Recursive	Systems	Iterative
	Experience		
Collaborating:	Discourse	Mind-mapping	Acknowledge uncertainty
	Feedback	Acknowledgement of biases	

Document Review:

Leadership:	Inter-disciplinary	Share	Team learning
	Acknowledge uncertainty		
Thinking:	Abductive reasoning	Complexity	Systems
Learning:	Assessment	Appreciating	Recognizing
	Comprehending		
Collaborating:	Drawing	Co-create	Sketch
	Discourse	Mind-mapping	

On-Site Observations:

Leadership:	Followership	Facilitating	Insight
	Guidance	Discourse	Visualize
	Describe	Group process	Feedback
	Organizing to learn	Understanding	
Thinking:	Graffiti walls	Systems	Acknowledge uncertainty
	Imagination	Role playing	Concept/mind mapping

Learning:	Understanding Feedback	Appreciating	Synthesis
Collaborating:	Discourse Visualize Mind mapping	Fair-mindedness Describe Feedback	Acknowledge uncertainty Sense making Storyboards

Data Analysis Form modified from Fairfax County Public Schools (2013),

Observation/Document Review form.

Appendix J: Meta-Interpretation

Central Question: How can military planners be better prepared to solve complex, ill-structured problems through design thinking?

	Themes / Sub-Questions	Leadership	Thinking	Learning	Collaboration
1	How can military planners receive comprehensive planning guidance needed to address complex, ill-structured problems?	open dialogue, discourse, insight, guidance, shared understanding, describe, approach	advanced thinking skills, analysis, synthesis, abductive reasoning, creative thinking, hinking, understand, reflection, storyboards, mental models, difference, identifying	group learning,advanced learning, recursive, iterative, loop learning,branching points, shared understanding, describing, context,guidance, leadership	Inter-disciplinary group, dialogue, discourse, shared understanding, sketches, mind mapping, drawing, transfer of knowledge, co-create, share that knowledge, understanding
2	What methods do military planners use to confront complex, ill-structured problems?	group leader, effective communicator, open mindedness, dialogue, discourse, share, insight, understanding, group leader, acknowledge uncertainty & biases, followership	reflection, abductive reasoning, creative thinking, role-playing, understanding,mind-mapping, mental models, concept mapping, storyboards, think through, synthesize,	learn, understanding, estimation, comprehend, meaning , recursive, iterative learning, feedback, brainstorming, interpretation, sensing discerning, differentiating, distinguishing, difference, general approaches	interdisciplinary, interact, dialogue, discourse, shared understanding, acknowledge uncertainty & biases, group dynamic, fair and open-mindedness, role-playing, brainstorming, storyboards, sketches, mind mapping, drawing
3	How or in what ways do military planners collectively integrate design thinking into problem solving to achieve collaborative learning?	open mindedness, facilitate, dialogue, discourse, acknowledge uncertainty & biases, unity of effort, group leader, group members, unity of purpose	process, advanced thinking, critical, systems, understanding, analysis, creative, visual, synthesis, meta-thinking	iterative, recursive, process, higher levels of learning, understanding	interdisciplinary, acknowledge uncertainty & biases, group dynamic, open and fair-mindedness, facilitate, dialogue, discourse, team learning, undertanding
4	How can the current problem-solving process be improved?	Guidance, feedback, group leader, open mindedness, facilitate, dialogue, discourse, insight, communicate knowledge, understanding, acknowledge uncertainty & biases, unity of effort and purpose	analysis, systems thinking, imagination, creative thinking, understanding, reflection, abductive reasoning, synthesis	contextual, recursive learning, sensing, iteration, identify, assess, recognize, difference, comprehend, understand estimation, interpretation, discernment	interdisciplinary, acknowledge uncertainty, group dynamic, open and fair-mindedness, acknowledge biases, facilitate dialogue and discourse, team learning, shared understanding, knowledge transfer
	Distillation of themes				
		open dialogue, discourse, **understanding**	abductive reasoning, synthesize, **understanding**	**understanding**, recursive, iterative	interdisciplinary, discourse, shared **understanding**

Meta-Interpretation Form adapted from Weed, (2005) *"Meta Interpretation": A Method for the Interpretive Synthesis of Qualitative Research*