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OPERATION SWIFT WITHDRAWAL: A NONCOMBATANT EVACUATION OPERATIONS (NEO) WARGAME

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THESIS

OPERATION SWIFT WITHDRAWAL: A NONCOMBATANT EVACUATION OPERATIONS (NEO) WARGAME

by

Kyle Britt

June 2021

Thesis Advisor: Imre L. Balogh
Co-Advisor: Glenn A. Hodges

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As the contemporary operational environment shifts, the United States Marine Corps (USMC) will be increasingly relied upon to conduct missions as the nation's force-in-readiness. One category of these missions is Noncombatant Evacuation Operations (NEOs). NEOs are Department of Defense (DOD) and Department of State (DOS) operations that evacuate noncombatant and other designated evacuees from hostile countries to safe locations. The USMC has encountered NEOs for the past 50 years and must be prepared to execute NEOs because of future uncertainty. However, because of the infrequency of mission rehearsals, NEO skill atrophy is a concern. Thus, an interactive classroom training tool that augments the passive learning associated with PowerPoint presentations could be beneficial. Therefore, this thesis describes a novel experiential exercise in the form of an educational wargame that reinforces the three NEO guiding principles. The data collected from several iterations of this wargame suggests that this educational training tool can be utilized to reinforce NEO guiding principles and augment current NEO training methods.

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OPERATION SWIFT WITHDRAWAL: A NONCOMBATANT EVACUATION OPERATIONS (NEO) WARGAME

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ABSTRACT

As the contemporary operational environment shifts, the United States Marine Corps (USMC) will be increasingly relied upon to conduct missions as the nation's force-in-readiness. One category of these missions is Noncombatant Evacuation Operations (NEOs). NEOs are Department of Defense (DOD) and Department of State (DOS) operations that evacuate noncombatant and other designated evacuees from hostile countries to safe locations. The USMC has encountered NEOs for the past 50 years and must be prepared to execute NEOs because of future uncertainty. However, because of the infrequency of mission rehearsals, NEO skill atrophy is a concern. Thus, an interactive classroom training tool that augments the passive learning associated with PowerPoint presentations could be beneficial. Therefore, this thesis describes a novel experiential exercise in the form of an educational wargame that reinforces the three NEO guiding principles. The data collected from several iterations of this wargame suggests that this educational training tool can be utilized to reinforce NEO guiding principles and augment current NEO training methods.

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LIST OF ACRONYMS AND ABBREVIATIONS

DES	Discrete Event Simulation
DOD	Department of Defense
DOS	Department of State
ECC	Evacuation Control Center
ELC	Experiential Learning Cycle
ELT	Experiential Learning Theory
FGC	Fire Ground Commanders
KTLE	Kolb Team Learning Experience
LSI	Learning Styles Inventory
MOS	Military Occupational Specialty
NDA	National Defense Strategy
NEO	Noncombatant Evacuation Operation
PME	Professional Military Education
RPD	Recognition-Primed Decision
USMC	United States Marine Corps

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I. INTRODUCTION

The 2018 National Defense Strategy (NDS) expresses that the new operating environment will consist of "rapid technological change, and challenges from adversaries in every operating domain" [1]. These challenges increase the need to protect American citizens worldwide. Although the NDS does not directly reference Noncombatant Evacuation Operations (NEOs), the uncertainty associated with the "increasingly complex security environment" [1], requires that the U.S. Armed Forces remain ready for the "evacuation of United States citizens and nationals abroad" [2]. The violence and disorder linked to uncertain environments necessitates continuous preparedness. An educational training tool that compliments current NEO training and enhances NEO readiness would benefit military units that are tasked to execute NEOs.

A. BACKGROUND

Since the United States Marine Corps (USMC) is the "Nation's premier naval expeditionary force-in-readiness" [3], the USMC supporting the Department of State (DOS) has conducted many NEOs since the Vietnam War. Although, General David Berger states in his Commandant's Planning Guidance (CPG) that "noncombatant evacuations do not define [the USMC]" [3], he acknowledges that NEOs "are the day-to-day consequence of being the force-in-readiness" [3]. Hence, the USMC will continue to conduct NEOs under the Title 10 task, "perform such other duties as the President may direct" [4]. However, only specific units receive NEO training, and those units only receive a few opportunities to rehearse the mission before deployments. Once aboard Amphibious Ready Group/Marine Expeditionary Unit (ARG/MEU) shipping, they will not receive other opportunities to execute physical NEO rehearsals before an actual mission. Skill atrophy is a major concern. This thesis addresses the skill decay resulting from limited mission rehearsals and training.

B. NEO SKILL ATROPHY

The Department of Defense (DOD) defines NEOs as operations "conducted to assist the DOS in evacuating noncombatants, nonessential military personnel, selected host-nation citizens, and third-country nationals whose lives are in danger from locations in a host foreign nation to an appropriate safe-haven and/or the United States" [5]. By reason of robust logistics capabilities and rapid response to crises, the NEO became a MEU core Mission Essential Task [6]. Thus, MEUs train to execute NEOs at any point during their deployment. Although NEOs require the skillful integration of multiple assets and capabilities from a host of national and international agencies, arguably the most important element of a NEO is the Evacuation Control Center (ECC). Joint Doctrine defines the purpose of the ECC as, "to process, screen, and conduct selected logistic functions associated with emergency evacuation of designated noncombatant evacuees to support DOS" [5]. Skill atrophy presents itself strongest with ECC activities.

An ECC Commander and Security Team Leader plan and execute operations in the ECC. These Marines only receive NEO specific training when they join units that are scheduled to deploy with MEUs. The current method for training the ECC encompasses sets of PowerPoint presentations and standardized training events. Current fiscal constraints on training only afford the ECC four opportunities to rehearse the mission set with live role players prior to deployment. Once the ECC team is aboard ARG/MEU shipping, physical ECC rehearsals are severely limited because of the logistical requirements and unpredictability of NEOs. This results in limited training repetitions, which leads to skill atrophy and reduced readiness.

C. RESEARCH QUESTION

This thesis intends to provide an educational board wargame focused on reinforcing the training objectives of NEOs specifically targeting ECC activities. The learning objectives are the three NEO guiding principles outlined in Joint Doctrine. The principles are, "accuracy (all personnel are accounted for), security (evacuees and the evacuation forces are safeguarded from all threats) and, speed (processing must be accomplished quickly and efficiently)" [5]. Currently, the Marine Corps uses several wargames as experiential and analytic tools. The Rand Corporation developed a board wargame that focused on a NEO in the Indo-Pacific. However, their wargame operated at the strategic level of war. It attempted to "assess the prospects for cooperation between the United States and China for NEOs from the Republic of Korea in the event of a Korean contingency" [7]. Conversely, this thesis will mainly focus on the tactical level. This thesis will investigate the following question: Can an educational board wargame model the NEO learning objectives/guiding principles and provide ECC teams with useful training experiences, experiential benefits, and augment the current passive learning and standardized scenario training methods?

D. METHODOLOGY

The design of this NEO wargame focuses on ensuring that the players use sound military strategies to process and evacuate evacuees while successfully implementing the three NEO guiding principles. The wargame uses simple, yet engaging game mechanics that reduces the player's extraneous load. This serves two important purposes. First, it allows the players to focus on different strategies to achieve their objectives without unnecessary distractions. Second, it reduces the duration of each game, allowing players to execute multiple iterations of the game without losing focus. After playing this educational wargame, players will be more knowledgeable about evacuation operations and will better apply the three NEO guiding principles to real life NEOs.

Students assigned to the Naval Postgraduate School (NPS) Modeling Virtual Environments and Simulation (MOVES) Institute conducted a month of play testing and wargame refinement to verify the game mechanics, playability, and game's ability to reinforce the three NEO guiding principles. Afterwards, data collection came from multiple iterations of USMC NPS Officer students playing the wargame. This data was then used to conduct a Training Effectiveness Evaluation. Players completed questionnaires regarding ECC operations before and after each game play. This method identified which participants possessed knowledge of ECC operations. The results were analyzed using a paired experimental design.

E. RESULTS

The NEO wargame provided by this thesis effectively incorporated the three NEO guiding principles of accuracy, security, and speed. Based on the questionnaire results of 10 iterations of the wargame (encompassing 20 players), players exhibited increased knowledge of the NEO guiding principles immediately after playing the wargame. Additionally, players with limited knowledge of NEOs prior to interacting with the wargame (measured by their pregame questionnaire scores) demonstrated the greatest increase in knowledge acquisition of NEOs.

F. CONCLUSION

Previous attempts to model NEOs were executed via Discrete Event Simulation (DES) and a single strategic level board wargame. This thesis expanded on the previous work by incorporating existing models to produce a board wargame that reinforced the three NEO guiding principles. Players were required to demonstrate accuracy by accounting for all evacuees and evacuating them in the correct order outlined in the NEO Joint Publication. They also had to display understanding of security operations by ensuring that security units supported processing operations at the evacuation site and were deployed to receive evacuees at all intermediate evacuation nodes. Lastly, players had to exhibit speed by making rapid decisions each turn within a five-minute time limit. The experiential benefits provided by this wargame directly resulted in increased NEO knowledge acquisition. Therefore, an educational board wargame can effectively model the NEO guiding principles. Additionally, the results of this experiment suggests that the interplay between the players and the wargame leads to faster skill and knowledge acquisition than engaging in passive learning methods.

II. LITERATURE REVIEW

A. OVERVIEW

This chapter will explore the connection between knowledge acquisition and experience. Discussions concerning experiential learning theory (ELT), naturalistic decision-making, recognition-primed decision, and wargaming will build the conceptual framework for how individuals learn, retain knowledge, and make decisions.

1. Experiential Learning Models

The works of Dewy (Model of Learning), Lewin (Model of Action Research and Laboratory Training), and Piaget (Model of Learning and Cognitive Development) heavily influenced David Kolb's well-known experiential learning model. All three models describe learning in terms of a cyclic process of stages. Although Kolb acknowledges that they all share multiple similarities, a few differences set them apart. According to Kolb, with Lewin's Model of Action Research and Laboratory Training, "learning, change, and growth are seen to be facilitated best by an integrated process that begins with here-and-now experience followed by a collection of data and observations about the experience. The data are then analyzed, and the conclusions of this analysis are fed back to the actors in the experience for their use in the modification of their behavior and choice of new experiences" [8]. Figure 1 is an illustration of Kolb's interpretation of Lewin's model. Next, Kolb states that Dewey's model differs from Lewin's model in that, "Dewey's Model makes more explicit the developmental nature of learning and the feedback process by describing how learning transforms the impulses, feelings, and desires of concrete experience into higher-order purposeful action" [8]. Figure 2 is an illustration of Kolb's interpretation of Dewey's model. Finally, Kolb states that the Piaget model differs from the other models in that it "emphasizes that the dimensions of experience and concept, reflection, and action form the basic continua for the development of adult thought. As a result, development from infancy to adulthood moves from a concrete phenomenal view of the world to an abstract constructionist view, from an active egocentric view to a reflective internalized mode of knowing" [8]. Piaget's model is shown in Figure 3. The similarities and differences of the Lewin, Dewey, and Piaget models became the foundation for Kolb's future model.

Figure 1. The Lewinian Experiential Learning Model According to Kolb. Source: [34].

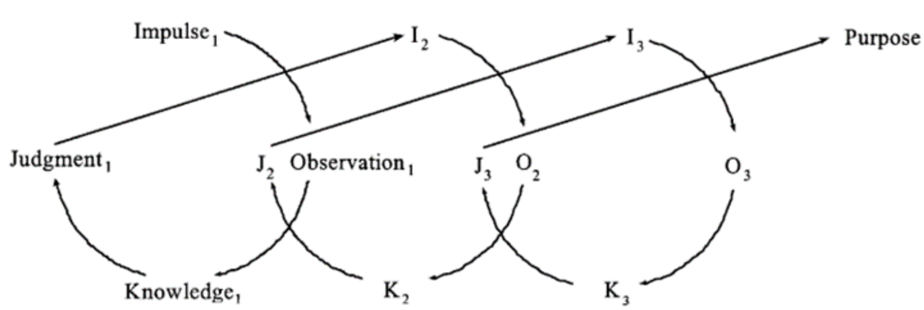


Figure 2. John Dewey's Concept of Experiential Learning According to Kolb. Source: [34].

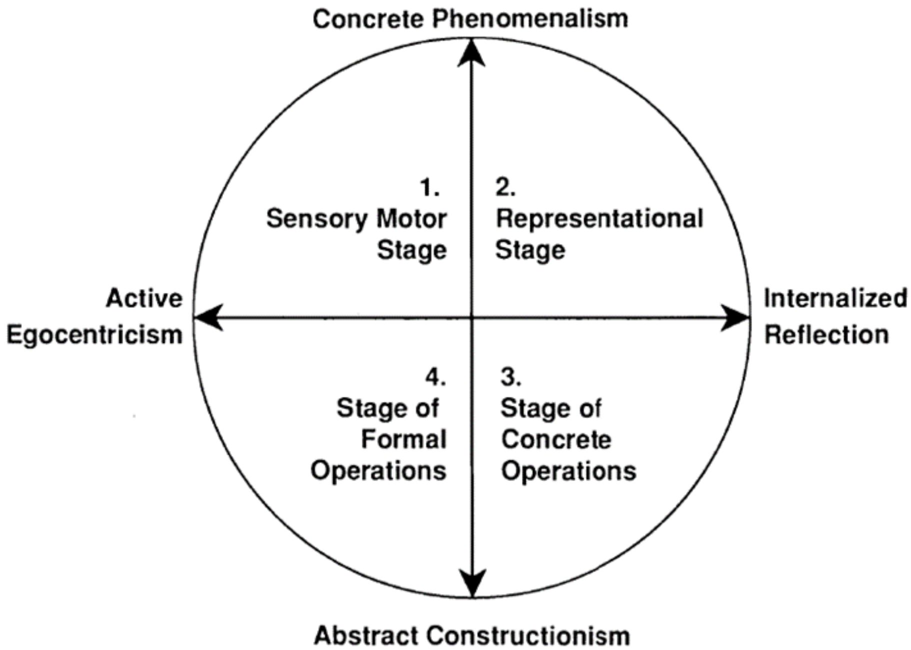


Figure 3. Piaget's Model of Learning and Cognitive Development.
Source: [35].

2. Kolb's Experiential Learning Model and Theory

Building on the works of Lewin, Dewy, and Piaget, Kolb describes his experiential learning model by first enumerating a list of experimental learning characteristics and then describing the four stages of his model. According to Kolb, experiential learning must include six distinct characteristics. They are, "learning is best conceived as a process and not as terms or outcomes, learning is a continuous process grounded in experience, the process of learning requires the resolution of conflict between dialectally opposed modes of adaption to the world, learning is a holistic process of adaption to the world, learning involves interactions between the person and the environment, and learning is the process of creating knowledge" [8]. Expanding on the meaning of these characteristics, Kolb defines learning "as the process whereby knowledge is created through the transformation of experience" [8]. Learning through experience is the underpinning of Kolb's Experimental Learning Cycle. The Experimental Learning Cycle has four stages that includes Concrete Experience, Reflective Observation, Abstract Conceptualization, and

Active Experimentation. According to Kolb, for effective learning to occur, a person has to engage in new experiences (Concrete Experience), actively engage in experience reflecting (Reflective Observation), develop sound theories about their reflections (Abstract Conceptualization), and use their theories as the source for future experimentation (Active Experimentation) [9]. Figure 4 is a visual representation of Kolb's learnings styles as well as their relation to each other while individuals are engaged in learning. An individual must traverse through all four stages of the cycle before learning can take place.

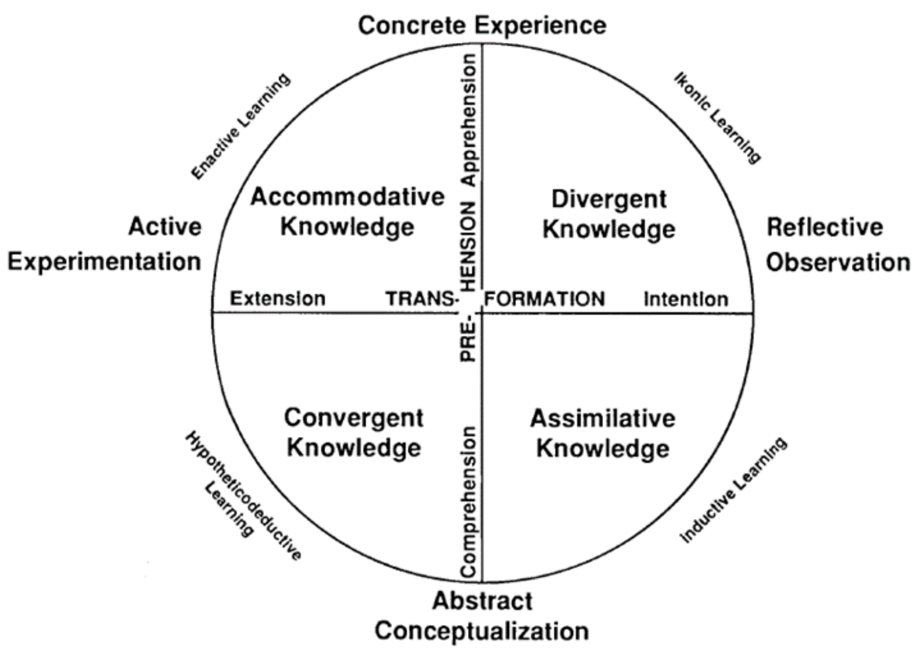


Figure 4. Kolb's Structural Dimensions of Knowledge. Source: [35].

Prior to the official release of his work on experiential learning in 1984, Kolb released a work that outlined his experiential learning model and Learning Styles Inventory (LSI). According to Kolb, "Immediate concrete experience is the basis for observation and reflection. Those observations are utilized by the individual to develop generalizations and theories about the implications of other actions. Those implications then serve as the basis for new experiences" [9]. To gain a better understanding of how an individual's experience and environment influence their ability to learn, Kolb conducted an experiment that revealed four prominent learning styles. The learning styles are based on the results of Kolb's LSI that measures the differences in learning styles along two basic dimensions of abstract-concrete and abstract-reflective shown in Figure 5 [9]. The four learning styles are Converges (possesses the ability to make informed decisions from a list of alternatives), Diverges (possesses the ability to analyze problems from multiple perspectives), Assimilators (possesses the ability to problem solve utilizing the scientific method), and Accommodators (possesses the ability to develop and execute detailed plans) [9]. These learning styles play an important role in an individual's ability to learn. Each stage of Kolb's Experiential Learning Cycle (ELC) relates to a distinct learning style. This is illustrated in Figure 6. Therefore, incorporating all four stages/learning styles in an individual's learning system results in effective learning.

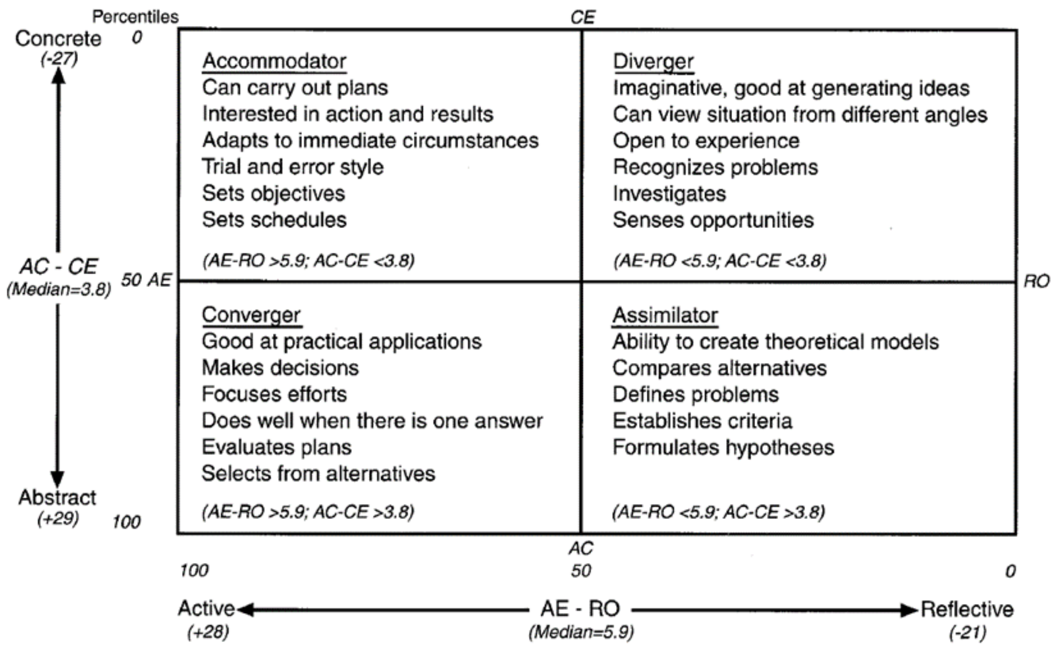


Figure 5. Kolb's Learning Style Inventory. Source: [11].

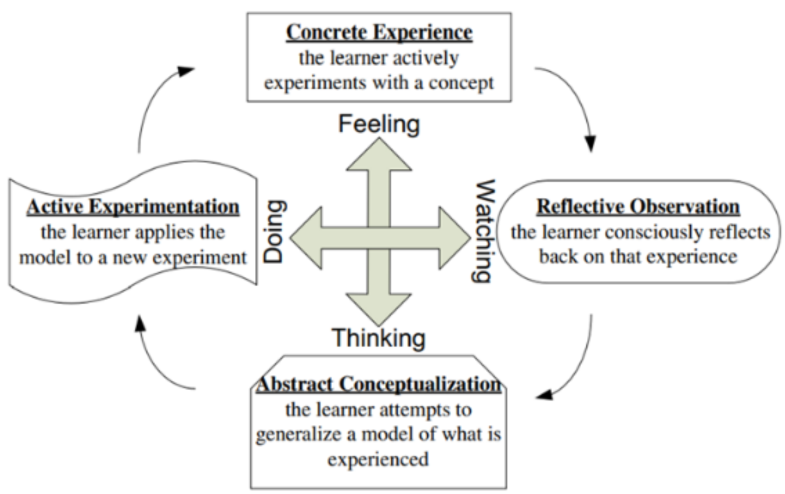


Figure 6. Kolb's Four Stage ELC. Source: [3].

3. Summary

The crux of Lewin, Dewey, Piaget, and Kolb's argument focuses on experience as the gateway to learning and retaining knowledge. This is most effectively accomplished through repeated iterations of the learning cycle, whereby individuals apply the four prominent learning styles to their experiences. Previous ideas regarding learning suggested that individuals gravitated towards a particular learning style to gain a better understanding of their experiences. However, utilizing one learning style, according to the experiential learning advocates does not result in efficient learning. Individuals learn when they enter the learning cycle and complete continuous repetitions transitioning through all the learning styles. While individuals can enter the learning cycle at any stage, the most common starting point is with a Concrete Experience. Here individuals actively engage in an experience. They then transition to the Reflective Observation, where they reflect on the meaning of the experience. The meaning that the individuals derived from the previous stage is manifested in the development of the generalized models of the experience in the Abstract Conceptualization Stage. Finally, the models developed in the previous stage are utilized as the foundation for experimentation with future experiences.

B. EXPERIENTIAL LEARNING IN HIGHER EDUCATION

Since the release of Kolb's ELT, many authors have written about its application and validity, especially in higher education. This section will explore the use of Kolb's ELT in higher education to include business management, accounting, history, geography, agriculture, study abroad programs, and ELT influence on teams.

1. ELT in Business Management, Accounting, History

Alice and David Kolb collaborated and reviewed studies across multiple fields of academic disciplines in higher education to learn how learning style information and the experiential learning model has improved teaching and learning. Their most interesting observations came from the business management, accounting, and history disciplines. In an Israeli military Academy experiment focused on problem solving conducted in 1983, results revealed that more students applied more attention to problem solving in courses where teachers successfully integrated experiential learning processes in their courses [10]. Likewise, in an experiment conducted in 1985, the authors observed that the application of experiential learning in an accounting class with an experiential instructor resulted in improved knowledge retention amongst students. This was because the experiential exercises led to active student participation and engagement in the learning process [10]. Lastly, a study conducted in 2001, revealed that history courses were inherently uninteresting for many undergraduates. According to the Kolb's "this is due to teaching methods that rely too heavily on lectures, note taking, and term papers" [10]. Furthermore, Alice and David argued "that this teaching method is lacking in the mechanism that allows for students' emotional and intellectual engagement in the learning process which is different from experiential learning" [10]. The Kolb's concluded that there is evidence that shows that experiential learning is an effective means of promoting teaching and learning in higher education. The Kolb's research reveals that when engaged learning replaces passive learning, individuals learn more and retain the material longer.

2. ELT in Geography

In their work, Mick and Alan [11] explore experiential learning and its application in higher education, specifically geography. The authors believe that experiential learning has some key strengths that apply directly to teaching. They include "helping teachers effectively link theory and application, emphasizes the importance of encouraging students to reflect and teachers to provide feedback to reinforce learning, and stresses the incorporation of combining different learning styles to yield effective learning results" [11]. Mick and Alan also acknowledge the validity of Kolb's different learning styles. They stress the idea that if teachers do not encourage students to explore all four styles of learning, they may hinder their development. Also, student development suffers when teachers elect to instruct using one style of teaching. To combat this, the authors discuss research that was conducted in 1987. The research concluded that knowledge retention increases as more learning stages are incorporated into student's education [11]. To identify how the incorporation of different learning styles enhances learning, the authors describe an introductory geography course exercise that used Kolb's ELT. The authors conclude that the course was effective because the teachers that taught the course took part in a staff development exercise that encouraged the use of Kolb's ELT. Mick and Alan's work further validates Kolb's ELT. Both their 1987 research and geography course exercise validate Kolb's claim that learning, and retention can only occur if learners traverse every stage of the ELC, exposing themselves to all four learning styles.

3. ELT in Agriculture

Expanding experiential learning to agriculture, Baker and Robinson [12] discuss how experiential learning has been at the core of agricultural education since inception. They do this by discussing the relationship between ELT and an agricultural education. Their main ideas are that the agricultural education model and experiential learning model share similar attributes, experiential learning is useless without meaningful instruction, experiential learning leads to a better understanding of thinking processes, and intentional curriculum development and evaluation is the foundation of productive experiential learning programs [12]. What makes their research insightful is that their key ideas regarding ELT are naturally visible in the agricultural curriculum. The authors state that "the Experiential Learning Model when overlaid on the Three Component Secondary Agricultural Model represents the total agricultural experience" as displayed in Figure 7 [12]. This is notable because it differentiates other educational experiences from the agriculture education. The key difference is that experience (such as grooming a steer) is essential to agriculture learning and developing agriculture professionals. This differs from a regular curriculum that the authors describe as mostly "sterile environments that rarely move outside the classroom" [12]. While participating in an agricultural education, students learn by immersing themselves in the activities that make up the profession. It transforms their experiences into knowledge when an individual uses it to traverse the ELC.

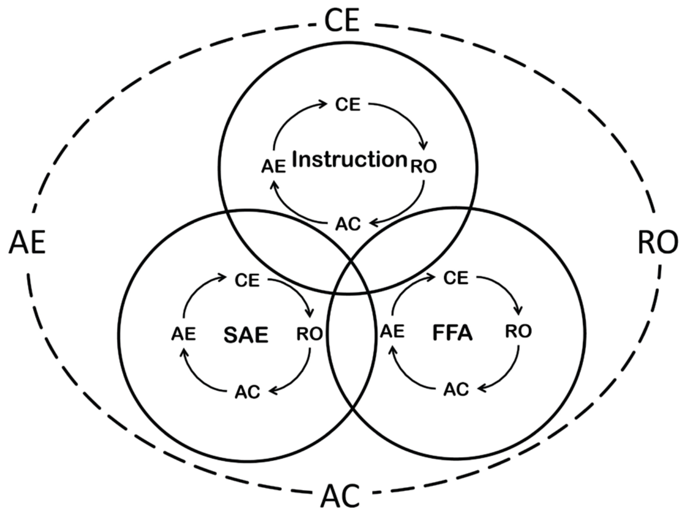


Figure 7. Model for Secondary Agricultural Education. Source: [12].

4. ELT in Study Abroad Programs

Angela and Kolb use study abroad programs as a case study to discuss how ELT can promote learning. They argue that study abroad programs can present a meaningful learning experience because it forces the students to adopt alternative ways of thinking, making sense of novelty and ambiguity, and develop fresh ways of relating to the world [13]. They can accomplish this through ELT by adopting a holistic approach that transforms experience into knowledge. They also highlight two additional areas concerning ELT, Learning Flexibility, and Learning Space. They describe Learning Flexibility as "learning the ability to use each of the four learning styles to move freely around the learning cycle and to modify one's approach to learning based on the learning situation" [13]. Likewise, Learning Space, or space for learning to take place, is also essential to learning. Rather than a physical place such as a classroom, they describe space in multi-dimensions. They include the physical, social, and cultural aspects. Because of the opportunities for growth and development, study abroad programs are a perfect means for applying ELT. For students to thrive in new environments, they must engage in experiences, reflect on the meaning of the experiences, and use the knowledge gained from the experiences as the foundation for navigating future experiences.

5. ELT for Teams

ELT yields favorable results for teams and individuals alike. Kayes and Kolb's work discusses ELT regarding teams. They conceptualized team development in the form of six aspects, with learning as the core element [14]. Their six aspects include "purpose, membership, role leadership, context, process, and action" [14]. These aspects are depicted in Figure 8. The authors address these aspects via a written simulation they call Kolb Team Learning Experience (KTLE). The KTLE is provided to teams as a workbook and "team members learn about team functions while engaging in the processes of knowledge creation, reflection, critical thinking, and action taking" [14]. Therefore, teams learn together as they progress through a series of activities and problems. Similar to the four stages of the (individual) learning cycle, the KTLE helps team members learn about team functions with a four-stage cycle. The cycle includes producing knowledge, thorough reflection, reasoning, and acting [14]. Therefore, the KTLE utilizes several simulation modules to develop effective teams (corresponding to the six aspects of team development).

Kayes and Kolb also emphasize the results of studies that were conducted regarding the combination of individuals with different learning styles within a team. They examined the differences in performances of homogeneous teams (composed of individuals with the same learning style) and heterogeneous teams (composed of individuals with different learning styles). Heterogeneous teams exhibited better performance results than homogeneous teams [14]. Similarly, "teams made up of members with balanced learning styles performed at a higher level on a critical thinking task than teams whose members had specialized learning styles" [14]. The authors' findings further validate Kolb's ELT as it applies to teams. Similar to how learning and knowledge retention depends on traversing all four stages of the ELC (exposure to all four learning styles), teams that are composed of individuals with different learning styles perform better than their homogeneous team counterparts.

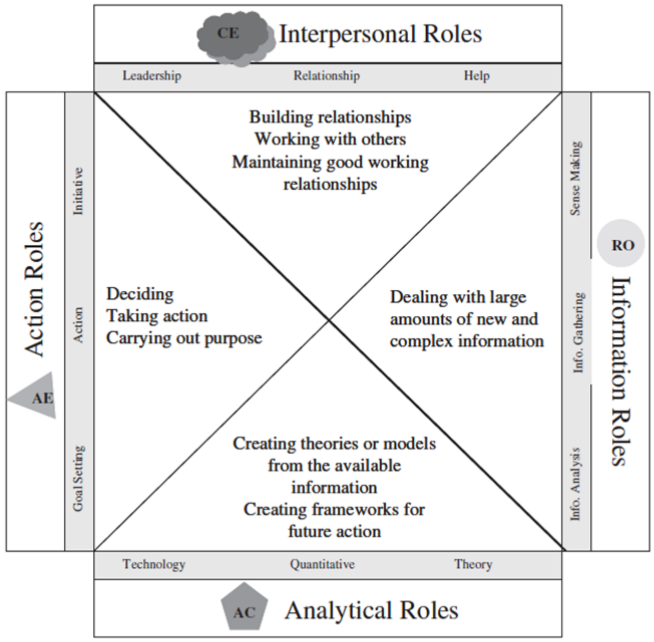


Figure 8. Kolb and Kaye Team Learning Model. Source: [14].

6. The Latest Updates to ELT

In 2017, Alice and David Kolb released an update to ELT and the LSI. The ELC remained the same. However, the LSI included additional learning styles to aid teachers in higher education with incorporating ELT in their teaching methods. The ELC still encompasses four stages. However, more learning styles are "systematically arranged on a two-dimensional learning space defined by the Abstract Conceptualization-Concrete Experience and Active Experimentation-Reflective Observation dimensions of the learning cycle" [15]. The new learning styles include the Initiating Style (the ability to develop and implement actions to apply to new situations), Experiencing Style (capacity to draw in-depth meaning from immersive experiences), Imagining Style (capacity to explore multiple possibilities based on associated experiences), Reflecting Style (capacity to merge ideas with related experiences) Analyzing Style (ability to develop unique ideas through a systematic process of reflection), Thinking Style (the ability to engage in logical reasoning), Deciding Style (the ability to utilize the scientific method to assist with decision-making), Acting Style (capacity to match people with tasks to accomplished specified goals), and Balancing Style (capacity to consider different courses of action to adapt to new situations) [15]. All of the additions to the LSI and their relationship to the original four stages of learning are illustrated in Figure 9. A need for individuals to alter their learning styles based on what needed to be learned as well as the changing situations was the impetus for the addition of these learning styles.

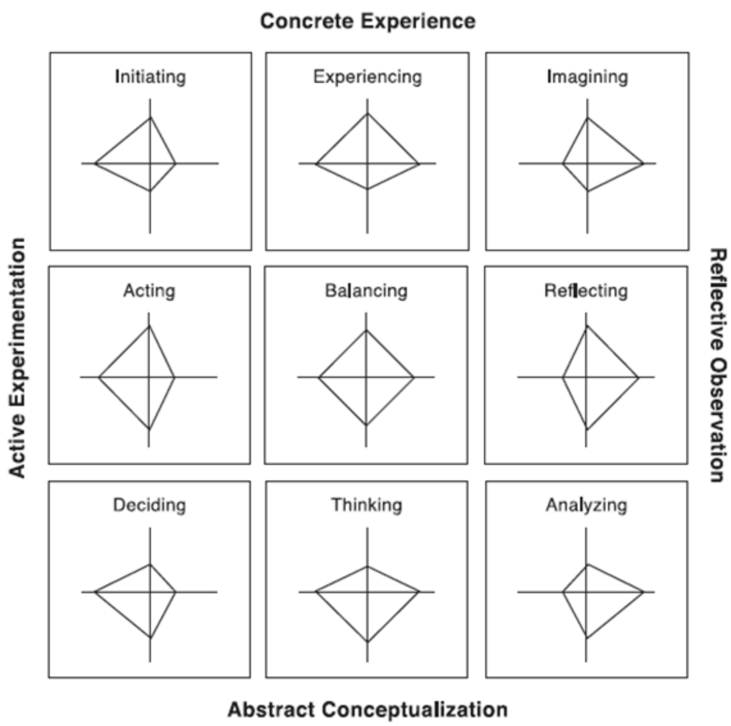


Figure 9. Kolb's Nine Learning Styles. Source: [15].

7. Summary

When considered only in a theoretical context, ELT appears to be a plausible approach to enhancing methods of instruction in higher education. Research as far back as the 1980s has acknowledged the benefits of ELT in academia. Not only is the theory logically sound, but researchers have successfully applied it across multiple academic disciplines to include Business Management, Accounting, History, Geography, and Agriculture. While these academic disciplines are often associated with passive learning delivered via PowerPoint presentations and lectures, incorporating experiential learning methods in the core curriculum positively influenced how students learn and retain knowledge. These findings strongly support Kolb's claim that knowledge acquisition is achieved through a systematic transformation of experience into knowledge. These outcomes are best achieved through academic programs that incorporate all four styles of learning.

Research into learning abroad programs also supports Kolb's ELT. Students participating in study abroad programs naturally engage in experiential learning to thrive in new environments. For instance, learning a simple phrase in a new language requires the students to traverse all four stages of the ELC. First the students experience a native speaking the phrase in a particular context. Then, they think about what the phrase actually meant. Afterwards, they develop mental models of what the phrase could have meant in the context it was spoken. Finally, they experiment using the phrase in different contexts that matches their mental models. Following multiple iterations of this behavior, the student's knowledge of what the phrase meant and how to use it elevates.

Exploring ELT and teams provides unique insight on how applying more than one style of learning to a problem yields the best results. The benefits that diverse teams provide to organizations are directly linked to the benefits gained by traversing the ELC. Teams composed of individuals that naturally have the same learning style tend to perform less efficiently than those composed of individuals with different learning styles. This is because teams with one learning style have to somehow get all the members to navigate the ELC from the same starting point/stage. Since, individuals process information at different rates, this method is cumbersome and time consuming. Conversely, teams with different learning styles have the added benefit of individuals navigating the ELC at different starting points/stages. This method is proven to be more efficient for two reasons. First, it allows the problem to be solved by applying solutions from different learning styles simultaneously. Second, since individuals in the team start the ELC at different points/ stages, they complete cycles/learn faster. This faster learning results in faster and more efficient problem solving.

ELT underwent its most recent update in 2017 when Alice and David Kolb added addition learning styles to the inventory. The new additions are supported by advancements in human cognitive research.

C. DECISION-MAKING

1. Klein's Fire Commander Study

For years, many professionals have attempted to address the subject of professional decision-making. In 1985, Gary Klein published the results of his study that examined how "highly proficient personnel make decisions under conditions of extreme time pressure, and in environments where the consequences of the decisions could affect lives and property" [16]. Klein used Firefighters as the subjects for his study, and the research focused on the decisions made by Fire Ground Commanders (FGC). The population size for his study was 26 experienced FGCs with a mean experience of 23 years. Klein's study included 156 decision points tied to different training scenarios. His study concluded that less than 12% of the FGC's decision points involved the comparison and evaluation of more than two options [16]. Also, over 80% of the decision points revealed the FGCs utilized "their experience to directly identify the situation as typical of a standard prototype and to identify a course of action as typical for that prototype" [16]. This resulted in the FGCs not needing to weigh the outcome of only one option at a time. These results informed Klein's Recognition-Primed Decision (RPD) Model. The RPD Model describes how a person's collection of experiences can be translated into a repository of patterns and cues to be used during future decision-making. Thus, RPD allows rapid matching of key aspects of the current situation with patterns from previous experiences. This is illustrated in Figure 10. Ideally, individuals use experience to produce a viable option as a leading choice to consider. This affords them quick access to sound solutions, that are based on experience and intuition. Instead of utilizing calculation or analysis for rapid decision-making, RPD emphasizes the use of recognition. Figure 11 is a simplified model of RPD based on the results of Klein's research.

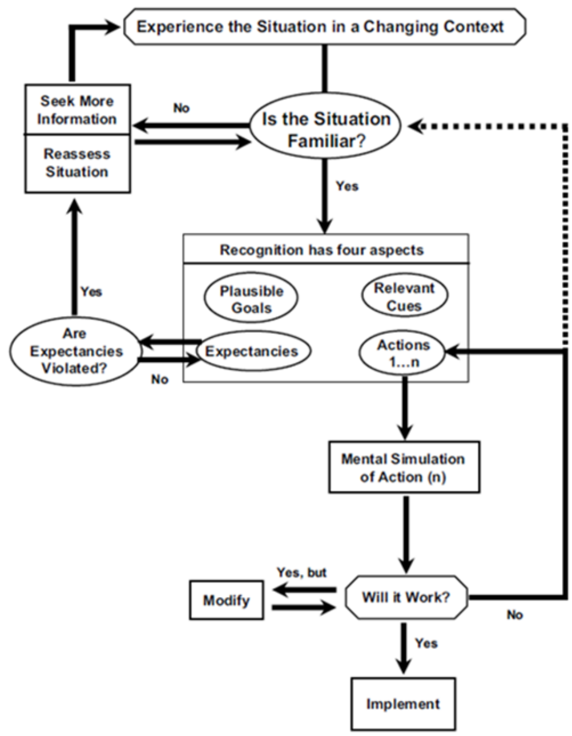


Figure 10. Klein's Detailed RPD Model. Source: [19].

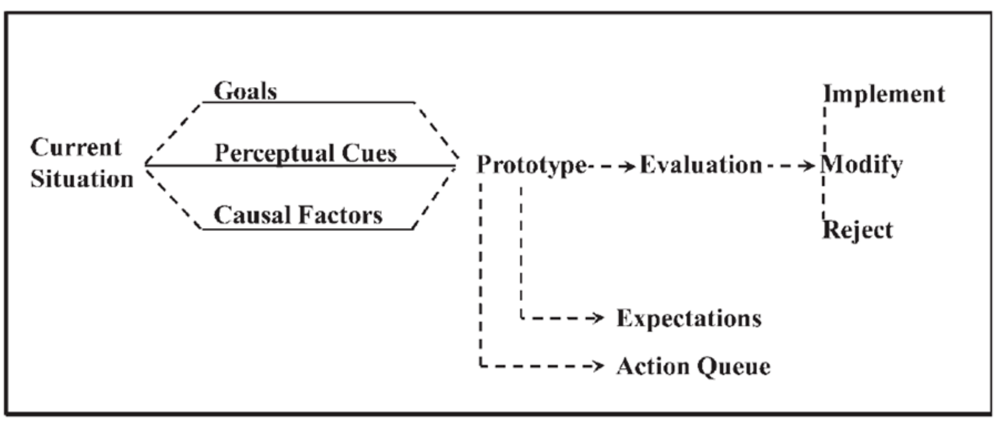


Figure 11. RPD Model from Fire Commander Study. Source: [16].

2. Klein's Thoughts on Military Decision-Making

Based on the results of his Fire Commander study and the subsequent formulation of the RPD Model, Klein published an article that criticized the analytical decision-making processes associated with the U.S. military. He states that, "military decision-makers have come to rely too heavily on analytical decision-making processes, contributing to a reduction in the effectiveness of training and decision support systems" [17]. When comparing the benefits of his recognitional model with the military's calculated analytical approach for most combat or field situations, Klein concludes his model is best suited for the rapid decisions that are necessary for military operations. A list of the major benefits provided by RPD are contain in Figure 12. The primary differences between analytical and RPD informed Klein's beliefs. The key differences are that RPD focuses on situation assessment, involves decision-makers imagining how the decision will play out in a situation, and RPD presents decision-makers options despite tight time constraints [17]. Klein showed this when he recalled a situation in his work where an officer used RPD to make a critical decision. He recalled that "the officer used experience to recognize the key aspects of the situation, enabling a rapid reaction" [17]. In a military context, RPD enables decision-makers to conceptualize problems based on cues developed from an individual's experience and conduct a mental simulation of different outcomes. This influences the speed required for individuals to decide.

1. First option is usually workable NOT random generation and selective retention
2. Serial generation/evaluation of options NOT concurrent evaluation
3. Satisficing NOT optimizing
4. Evaluation through mental simulation NOT MAUA, Decision Analysis, or Bayesian statistics
5. Focus on elaborating and improving options NOT choosing between options
6. Focus on situation assessment NOT decision events
7. Decision Maker primed to act NOT waiting for complete analyses

Figure 12. Key Benefits of RPD. Source: [36].

3. Expert Decision-Making

In 1999, Klein published an article that addressed expert decision-making. This work expanded on his previous work regarding RPD and the calculated analytical approach. Piecing together the results of all his work, Klein emphasizes that that decision-making in dynamic settings is perceptual rather than conceptual [18]. He outlined his views in three variations which are shown in Figure 13. This approach allows rapid analysis of the situation and development of quick solutions. His recognitional approach to decision-making is in stark contrast to previous views. Previous views describe decision-making as gathering all the details, conducting an exhaustive analysis of the details followed by an analysis of all the options, and finally selecting the optimal decision. In uncertain environments characterized by high stress, time-pressure, and high stakes, it is apparent that the RPD approach yields the best results. It significantly reduces the time required to make decisions because its perceptual approach allows decision-makers to narrow the number of choices to a manageable number.

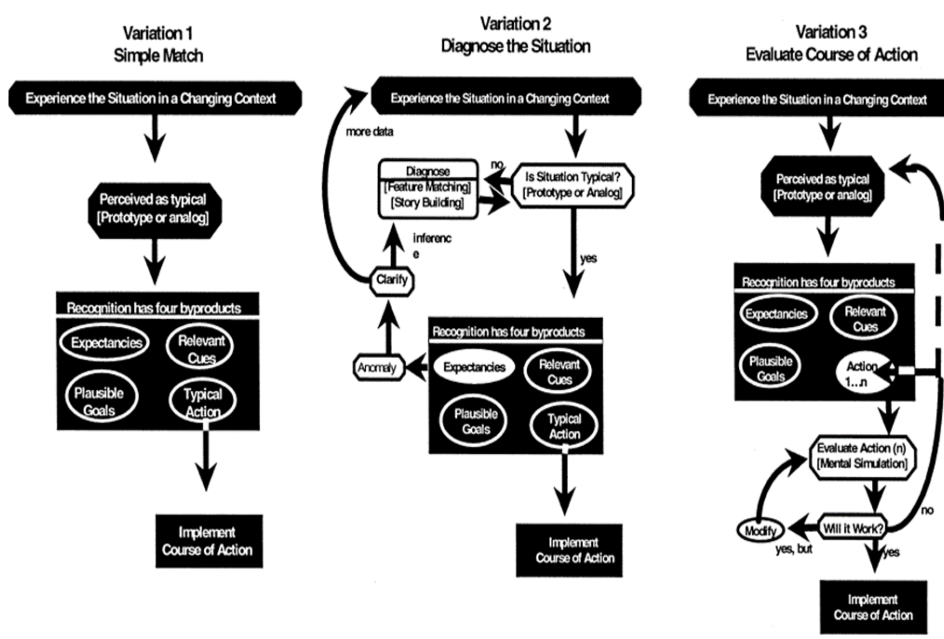


Figure 13. Klein’s Three Levels of Expert Decision-Making. Source: [18].

4. Naturalistic Decision-Making

Following the publishing of Klein's work detailing the significance of his RPD Model, he published an article discussing Naturalistic Decision-Making. Research began in the 1980s to understand real-world human decision-making. However, the results of the studies had limitations because researchers conducted them in carefully controlled environments not equivalent to ideal situations. Consequently, other researchers developed models to help explain how difficult decisions are made in real-world settings. These included Hammond's Cognitive Continuum Theory and Rasmussen's Model of Cognitive Control. Hammond's Cognitive Continuum Theory "asserts that decisions vary in the degree to which they rely on intuitive and analytical processes. Conditions such as amount of information and time available determine where decisions fall on this continuum and whether people rely more on patterns or on functional relationships" [19]. Rasmussen's Model of Cognitive Control describes decision-making in terms of "skill-based, rule-based, and knowledge-based behavior operating within the context of a decision ladder that permitted heuristic cutoff paths" [19]. Both Hammond and Rasmussen's models advanced the human decision-making research. Their models combined with Klein's RPD provide a holistic understanding of how humans make decisions.

5. Fast and Slow Thinking

In 2014, Daniel Kahneman published a book that revealed the results of his research to understand how humans think. The task was to look at a picture of a woman and execute a multiplication problem. His research results conceptualized human thinking into two prominent systems. The first system "operates automatically and quickly, with little or no effort and no sense of voluntary control" [20]. We associate this system with fast thinking. Activities that require fast thinking include solving simple math problems or making a facial response to an image. However, the second system "allocates attention to the effortful mental activities that demand it, including complex computations" [20]. We associate this system with slow thinking and is more synonymous with ideas of choice and concentration. Therefore, activities that are associated with this system are solving a complex math problem or attempting to identify patterns within a body of text. Although the systems appear as opposites, information flow connects them. According to Kahneman, although we want to identify with system two, the reality is that system one's effortless impressions "are the main sources of the explicit beliefs and deliberate choices of system two" [20]. Thus, the fast, unconscious, effortless thinking of system one is valuable. It is the starting point for deliberate thought under system two when timing and situation permit and have a significant impact on follow on choices during deliberate thought.

6. Heuristics and Biases

The heuristics and biases paradigm of 1982 provides critical insight on how people make decisions. They revealed that "people did not adhere to the principles of optimal performance, they did not generate alternative options and compare them on the same set of evaluation dimensions, and they did not generate probability and utility estimates for different courses of action and elaborate these into decision trees, and they rarely employed systematic evaluation techniques" [19]. In the study of human thinking, problem solving, and decision-making, heuristics are a means to allow people to make fast decisions in a time sensitive environment. Whereas biases, can influence a person's decision-making by focusing on unnecessary information. In 1974, Kahneman and Tversky conducted research on common heuristics that are employed by individuals to make rapid decisions in uncertain environments that result in biases. Their findings suggested that although the "heuristics are highly economical and usually effective; they lead to systematic and predictable errors" [21]. This finding is important to understanding how the elements that help people think faster and make decisions actually produce biases that have a profound impact on their decision-making process.

7. Prospect Theory

Building on their heuristics and biases research and their influence on human decision-making, Kahneman and Tversky's delved into prospect theory. Their motivation behind prospect theory was to "integrate [the] behavioral anomalies in rational decision theory into an alternative theory of risk choice" [22]. Their description of the fundamental assumption of prospect theory revolves around the idea that people conceive value in terms of deviation from a reference point [22]. What this means is that human value can be measured based on how situational changes influence fluctuations from their established baseline. For instance, in a situation where people possess a certain amount of resources, they tend to value and react positively to situational changes that result in them maintaining or gaining more than their baseline amount. However, when situational changes result in negative deviation from the baseline amount (they have less than their baseline amount) people react irrationally and place more value on their baseline amount. This phenomenon results in what Kahneman and Tversky call loss aversion behavior [22]. This behavior "induces them to take significant risks in the hope of avoiding loss" [22]. Prospect theory provides valuable insight on how individuals weigh and contemplate risk and reward.

8. Summary

Klein's Fire Commander study debunked preconceived notions about how experienced professionals approached decision-making. He proved that expert decision makers do not make decisions by gathering all of the pertinent information and analyzing each alternative for the optimal solution. Instead, they have developed the ability to identify workable solutions based on the recognition of cues within their environment. Instead of engaging in time consuming analysis, professionals lean heavily on their experience to inform their decisions. These findings were the foundation of his RPD Model. Also, from Klein's perspective, the expertise required to excel as a Fire Commander is similar to the skills necessary to prosper as a military professional. Thus, Klein applied his RPD Model to military professionals and concluded that they too rely on their experience to make rapid decisions, especially in stressful environments. Klein's findings were so vital to the study of human decision-making, that his RPD Model is still widely accepted today.

The RPD Model was not the only attempt to understand human decision-making. Hammond and Rasmussen's contributions to Naturalistic Decision-Making research conceptualized human decision-making as cognitive exercises that are governed by rules, the amount of time before the decision has to be made, and analytical decision ladders. Thus, Hammond and Rasmussen's findings view human decision-making as a more complex endeavor than Klein's simple RPD model. However, when combined, all three researcher's findings provide explanations for how humans make decisions in different types of environments.

Kahneman and Tversky's research on fast and slow thinking, heuristics and biases, and prospect theory added another layer of detail and understanding about how humans make decisions by examining how humans think. Fast thinking happens rapidly as a result of extreme familiarity with the subject matter. Slow thinking is intended for more methodical tasks because it requires more cognitive load. Therefore, humans utilize slow thinking to solve complex problems. Both types of thinking were utilized in Kahneman and Tversky's heuristics and biases research to gain a better understanding of human decision- making in uncertain environments. Their finding revealed that environmental cues that are supposed to assist in faster human decision-making often lead to biases that can positively or negatively influence decision-making processes. This finding is important because it emphasized that developers of synthetic training environments must be careful not to include cues that may produce biases that will transfer to poor decision-making in live events. Finally, Kahneman and Tversky's Prospect Theory research attempted to explain anomalies and human decision-making. In the context of possessions, humans tend to place value on what they currently have rather than what they can potentially gain by making a series of sound decisions. Thus, humans make risk-averse decisions when they perceive that the risk outweighs the reward.

D. WARGAMING

1. Definition of Wargames

The words "war" and "game" often conjure ideas of adults and children playing games to place themselves in the shoes of history's greatest military Commanders for a brief period of battlefield glory. It is for this reason that there are misconceptions about wargames which distracts from their utility. Further complicating the comprehension of what wargames are, is the fact that the leading wargaming advocates typically agree on what wargames are, but all have their own unique interpretations. Perla describes what wargaming is not before he states what it is. He asserts, "wargaming is not analysis, real, or duplicable" [23]. Conversely, a wargame "is an exercise in human interaction, and the interplay of human decisions… Its forte is the exploration of the role and potential effects of human decisions" [23]. Dunnigan defines a wargame as "an attempt to get a jump on the future by obtaining a better understanding of the past… [it is] a combination of 'game', history, and science. Basically, it is glorified chess" [24]. By far the most detailed definition comes from Sabin. He states wargames are "military simulation games'… They are based on the military capabilities of some past or present antagonists… They attempt to simulate aspects of a real or imaginary armed conflict involving such military forces, and to do so with at least some concern for accuracy or 'realism'… they do this in the form of a game, which players can win or lose by making decisions which need not be the same as those of the actual commander" [25]. Appleget and his colleagues explored the validity of the aforementioned definitions and settled on the 2017 Joint Publication version. A wargame is "A dynamic representation of conflict or competition in a synthetic environment, in which people make decisions and respond to the consequences of those decisions" [26]. While similar in most aspects, the minor differences in these definitions have the potential to lead to a misunderstanding of what wargames are.

2. Brief History of Wargaming

Although the exact origins of wargaming are unknown, Caffery accredits the early wargame Wei Hai to Sun Tzu [27]. However, Perla acknowledges the development of Chaturanga in India around the same time [23]. Following these two pivotal wargames were abstract strategy games that appealed to the world's nobility classes (such as chess). Wargaming experienced an increase in production between 1664 and 1880. Although they gradually incorporated elements of models, terrain maps, and simulations of movement, most kept their chess-like features. It was not until Prussian Baron Leopold Von Reisswitz created the *Kriegsspiel* in 1811 that a wargame became a simulation that could model space and time with a consistent scale [27]. Historians agree that Von Reisswitz's game was the birth of modern wargaming. Shortly after impressing the Prussian nobility with the *Kriegsspiel*, Reisswitz's son Georg Von Reisswitz took over development of the game. The two greatest contributions that he made to the *Kriegsspiel* were greater map resolution and inclusion of an umpire. The umpire could resolve combat, physically move units on the terrain map and provide each side with information about the battle similar to how they would receive the information during live combat. The *Kriegsspie*l was shown to General Karl Von Müffling in 1824 to which he replied, “This is not a game! This is training for war! I must recommend it to the whole army” [23]. Following the demonstration, the *Kriegsspiel* underwent one last development, which relaxed rigid rules and allowed the umpires to adjudicate the outcomes of decisions based on their personal experience. These updates were manifested in the free *Kriegsspiel* of 1876 [28].

After a series of successful wars by Prussia, other countries attributed wargaming to their success, which was the catalysis for the spreading of wargaming throughout the world. While wargaming spread throughout Europe and parts of Asia around the mid-1800s, the first United States (U.S.) introduction to wargaming was from a book titled *The American Kriegspiel* published in 1883 by Colonel W. R. Livermore U.S. Army [27]. Since his work was a simply a translation of German manuals and wargaming rules, it experienced much criticism. However, the benefit of the criticism was that it spread wargaming throughout the U.S. Army. Although the U.S. Army was the first service to experiment with wargaming, the U.S. Navy was the first U.S. service to adopt wargaming due the contributions of William McCarthy Little [27]. His life’s work ensured the Navy adopted wargaming, which he successfully accomplished when in 1913 Admiral William S. Sims introduced wargaming to the U.S. fleet [27].

From 1905 until 1945, wargaming played a significant role and how the world’s military leaders prepared their troops for war. Count Von Schlieffen used wargaming to develop the Schlieffen Plan (post World War I German war Plans), the British played wargames examining the possibilities of war with Germany or France, and the Russian and U.S. generals were actively wargaming different courses of action for their perceived threats [27]. Wargaming continued throughout WWI and was a major contributing factor in German’s initial success during WWII. Likewise, Japan’s use of wargaming to plan the attack on Pearl harbor was a contributing factor to their tactical success. Although wargaming declined in the U.S. during the interwar period, it too was a contributing factor to America’s success during WWII. Following WWII, wargaming continued to play a major role in how military leaders prepared their troops for war. In the U.S., introducing Operations Research professionals to wargaming granted wargamers access to combat models that provided more realistic combat effects [27]. These combat models proved very important during the Cold War when government officials had to weight the options of launching nuclear weapons as a defensive or offensive response to adversary actions. Today, wargaming serves to train and educate military professionals on the consequences of their decisions. The transition from strictly tabletop games with unit counters to integrating computer software that can provide more realistic combat outcomes has only increased the utility of wargaming. Wargaming has played such a significant role in the outcome of past military engagements that the world's militaries continue to use wargames to prepare for future conflicts.

3. Types of Wargames

There are many ways to categorize wargames. Perla states that there are two popular ways of categorizing them, which determine the combat resolution of the game. He states, "The two most popular criteria for categorizing the level of a game are based on the command level represented by the player, or on the level of activity at which a player's decisions are implemented and evaluated [23]. Perla also acknowledges a hybrid level where the decisions of the players revolve around the Strategic-Operational and Operational-Tactical levels. Mode of evaluation, number of players, information limitations, style, and instrumentality are other methods of categorizing wargames [23]. Although there are different categories/types of wargames, "the role of wargames of all types, sizes, and levels is to help human beings investigate the processes of combat, not to assist them in calculating the outcomes of those processes" [23]. Also, "Wargames can help explore questions of strategy, human decision-making, and war-fighting trends" [23].

Sabin adopts a novel approach and describes wargames based on media. He recognizes three types of wargames: board games, figure games, and computer games [25]. Appleget and his colleagues recognize three types but also acknowledge that all three have different purposes. The three wargames are analytical, educational, and experimental. An analytical wargame focuses not on educating the players but on extracting knowledge or information from the game to support a sponsor who is seeking answers or insights to a particular problem [26]. The purpose of an educational wargame is to educate its players. It is designed to convey knowledge of some subject to the participants [26]. The intent is to present the students with situations that they are likely to encounter during their professional careers and to reinforce the knowledge they gained in the classroom. The focus of an experiential wargame is to impart the experience onto players that will enable them to perform specific jobs or tasks, and this category includes training wargames [26]. Dunnigan enumerates seven types of wargames. There are Manual Model with map, Manual Model without map, Spreadsheet Combat Model, Cost/benefit Model, Expert System Combat Model, Computer Combat Model with Map, and Computer Combat Model without Map [24]. Each of these types of wargames encompass characteristics to enhance the realism and playability of the wargames and serves a particular purpose. However, the focus of this thesis will be of the educational wargaming.

One of the important definitions of educational wargaming comes from Caffery. He defines educational wargames as "wargames designed and conducted in such a way as to maximize the effectiveness of the wargame as an aid to education" [27]. Thus, the DOD has a long history of incorporating wargames into their Professional Military Education (PME) institutions. Appleget acknowledges two unique instances in history where the Naval Service included educational wargames in their service member's curriculum. From 1919 to 1940, the U.S. Naval War College used wargames to educate services members about the possibilities of armed conflict with the Empire of Japan. Likewise, the USMC "used modified off-the-shelf hobby games as capstone events to drive home the concepts taught in the classroom" [27]. Also, the USMC and U.S. Army frequently take part in Command Post Exercises. During these exercises, staffs receive the opportunity to exercise staff functions. In doing so they provide staffs, "with useful training experiences that they can leverage when their organizations go to war" [27]. The experience gained through wargaming serves as the foundation for an individual's education throughout their career.

4. Experiential Benefits of Educational Wargames

Educational wargames can provide its players with many experiential benefits. This is because the primary focus of educational wargames is to "produce better educated, better trained, or more experienced players" [26]. Developers design educational and experiential wargames to impart specific knowledge on players through the experience of playing the game. For instance, a training specific wargame affords its players the ability to experience performing their duties in a simulated environment [26]. Likewise, other wargames "are intended to establish a synthetic decision-making environment to help students develop their skills as strategists" [27]. These simulated environments afford players a host of benefits to include operating in new environments, understanding the effects of new technology, and engaging in dialog about new doctrine and mission sets. Therefore, properly designed educational wargames should impart new knowledge or provide valuable experiences to the players" [26]. The experiential benefits that wargames afford players enhances the lessons taught in the classroom by providing them a means to experience events that are tied to their subject.

5. Wargame Design

Since the major wargaming advocates have slightly different approaches to wargame design, there is a plethora of academic writing that addresses the major elements of design instead of an exact step-by-step process. Perla's list of wargame elements and how they all merge to produce a wargame that satisfies the wargame's purpose is the easiest to understand and apply. According to Perla, a good wargame needs "objectives, a scenario, a database, models, rules, players, and analysis" [23]. Clearly defined objectives are the most crucial elements of wargaming design because they will dictate the type of experience and information that the wargame needs to provide. As Perla states, "A wargame's objectives should be the principal drivers of its entire structure" [23]. The scenario exposes the players to the game's situation, which sets the stage for the decisions that they will be required to make. The database is a conglomeration of unit and equipment capabilities, and environmental factors that aids players in making decisions. Models such as Look-up tables, Combat Results tables, and Mathematical Models, "translates the game's data and the players' decisions into game events" [23]. However, game events are governed by a set of carefully designed rules that attempt to replicate aspects of actual events such as delays in critical information needed to make decisions during uncertainty. The players and their experience are at the heart of wargaming design because the wargame's events should influence the player's decisions. Lastly, all wargames should provide a means of analysis to determine whether the wargame met its objectives.

6. Game Mechanics

Game mechanics are an important element of wargame design because as Perla states, "There is no recipe for translating a game's objectives into its mechanics" [23]. The quality of the translation is a matter of the abilities of the wargame designer. While Perla and other wargaming advocates discuss the importance of game mechanics throughout their books and how they relate to every element of game design, Sabin dedicates an entire part in his book to game mechanics. He states, "the real art in wargame design is to reflect the almost infinite complexities of warfare within a model that is simple enough to be played but still subtle enough to capture the key dynamics of the actual conflict it seeks to portray" [25]. The game mechanic elements that he finds most important are battlefield resolution/game board design (dictates how fast and how much terrain units will traverse during game play), number of unit counters/level of unit organization, how long the game should last, unit movement, modeling combat, modeling resupply/logistics, modeling command dynamics, fog of war, and decision cycles.

In 2004, Robin Hunicke and a few colleagues published an article that described an approach to game design that used a simpler model. The model that they described was the Mechanics, Dynamics, and Aesthetics (MDA) framework [29]. Understanding the three elements of the model results in a greater appreciation for it. According to Hunicke, "Mechanics [are] the particular components of the game, at the level of data representation and algorithms, Dynamics [are] the run-time behavior of the mechanics acting on player inputs and each other's outputs over time, [and] Aesthetics [are] the desirable emotional responses evoked in the player" [29]. Figure 14 is a simple illustration of the MDA framework. Under this framework, developers approach game design from two perspectives, the player and designer. This ensures that the behaviors that the designers want the players to exhibit are motivated by emotional experiences provided by the game mechanics. Therefore, a game's mechanics are the elements that link a player's desired behaviors to their actual behaviors.

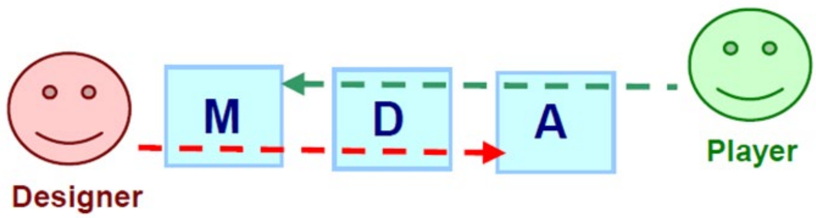


Figure 14. MDA Framework. Source: [29].

7. Game Theory and Wargaming

The definition of Game Theory has taken on a variety of meanings in recent years. These definitions include "a bag of analytical tools designed to help us understand the phenomena that we observe when decision-makers interact" [30], the "study of multi-person decision problems" [31], a "collection of games with the central feature that the game's outcome is determined by the actions of multiple decision-makers, and that they do not all desire the same outcome" [32], and "the study of the ways in which interacting choices of economic agents produce outcomes with respect to the preferences (or utilities) of those agents, where the outcomes in question might have been intended by none of the agents" [33]. Based on these definitions, the focus of Game Theory is the complexities related with decision-making and the outcomes of such decisions. Agents/players can use logical thought patterns and mathematics to assist with selecting the optimal sequence of decisions.

Wargames encompass similar elements as Game Theory. These include players, decisions, and outcomes. However, despite the similarities, there is little academic literature that links them. Instead, there is a concerted effort to outline their differences. The key difference is theoretical versus experimental. Washburn states, "analysts have followed two separate lines of thought in trying to deal with multi-sided decision-making situations. One line of thought is theoretical and leads to game theory the other is experimental and leads to wargaming" [32]. He further expresses another difference regarding goals and payoffs. He asserts, "Game Theory requires that payoffs be explicit functions of the strategies. In wargaming, on the other hand, one can argue that the payoffs come with the backgrounds of the players, so that a brief statement about goals will suffice" [32]. Here, Washburn makes a crucial point. In Game Theory, players select strategies based on optimal payoffs. However, players may encounter situations where the only available strategy results in an unfavorable payoff. Conversely, wargaming is more concerned with accomplishing goals than receiving payoffs. During wargames, players prioritize accomplishing wargame objectives/goals rather than selecting strategies that may lead to optimal payoffs.

8. Summary

Wargames have served multiple purposes throughout history. They started as abstract strategy games meant for entertainment, then transitioned into experiential and educational tools utilized to train militaries, and finally adopted by the gaming industry for entertainment purposes. It is for this reason that what wargames are and are not tends to cause confusion. However, this thesis simply acknowledges wargames as any simulation of contention that combines players, decisions, and consequences in a synthetic environment. Since there are many definitions for wargames, it is helpful to differentiate the types of wargames. The major types of wargames are wargames based on the level of command (Strategic, Operational, Tactical, and hybrid), wargames based on media (board games, figure games, and computer games), and wargames meant for specific purposes (analytical, educational, and experimental).

Wargames have undergone numerous updates since their inception. Over the years they have gradually increased the level of fidelity to closely match real events. The first type of wargames resembled modern day chess. Then, elements of models, terrain maps, and simulations of movement were incorporated. Following that, the *Kriegsspiel* was developed which included better map resolution and an umpire to adjudicate combat based on his war experience. The wartime success of the nations that used the *Kriegsspiel* to train for war was the driving factor for how wargaming spread across the world. Knowledge of other nations using wargames to train for war contributed to the advancements in wargames that are enjoyed today. Modern wargames integrate modern technology to provide the most realistic wargaming experiences.

Educational wargames have been an integral part of U.S. military PME as early as the 1900s. They are used to educate individuals to perform specific tasks and aid in acquiring the knowledge required to perform tasks more efficiently. Kolb, Klein, and Kahneman proved through their research that experience and knowledge are inseparable. Specifically, experience begets knowledge. Educational wargames support their claims because they convert experience into knowledge. However, positive transfer of knowledge is made possible only through methodical wargame design procedures that properly pinpoints the wargame's objectives and translates them into the game mechanics.

Wargames are unique platforms where the benefits of the ELT can be leveraged to transform experience into knowledge. Developing educational wargames that force players to traverse all four stages of the ELC while targeting specific learning objectives has the potential to increase their understanding and comprehension of the subject matter. This is because wargames afford players all the tools needed to apply ELT. Wargames provide players experiences, time to reflect on the meaning of the experiences, time to develop mental models based on the experiences, and an opportunity to test the validity of their models by providing instantaneous feedback after decisions are made. Repeating this cyclic process throughout an iteration of a wargame leads to knowledge acquisition.

E. 2006 LEBANON NEO

The 2006 Lebanon NEO was a DOS directed U.S. military operation to evacuee American citizens, third country nationals, and other designated evacuees from the hostile Lebanese territory to safer locations. Motivated by a "34-day military conflict between Israel and Hezbollah in Lebanon" [37], the U.S. Ambassador to Lebanon requested evacuation operations to commence on 15 July 2006. A Naval Task Force that included the 24th Marine Expeditionary Unit which was composed of the USS Iwo Jima (LHD 7), USS Trenton (LPD 13), USS Nashville (LPD 14), and the USS Whidbey Island (LSD 41) responded to the crisis. Their efforts resulted in the Ambassador terminating the operation after 15 days of evacuations. Although the exact total number of evacuees continues to be a subject of debate, the State Department released a report in 2007 that claimed the Naval Task Force evacuated a total of 15, 000 evacuees [38]. The wargame that this thesis will explore will be loosely based on the events of the 2006 Lebanon NEO.

III. METHODOLOGY

A. NEO WARGAME DESIGN

This NEO educational wargame is designed to emphasize NEO learning objectives, which are the three guiding principles. Joint Publication 3-68 stresses that strict adherence to the guiding principles of accuracy, security, and speed results in successful NEOs. Therefore, this educational wargame captures all three guiding principles in a six-turn game duration divided into three phases. Each phase corresponds to one of the learning objectives/guiding principles. Similar to all games, this educational wargame consists of a number of core mechanics. These, "core mechanics create patterns of repeated behavior, the experiential building blocks of play" [39]. These mechanics include Cooperative Game (players work together to accomplish a common goal), Dice Rolling (players roll dice to introduce elements of randomness into the game), Pick-up and Deliver (players pick up evacuees from one location and deliver them to another), Events (players experience uncontrollable changes in game events to challenge their decision-making processes), Once-per-Game (players are given the opportunity to utilize an extra transportation asset to assist with the evacuation one time per game), and Resource to Move (players expend transportation assets to transport evacuees).

Since Perla provides the greatest clarity regarding wargame design, this educational wargame was designed using his fundamental principles of wargame design. Combining data from the 2006 Lebanon NEO and models borrowed from previous NEO thesis work, this wargame encompasses all of the seven principles that Perla attributes to effective wargame designs. Each principle is discussed in detail below.

1. Objectives

Whilst game mechanics develop patterns of behavior among players, the game objectives are what the player strives to achieve by demonstrating the patterns of behavior. Therefore, carefully employed game mechanics coupled with specific game objectives can reinforce learning objectives. This educational wargame uses the game mechanics described above to meet the game objective of planning and executing the evacuation of evacuees from Lebanon to the three designated safe haven/ follow on evacuation sites (Port of Limassol, Port of Mersin, and Larnaca Airport) within six game turns. This wargame objective is the same objective that the operating forces that conducted the actual NEO had to achieve in 2006. However, to meet the game objective, the players must navigate a few obstacles. First, the players must properly manage and optimize the use of their transportation assets. Second, the players have to deploy their security forces to locations that facilitate the fastest evacuation of evacuees. Lastly, the players need to employ adaptive techniques to rapidly changing events so that evacuation operations are unhindered.

2. Scenario

One of the major objectives of wargaming is to fully immerse the players into the wargame so that their actions will reflect similar actions as if they were in a real-life situation. Consequently, significant effort is placed in scenario writing. Perla conceptualizes scenario design as a process that encompasses four elements. They are "understanding the problem, building from the bottom up, documenting choices, and communicating results" [23]. These elements are all captured in the scenario for this wargame.

The scenario for this educational wargame is similar to the scenario that the 24th MEU encountered in 2006 with a few differences. The scenario is: the 55 MEU consisting of three ARG/MEU ships positioned off the coast of Lebanon. A coup d'état in Lebanon has led to civil unrest throughout the country. This unrest has resulted in massive loss of life amongst the Lebanese and American citizen population. Consequently, the U.S. Ambassador to Lebanon has deemed it necessary to evacuate the U.S. embassy and has requested for assistance from the 55 MEU to evacuate all American Citizens and other designated evacuees. The U.S. government has approved the evacuation, which will take place at H hour on D Day. The DOS's F-77 Report (report that contains an estimate of the number of American Citizens and other designated evacuees) estimates that the total number of evacuees are 3600. However, previous NEO missions have proved that the F-77 Report typically underestimates the total number. The 55 MEU NEO Mission

Commander has designated Player One as the ECC Commander and Player Two as the Security Team Leader. The mission is to establish an ECC in Lebanon and facilitate the evacuation of American Citizens and other designated evacuees from Lebanon to the Port of Limassol, Port of Mersin, or Larnaca Airport.

3. Data Base

A wargame's data base contains the information that enables the players to make the decisions that will lead to the achievement of the game objectives. Perla states that, "the data base of the game contains the quantitative information about capabilities of forces [and] levels of logistics" [23]. The data base for this educational wargame consists of data for the ECC, Security Team, and transportation assets. The ECC is composed of a 19-man workforce tasked organized into four major working groups (reception, registration, embarkation, and comfort stations). Processing and registering outputs are dependent on the number of hours the team works (refer to Cheat Sheet in Appendix). A Marine Infantry Company organized into 3 Platoons provides security for the NEO. Platoons are able to occupy and secure a location for any length of time except when updates to the scenario events deem the location off limits for evacuation operations. Transportation assets are divided into three categories: aviation assets, ARG/MEU shipping, and merchant vessels. The aviation assets comprise 3 Sikorsky CH-53 Sea Stallions, each capable of transporting 50 evacuees. The ECC team will also have three ARG/MEU ships to assist with evacuation operations. Each ship is capable of transporting 200 evacuees due to the limitations on the personal space of the Landing Craft Air Cushion Personnel Transport Module. The merchant vessels possess the best logistics capability in that it can transport a maximum of 400 evacuees at a time. This data "provide all the inputs required to allow the game's models to reproduce the qualitative scenario conditions and to generate outcomes of interaction" [23].

4. Models

Models within wargames are significant in that they use data and decisions to update the state of the game. Perla states "models translate data and decisions into game events” [23]. This educational wargame consists of one model from previous NEO research and two simple computational models developed from the data collected from other NEO research. In 2015, Defence Research and Development Canada [41] published research that revealed the optimal number of members for an ECC team that yielded the most processed and registered evacuees within a 24-hour time period. Utilizing DES modeling in MATLAB, their results revealed that a 19-personnel work force organized in four teams of 5–5-7-2 (meaning a 5-man team conducting evacuee Screening, a 5-man team conducting evacuees Triage/document verification, a 7-man team conducting evacuee Processing, and a 2-man team conducting evacuee Registration) could process and register approximately 750 evacuees in 18 hours. Also, a 19-personnel work force organized in four teams of 4–3-9-3 could process and register approximately 750 evacuees in 24 hours. Combining these results with simple math updates to reduce the player’s cognitive load, this wargame consists of three ECC configurations for players to select from. They are 12-hour operations with a 5–5-7-2 workforce that can process and register 700 evacuees, 18-hour operations with a 5–5-7-2 workforce that can process and register 1000 evacuees, and 24-hour operations with a 4–3-9-3 workforce that can process and register 700 evacuees.

This educational wargame also consists of two mathematical models that calculate how many sorties the helicopters can fly each day of operations and how many surface vessel trips the ships can conduct in a day. Barker and his colleagues provide data on the evacuation activity of each day of the 2006 Lebanon NEO. Based on their data, there were no more than three helicopter sorties each day [37]. However, for this wargame, the number of sorties is dependent on the number of evacuees that the ECC are able to process and register in a day. For simplicity, it is assumed that evacuee transportation does not begin until all of the evacuees for a particular turn/day of operation are processed. Therefore, this educational wargame provides players with three sortie options that are linked to the ECC configurations. For instance, if the players select to process evacuees for 12 hours, they only have 12 hours to conduct transportation operations. Hence, 12-hour operations result in three sorties (capable of transporting 300 evacuees), 18-hour operations result in one sortie (capable of transporting 100 evacuees), and 24-hour operations result in zero sorties. Barker and his colleague’s evacuation activity research also highlight the fact that ship movements from Beirut to the ports of Mersin and Limassol took an entire day of operation. Utilizing ESCAPE DES, they were able to develop the best estimates for transit times incorporating actual distances and standard ship underway speeds. This educational wargame used their results to produce the regulations on ship movements. Since the transit time from Beirut to the ports of Mersin and Limassol takes approximately 6–7 hours, ship movements are limited to one evacuation trip per day of operation.

5. Rules

All wargames contain rules that govern the actions of the players and events during game play. This educational wargame consists of six simple rules. First, there has to be a security unit at the ECC site to conduct processing and evacuation operations. Second, evacuees cannot be transported to locations that are not occupied by a security unit. Third, if evacuees are transported to the ports of Mersin and Limassol, they are not counted as "evacuated" until the end of the next turn. This is because the ports serve as intermediate logistics hubs. The evacuees still must be transported form the port of Mersin to Incirlik Air base and from the Port of Limassol to Larnaca Airport. This transit time is simulated by waiting until the next turn to consider them "evacuated." Fourth, helicopters can only transport evacuees to Larnaca Airport. Fifth, the event update provided by the situation update card remains active for the turn after it was drawn. Sixth, if a merchant vessel card is draw, players can continue to roll the dice for another merchant vessel. This rule introduces the variability associated with the availability of non-military transportation assets assisting with military missions. Although the 2006 Lebanon Neo utilized multiple merchant vessels, these assets may not be available for future NEOs.

6. Players

All wargames consist of players. However, one of the most important elements of designing a wargame is selecting the right target audience. Selecting the right audience influences everything about the wargame from game mechanics to achieving objectives. There are a host of players involved in NEOs to include government and non-government agencies. However, the two most important individuals are the ECC Commander and

Security team leader because they perform the essential actions required for successful NEOs. This educational wargame is designed to provide individuals that may perform those duties with an experiential decision-making exercise.

B. WARGAME PHASES

This educational wargame is executed in six game turns. Each turn represents a full day of evacuation operations. The turns are composed of three separate phases. The phases correspond to specific NEO learning objectives/guiding principles. To begin the game, the players lay down the gameboard and collect all unit counters. They then begin the initial game set-up (refer to Appendix). This is accomplished by establishing the ECC at Beirut (place ECC counter at Beirut), selecting and ECC configuration (12, 18, or 24 hour processing and registration operations), drawing an ECC card (the card indicates the number of evacuees and their evacuation priority), placing the evacuees in the Non-Processed bank on the game board, and selecting and placing the security units in their initial positions (one has to be placed at the ECC site to begin processing and registration operations). After the initial game set-up, the players can transition to the ECC Phase.

1. ECC Phase

During the ECC Phase, players collect the evacuees at the evacuation site and begin processing and registration operations. This phase corresponds to the NEO guiding principle of speed. In live NEOs, a reception team collects the evacuees as they arrive to the evacuation site and briefs them on events that will occur throughout the evacuation process. Then, the evacuee's transition to registration operations. During registration, the identity and priority of each evacuee is verified through such documentation as passports, birth certificates, or driver's license. Once the evacuees are verified, they are organized in order of evacuation. Before they are transported from the evacuation site, they receive equipment required for their particular mode of transportation. Modeling and incorporating all of these specific events in a wargame is cumbersome and has the potential to distract players from the main objective. Therefore, this educational wargame abstracts these unnecessary details from the player's actions. This phase focuses more on the idea of processing the evacuees and organizing them into three priorities of evacuation. During this phase, the ECC Team leader will simulate processing the evacuees by moving them from the Non-processed evacuee bank to the Processed evacuee bank. This action has a time limit of one minute. When this action is completed, the players transition to the Movement Phase.

2. Movement Phase

During the Movement Phase, players evacuate the evacuees by moving them from the ECC site to the next evacuation location (airport or ports) and move the security units to different locations by anticipating future game events. Players have to make decisions regarding where to send the evacuees and security units with a five-minute time limit. This phase corresponds to the NEO guiding principles of accuracy and security. These actions directly mirror the events of real NEOs. In evacuation priority, evacuees are loaded onto transportation assets and transported to the next evacuation node or directly to a safe haven. To ensure the safety of the evacuees throughout the evacuation process, security arrangements are made to ensure each evacuee arrives to an evacuation node or safe haven. When the evacuees are transported and the security units are in place, the players transition to the Situation Update Phase.

3. Situation Update Phase

During the Situation Update Phase, players draw a card from the Situation card bank and the Evacuation Card bank. The Situation Update cards update the players on the changes in the state of the game triggered by events out of the control of the players. Some have good events and others have bad events. The good events range from being afforded extra sorties, a merchant vessel, or no update. Bad events range from closure of ports or airports due to bad weather, sea state, or terrorist activity to the loss of a transportation asset due to evacuations in the incorrect priority. Drawing the Evacuation Card discloses the number and priority of the next group of evacuee arrivals to the ECC site. Similar to the initial game set-up, players will place the evacuees in the Non-Processed bank on the game board. When all the above actions are completed, the first turn ends (first day of operations). Players will transition back to the ECC Phase and repeat the three phases for five more turns.

C. WINNING CRITERIA

Players interacting with the wargame mechanics and engaging in critical thought to develop strategies to achieve the game objectives meet the intended purpose of this wargame. This is because playing the wargame naturally exposes the players to the NEO learning objectives/guiding principles. However, the winning criteria for this wargame is to evacuate all the evacuees by the end of the sixth game turn (sixth day of operations). Hence, the end state is for all evacuees drawn from the Evacuation Card bank to be evacuated to a safe haven and no evacuees are left on the game board at the end of the sixth turn.

D. PLAY TESTING

Play testing for this educational wargame was conducted with a foreign national student from the MOVES Institute. The student was an excellent selection for play testing because he was an avid wargame and recreation game enthusiast, and he provided useful feedback to improve the wargame. The play testing resulted in a few updates to the original game design. First, the wargame originally encompassed five Evacuation cards. During play testing this was identified as not enough to provide appropriate game variability. As a result, the number of cards was increased to 15. Second, the Situation Update cards originally contained all bad events. This resulted in too many scenarios where the players could not win the game. This was rectified by including good and bad event updates to the Situation Update card deck. Third, because of the large number of 5 card combinations from a 15-card deck, it was difficult to map out every game decision tree. The solution for this issue was to code the total number of evacuees for each 5-card combination in Python (refer to code in Appendix). This allows the game designer to vary the number of evacuees on the 15 cards and view the impact to the logistics assets of the evacuation team.

IV. EXPERIMENT AND RESULTS

This experiment was conducted to ascertain whether an educational wargame can model a NEO and reinforce the three learning objectives/guiding principles of NEOs. Utilizing the 2006 Lebanon NEO as the base scenario, players were required to demonstrate the three guiding principles (accuracy, speed, and security) to achieve a favorable outcome for the wargame. Due to limitations on time and availability of subjects, this experiment was conducted and completed during the first two weeks of April 2021. The results of this experiment were derived from 10 iterations of the wargame consisting of 20 subjects.

A. SUBJECTS

The subjects for this experiment included 20 Active-Duty USMC Officers currently serving at NPS as students pursuing master's degrees across a wide range of disciplines to include MOVES, Operations Analysis, Computer Science, Space Systems, National security Affairs, Electronic Systems Engineering, and Information/Electronic Warfare & Special Operations. Actual NEOs are typically conducted by Logistics, Infantry, or Artillery Officers. However, the inclusion criteria for this experiment were Active-Duty USMC Officers currently serving at NPS. Consequently, Officers from a variety of Military Occupational Specialties (MOS) volunteered for this experiment to included Logistics, Infantry, Artillery, Communications, Intelligence, Combat Engineers, and Aviation Maintenance. Company Grade Officers (1^{st} Lieutenants and Captains) usually execute actual NEOs. Therefore, the target audience for this wargame and experiment were Company Grade Officers. However, this experiment consisted of 18 Company Grade Officers and 2 Field Grade Officers (Majors). The inclusion of the Field Grade Officers in this experiment added value because Field Grade Officers comprise the staffs that plan the NEOs for the Company Grade Officers to execute. Observing their reactions to the wargame and receiving their feedback provided valuable insight as to whether the wargame actually simulated NEO events from an operational planning perspective. Lastly, including a mixed group of subjects of different MOS, grade, and academic discipline provided for better decision-making and critical thinking. Subjects were able to leverage their experience and the experience of their team mates to develop sound strategies, make logical decisions, and react appropriately to wargame events.

B. GAMEBOARD AND MATERIALS

1. Gameboard

The gameboard for this experiment consisted of a simple schematic of the operational area with additions that help guide the players through the game. Figure 15 is an illustration of the gameboard. The gameboard clearly highlights the major territories in the wargame scenario (Turkey, Syria, Lebanon, and Cyprus), the locations that the evacuees can be evacueed to (Larnaca Airport, Port of Limassol, and Port of Mersin), and the Airbase that the evacuees will be transported to after arriving at the port of Mersin (Incirlik Airbase). To the left of the gameboard are step-by-step instructions for setting up the game and the actions that must be conducted during each phase of the game. A Situation Update Card Bank and an ECC card Bank are included on the right side of the gameboard to hold the respective cards. Lastly, the right side of the gameboard has a Non-processed and Processed evacuee bank. They were included to simulate the processing of evacuees as well as assist the players with evacuee accountability and organizing the evacuees in the correct evacuation order.

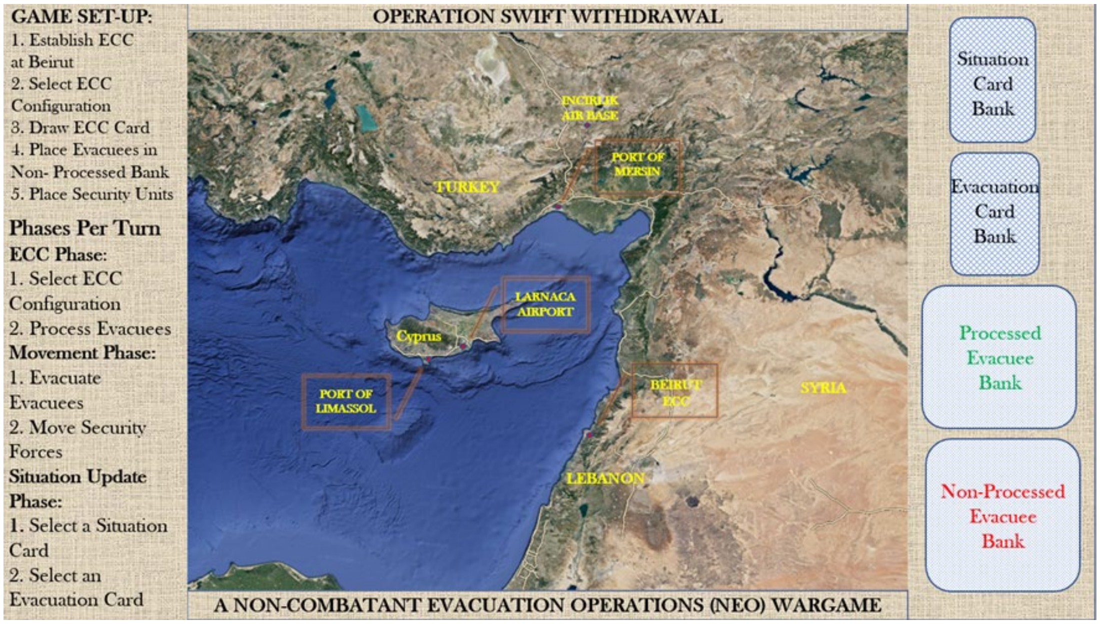


Figure 15. Operation Swift Withdrawal Gameboard

2. Counters

Counters are an important aspect of wargaming because they are a means to represent people or things in a game. This NEO wargame experiment consisted of four counters. The experiment utilized standard object game pieces and 3 tokens taken from a list provided by Tabletopia. However, future iterations of the wargame can utilize any set of counters as long as they are distinguishable from one another. Each security unit was represented by a large blue counter (illustrated in Figure 16). Joint Publication 3-68 designates five separate categories of evacuees. This thesis only utilizes the first three which are "American citizens, Non-American immediate family members of American citizens, and Foreign service national and third country national employees of the U.S. Government" [5]. American citizens (100 per counter) were represented by a green counter (illustrated in Figure 17). Non-American immediate family members of American citizens (100 per counter) were represented by a yellow counter (illustrated in Figure 18). Foreign service national and third country national employees of the U.S. Government (100 per counter) were represented by a red counter (illustrated in Figure 19).

Figure 16. Security Unit Counter

Figure 17. American Citizen Counter

Figure 18. "Non-American Immediate Family Members of American Citizens" [5] Counter

Figure 19. "Foreign Service National and Third Country National Employees of The U.S. Government" [5] Counter

The three standard ships of a MEU were represented by black tokens. Figure 20 is an illustration of the tokens.

Figure 20. MEU Ship Counter

3. ECC Cards

This experiment consisted of a total of fifteen ECC Cards. When drawn, each card disclosed to the players the total number of evacuees that arrive to the ECC during the turn/ day of operations. The total number of evacuees on each card varied from 300 to 1300 evacuees. In addition to total number of evacuees listed, each card disclosed to the players the priority of evacuation for each group of evacuees. This was presented to the players in the form of green (1st evacuation priority), yellow (2nd evacuation priority), or red (last evacuation priority) blocks next to the number of evacuees. Figure 21 is an illustration of an ECC Card. Each iteration of the game consisted of the players randomly drawing 5 ECC Cards from the 15-card deck. This resulted in a total of 3003 different card combinations (total number of evacuees requiring evacuation per game) that ranged from roughly 2400 to 5000 evacuees per game.

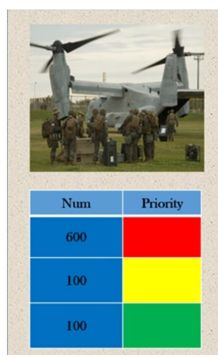


Figure 21. ECC Card

4. Situation Update Cards

Similar to the total number of ECC Cards, this experiment consisted of 15 total Situation Update Cards. Figure 22 is an illustration of a Situation Update Card. Players drew these cards at the end of each turn/day of operations to receive updates on changes in the environment, ECC progression, locations to transport evacuees, or the availability of additional assets to assist with the evacuation. These cards included extra sorties, a penalty of a sortie due to improper evacuation procedures, closure of the airport due to terrorist activity, closure of the ports due to works strike, and closure of the ports due to bad sea state. Similar to the ECC Cards, each iteration of the game consisted of the players randomly drawing 5 Situation Update Cards out of the 15-card deck. The 3003 different card combinations (event updates per game) increased the variability of game so that no two players experience similar game events.

Figure 22. Situation Update Card

5. Tabletopia

Due to restrictions on person-to-person contact resulting from the COVID -19 virus, this experiment was conducted via the online platform Tabletopia. Tabletopia is Unity Technology based "digital sandbox system for playing [tabletop] board games with no AI to enforce the rules" [40]. Developers create board games by importing images of the game board and other items to play the game in an online platform. They are then able to setup a board game that consists of the imported images and use objects such as game counters from a built-in database provided by the Tabletopia software. Tabletopia also features networked virtual game rooms to allow multiple users to play the game together. Similar to playing a board game in person, Tabletopia allows users to simultaneously manipulate game pieces on a game board and display the updates to all users in real time. Coupled with the real-time audio provided my Microsoft Teams, Tabletopia's software was invaluable to the conduct of this experiment because it allowed subjects to play the wargame and interact in a near similar way to a live event.

C. PROCEDURES

This section discusses the experiment procedures from recruitment to conducting the postgame questionnaire.

1. Recruitment

Recruitment for this experiment was conducted during the last week of March 2021. All the subjects for this experiment were recruited from the USMC NPS student population. Subjects came from a population of approximately 200 USMC NPS students. All subjects volunteered to participate in this experiment because they either participated in NEO training or conducted discussions about NEOs in their respective PME seminars prior to matriculating at NPS.

2. Pregame

After providing the subjects with an overview of the sequence of events for the experiment and collected signed consent forms, subjects were given an 11-question forced-choice questionnaire. This questionnaire was designed to serve two essential purposes. First, it provided a means to establish a baseline level of knowledge of NEOs amongst the subjects. Second, it tested the subject's knowledge of the NEO guiding principles prior to playing the educational wargame. Collection of this data was crucial to conducting a comparative analysis of the postgame questionnaire results. Following the questionnaire, subjects were given an oral brief on the objectives of the game, the game rules, game set-up, and a demonstration of a full turn of the game. Additionally, subjects were provided with a cheat sheet that listed the game rules, ECC configurations, and transportation throughput capabilities. Afterwards, the subjects were given an opportunity to ask questions about anything that was unclear during the brief. The oral brief and demonstration were delivered and conducted in the exact same manner during all 20 iterations of the game.

3. During Game

After pregame events, the subjects were directed to a private game room utilizing the Tabletopia platform. Figures 23 and 24 are illustrations of the game subjects playing the wargame in virtual game rooms. The researcher/game developer observed all 20 iterations of the game, answered questions when they arose, and intervened when subjects violated a game rule. The game rules were simple enough that they were rarely violated. The rule that subjects had issues with was the rule that an evacuee cannot be transported to a location that is not occupied by a security unit. This was a common occurrence during the first two turns, but rarely happen during turns three through five. A common strategy adopted by the players were to take full advantage of evacuation through the airport even if it meant a sizable number of processed evacuees would be stuck at the ECC waiting for available aircraft transport. Additionally, players tended to consistently select the 12-hour ECC configuration to maximize aircraft sorties without considering switching to other configurations to process more evacuees in anticipation of a large number of evacuees entering the ECC on a later turn/day of operation. Overall, subjects were able to easily adjust to the game rules and employ strategies that enabled them to win 13 out of the 20 games.

Figure 23. Tabletopia Game Room 1

Figure 24. Tabletopia Game room 2

4. Postgame

At the conclusion of each iteration of the wargame, subjects were given a postgame questionnaire. The questionnaire consisted of the same 11 forced-choice questions given to the subjects during the pregame questionnaire. Collection of this data allowed for an accurate statistical paired design consisting of a paired t test. Additionally, subjects were asked to provide feedback on their reaction to the wargame. One subject commented that it would have been helpful to include the info contained on the cheat sheet on the game board instead of a separate sheet of paper. Also, subjects believed that including a mechanism in the game that instantly told the players the total number of evacuees evacuated at a given time would have been helpful. Lastly, another subject commented that it might be helpful to have a more detailed information script that teaches the main concepts of the game and presents them to the players during periodic situation updates. Overall, the subject’s reaction to the wargame was positive throughout all 20 iterations.

D. RESULTS

This section discusses the pregame and postgame questionnaire results. The data is displayed via graphs, histograms, and bar charts. Results from hypothesis testing via a Paired t Test is also discussed. This test was utilized to determine whether there was a difference in the questionnaire scores after playing the wargame. Analysis of the data provided by this experiment strongly suggests that playing the educational wargame does lead to knowledge acquisition of the NEO learning objectives/guiding principles.

1. Pregame Questionnaire Results

The Pregame Questionnaire consisted of one question (yes or no) about the subject's familiarity with NEOs and 10 forced-choice questions regarding the NEO guiding principles. On average, subjects answered 3.45 questions correctly. This suggests that although the majority of subjects were familiar with NEOs, they did not have clear understanding of the NEO guiding principles. Three of the 20 subject's disclosed that they were not familiar with NEOs prior to the experiment. Table 2 is a chart listing the Pregame Questionnaire scores and Figure 25 is a histogram of the scores. The histogram illustrates that the majority of subjects answered three of the 11 questions correctly.

Table 1. Pregame Questionnaire Scores

Subject	Pregame Questionnaire Score
1	2
2	3
3	5
4	3
5	3
6	5
7	2
8	3
9	4
10	3
11	1
12	5
13	4
14	4
15	7
16	3
17	3
18	3
19	1
20	5

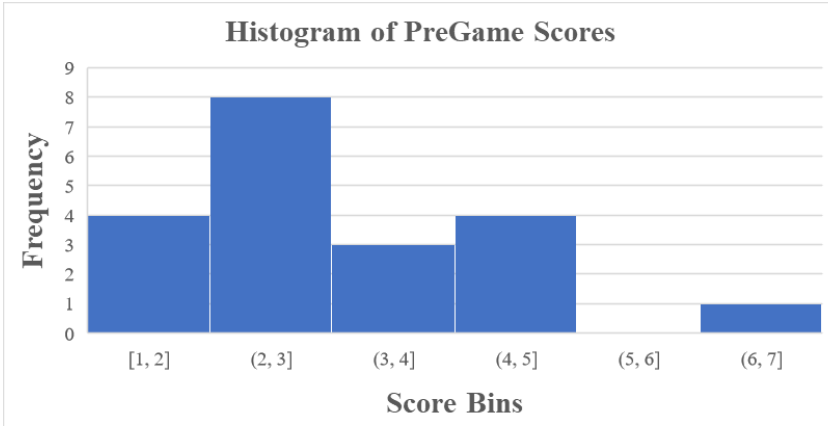


Figure 25. Histogram of Pregame Questionnaire Scores

2. Postgame Questionnaire Results

The Postgame Questionnaire contained the exact same questions as the Pregame questionnaire. On average, subjects answered 5.54 questions correctly. This suggests that the mental stimulation and experience provided by the wargame was able to increase the average questionnaire score by an average of 2 points. Of the three subjects that disclosed no prior knowledge of NEOs prior to the experiment, all displayed a questionnaire score increase of at least 2 points. Additionally, one subject with no past NEO experience demonstrated the highest increase in questionnaire score. This subject scored a 1 on the pregame questionnaire and a 6 on the postgame questionnaire. Table 3 is a chart listing the Postgame Questionnaire scores and Figure 26 is a histogram of the scores. The histogram illustrates that the majority of subjects answered six of the 11 questions correctly.

Table 2. Postgame Questionnaire Scores

Subject	PostGame Questionaure Score
1	6
2	7
3	8
4	3
5	6
6	7
7	4
8	5
9	4
10	5
11	6
12	5
13	7
14	5
15	6
16	6
17	7
18	3
19	4
20	6

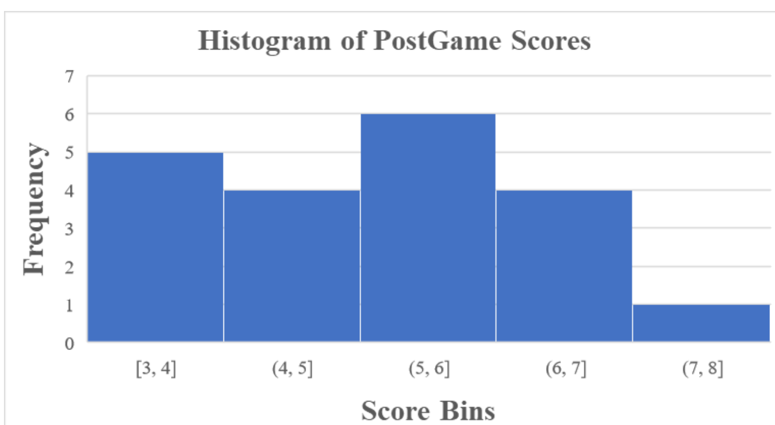


Figure 26. Histogram of Postgame Scores

3. Comparison of Results

Other than the average score for each questionnaire, the data illustrates more useful information. Of the 20 subjects, 4 subjects demonstrated no change in scores for the questionnaires. This may have been a consequence of uncertainty towards the questions after playing the wargame resulting in selecting the same answers for both questionnaires. One subject demonstrated a postgame questionnaire score 1 point lower than the pregame questionnaire. Again, this behavior may be explained by uncertainty towards a question after playing the wargame resulting in the subject changing a correct answer to an incorrect answer on the postgame questionnaire. Other than the aforementioned subjects, all other subjects demonstrated a measurable difference in their questionnaire scores. Figure 27 is a graph of the questionnaire scores and Figure 28 is a bar chart of the questionnaire scores with the associated differences. The grey region of the bar chart is a measurement of the difference in pregame and postgame questionnaire scores. A subject with no grey region on their respective bar demonstrated no difference in questionnaire scores.

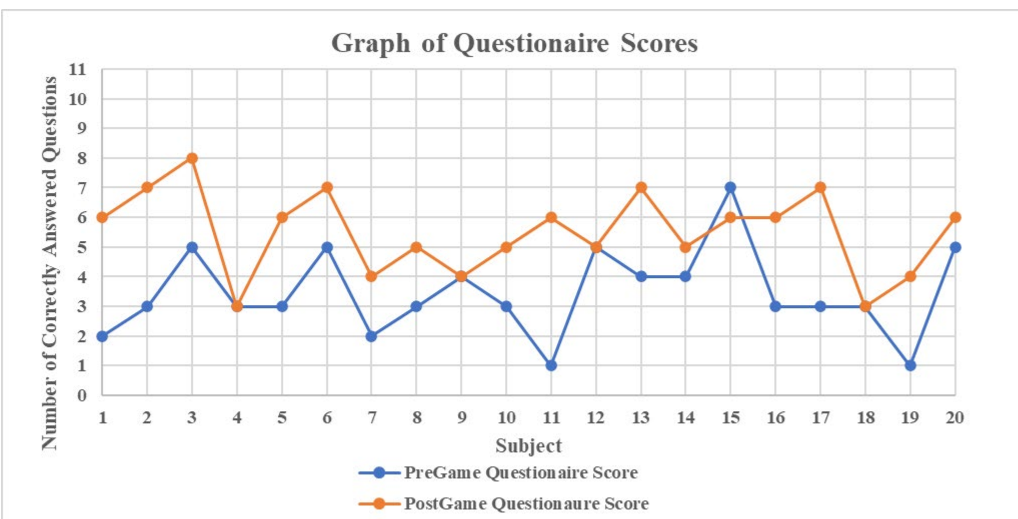


Figure 27. Graph of Questionnaire Scores

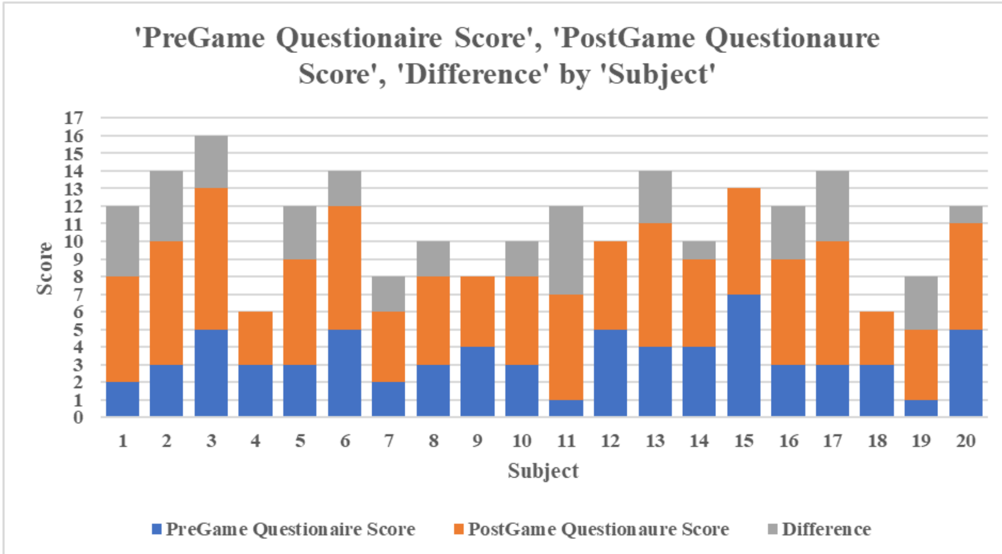


Figure 28. Bar Chart of Differences in Questionnaire Scores

4. Paired Design t Tests

To ultimately determine whether the wargame reinforced NEO learning objectives/ guiding principles, statistical analysis needed to be conducted on the questionnaire scores. Specifically, a measurement of whether the mean difference in questionnaire scores was zero. This was conducted via a paired t test. The paired t test was selected for this hypothesis test because the data met the criteria for testing. All the subjects were independent, meaning that each subject provided their own answers to the questionnaires. Each of the paired measures were taken from the same subject, meaning each subject submitted both a pregame and postgame questionnaire. Lastly, the difference in questionnaire scores were normally distributed. Figure 29 illustrates the normal quantile plot of the differences in scores. The differences appear to be normally distributed enough for the paired t test.

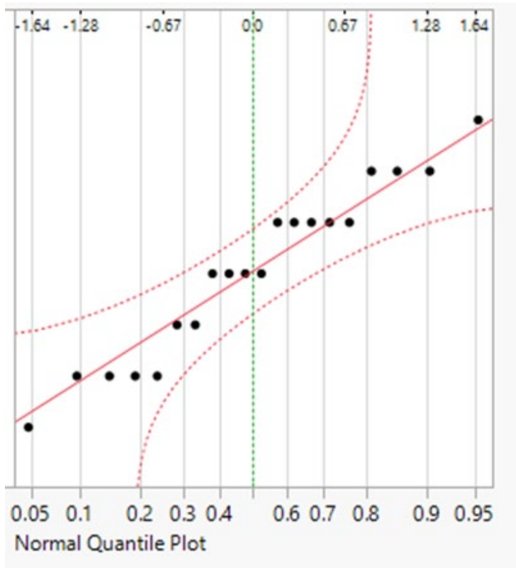
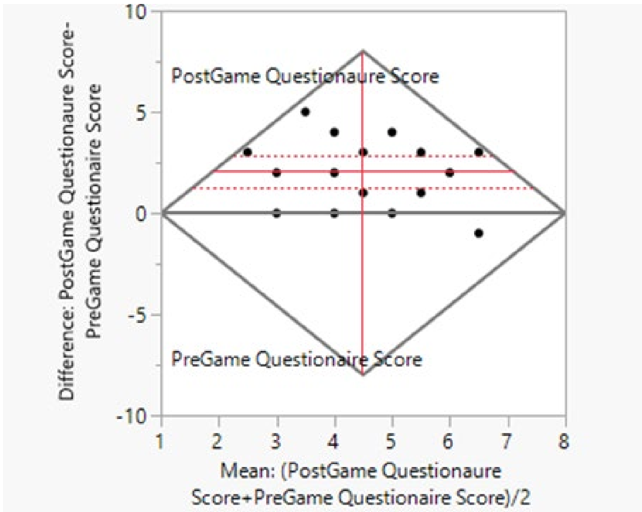


Figure 29. Normal Quantile Plot of Questionnaire Differences

The null hypothesis: H_0: $\mu_d = 0$

The alternative hypothesis: H_0: $\mu_d \neq 0$

JMP software was utilized to conduct the paired t-test. Figure 30 is an illustration of the results. Here the results of the test suggests that there is a difference in questionnaire scores. Zero difference in questionnaire scores is illustrated by the horizontal line at “0,” and the average difference in questionnaire scores is displayed by the horizontal line at approximately “3.” Three questionnaire score differences are shown to be zero and one is shown as less than zero. All other questionnaire score differences are above zero with the majority lying on or above the average difference of questionnaire scores. Additionally, the p-value for the two tailed tests was .0001. This means that the probability of reaching the same results due to randomness is very small. Thus, there is significant evidence to reject the null hypothesis. The results of this paired t test clearly suggest that there is a difference in questionnaire scores.



PostGame Questionaure Score	5.5	t-Ratio	5.491774
PreGame Questionaire Score	3.45	DF	19
Mean Difference	2.05	Prob > |t|	<.0001*
Std Error	0.37329	Prob > t	<.0001*
Upper 95%	2.8313	Prob < t	1.0000
Lower 95%	1.2687		
N	20		
Correlation	0.32113		

Figure 30. JMP Paired t Test Results

V. CONCLUSION

This educational NEO wargame was designed to reinforce the three learning objectives/guiding principles of NEOs (accuracy, speed, and security). Utilizing eight popular board game mechanics, players executed NEOs by establishing an ECC, processing evacuees, and evacuating the evacuees from the ECC to a designated safe haven. Players performed the aforementioned steps five times per iteration of the wargame while reacting to updates in the environment. These updates included denied utilization of evacuation nodes, addition and reduction of transportation assets, and overwhelming number of evacuees entering the ECC. Players were required to balance processing/ evacuation time, evacuation priorities, utilization of transportation assets, and distribution of security forces and evacuees. All requirements directly relate to the three learning objectives/guiding principles of NEOs. Therefore, this educational wargame was successful in modeling NEOs, and reinforcing NEO learning objectives/guiding principles.

Data collected from 10 iterations of the experiential exercise provided by the wargame confirms that players are more knowledgeable about NEOs after playing the wargame. Pregame questionnaire scores demonstrated an overall modest comprehension of the learning objectives/guiding principles. However, fifteen of the 20 subjects demonstrated a significant improvement in questionnaire scores after playing the wargame. Unsurprisingly, the subject that demonstrated the greatest improvement in questionnaire score had no prior knowledge of NEOs prior to playing the wargame.

A. FUTURE WORK

1. Additional Models

A major concern to NEOs that was not necessarily replicated in the wargame, is the reaction of evacuees when they perceive that the evacuation team is not processing or evacuating individuals fast enough. In a live scenario, this has the potential to lead to the mistrust of the evacuation team and result in unrest at the ECC. Incorporating a model that measures the evacuee's level of trust in the evacuation team (based on the rate of processed and evacuated evacuees) would add more fidelity to the wargame. The level of trust could be utilized to add more stress to the security units which would influence decisions regarding their placement.

Additionally, situations regarding discrepancies in proof of identification and other related paperwork have the potential to reduce the number of processed evacuees in an hour timeframe. Normally, ECCs are able to process 100 evacuees in an hour under perfect conditions. However, ECCs rarely experience perfect conditions due to strict identification requirements. This thesis abstracted this phenomenon from the wargame and assumed all evacuees experienced no issues at the ECC due to identification discrepancies. Developing and incorporating a model for this phenomenon would also add more fidelity to the wargame. Fluctuations in the throughput of evacuees at the ECC would stress the ECC processing team and introduce such human factors as fatigue and errors caused by fatigue into the wargame. This would in turn provide players opportunities to make more decisions regarding how long the processing teams work during turns/days of operation.

2. Additional Game Rule

Adding more rules to the game would be an excellent method for increasing the level of complexity. One rule that could be added that would result in increased stress on the player's logistics structure, would be mandating that one group of evacuees are only allowed to be evacuated from the ECC via aircraft. The player's simple strategy of evacuating everyone via any means available, would have to be altered to ensure enough sorties are available to transport all of the evacuees belonging to the evacuee group that the new rule pertains to.

3. Additional Information on ECC Cards

ECC's that are conducted as a result of natural disasters or civil unrest often consist of evacuees with injuries. This wargame did not incorporate aspects of evacuee health. Including health related information on the ECC cards would serve two future purposes. First, it would provide players with experience prioritizing the evacuation of evacuees with health issues while balancing the priorities outlined in the NEO joint publication. Second, it would influence the decision-making process of players by adding another layer of complexity. Both would undoubtedly add value to the experiential exercise.

4. Future Application of Wargaming

The results of this thesis have proven that playing a simple wargame provided players with the experience necessary to transform little, to no familiarity with NEOs, into knowledge about the very principles that make NEOs successful. This finding illustrates that educational wargames can be applied to a broader range of areas, and yield similar results. Using the procedures outlined in this thesis could assist in developing wargames to educate individuals on a variety of topics to include Cyber Security, Expeditionary Advanced Base Operations, and Stability Operations. Ideally, applying wargaming to all types of operational situations build better experienced and knowledgeable individuals, which strengthens the effectiveness of the Armed Forces.

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APPENDIX

B. PLAYER CHEAT SHEET

Counters:

3 Security Units (simulates a 3 platoon Company)

3 Ships

1st Priority Counters (each 1 represents 100 evacuees)

2nd Priority Counters (each 1 represents 100 evacuees)

3rd Priority Counters (each 1 represents 100 evacuees)

Basics Rules:

This educational wargame consists of six simple rules. First, there has to be a security unit at the ECC site to conduct processing and evacuation operations. Second, evacuees cannot be transported to locations that are not occupied by a Security Unit. Third, if evacuees are transported to Ports, they are not counted as "evacuated" until the end of the next turn. This is because the ports serve as transitional logistics hubs. The evacuees still must be transported from the port to a safe haven. This transit time is simulated by waiting until the next turn to consider them "evacuated." Each port can support only 600 evacuees at a time. Fourth, the CH53's can only transport evacuees to the Airport. Fifth, the event update provided by the Situation Update Card only remains active for the turn after it was drawn. Sixth, players roll dice at the end of each turn for a merchant vessel. If a double is rolled, then the players receive a merchant vessel (players can only use the merchant vessel once per game).

ECC Configurations:

1 ECC of 19-man work force:

12 hrs. = Can Process 700 evacuees

18 hrs. = Can Process 1000 evacuees

24 hrs. = Can Process 1400 evacuees

Sorties (dependent of ECC Configurations):

Includes 2 CH53's capable of transporting 50 pax

12 hrs. = 3 Sorties = can evacuate 300

18 hrs. = 1 Sortie = can evacuate 100

24 hrs. = 0 Sortie = can evacuate 0

Naval Vessels:

Each Naval Vessel can evacuate 200 evacuees

The merchant vessel can evacuate 400 evacuees

C. PYTHON CODE

The following program was developed in Python to list all of the five card combinations out of a deck of 15. Additionally, this code is meant to assist game administrators with visualizing how changings to the number of evacuees on a card influences the total number of evacuees per game.

1. Five Card Combination Code

The following code will list all of the five card combinations out of a deck of 15.

```
def per_15():
    cards = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15]
    for L in range (0, len(cards) + 1):
        for subset in itertools.combinations(cards, L):
            print(subset)
```

2. Calculating the Total Number of Evacuees in A Game Iteration

The following code will calculate the total number of evacuees when the following cards are drawn for the 15-card deck. Varying the number of evacuees in each list will vary the total number of evacuees for that respective game. Here, lists are created with the total number of evacuees for each evacuee category. This allows the total number of evacuees for each card to be calculated by simply adding the elements of the list, and printing the sum to the screen. Altering any array element (total number of evacuees in a category), allows the viewer to see how changing one group of evacuees impacts the rest of the game.

```
array1 = (600, 100, 100) #represents the number of evacuees per priority
card_o1 = array1[0] + array1[1] + array1[2]

array2 = (100, 100, 300)
card_o2 = array2[0] + array2[1] + array2[2]

array3 = (300, 600, 200)
card_o3 = array3[0] + array3[1] + array3[2]

array4 = (200, 200, 200)
card_o4 = array4[0] + array4[1] + array4[2]

array5 = (400, 100, 100)
card_o5 = array5[0] + array5[1] + array5[2]

array6 = (100, 200, 400)
card_o6 = array6[0] + array6[1] + array6[2]

array7 = (300, 100, 100)
card_o7 = array7[0] + array7[1] + array7[2]

array8 = (800, 300, 200)
card_o8 = array8[0] + array8[1] + array8[2]

array9 = (100, 100, 100)
card_o9 = array9[0] + array9[1] + array9[2]

array10 = (200, 300, 500)
card_10 = array10[0] + array10[1] + array10[2]

array11 = (700, 200, 100)
card_11 = array11[0] + array11[1] + array11[2]

array12 = (200, 500, 100)
card_12 = array12[0] + array12[1] + array12[2]

array13 = (200, 500, 100)
card_13 = array13[0] + array13[1] + array13[2]
```

```
array14 = (100, 100, 100)
card_14 = array14[0] + array14[1] + array14[2]

array15 = (500, 200, 200)
card_15 = array15[0] + array15[1] + array15[2]


print("card_o1 + card_o2 + card_o3 + card_o4 + card_o5 = ", end="")
print(str(card_o1 + card_o2 + card_o3 + card_o4 + card_o5) + " " + "Evacuees")
```

3. Illustration of Game Set-Up and First Turn

Figure 31. Establishing ECC

Figure 32. Selecting ECC Configuration

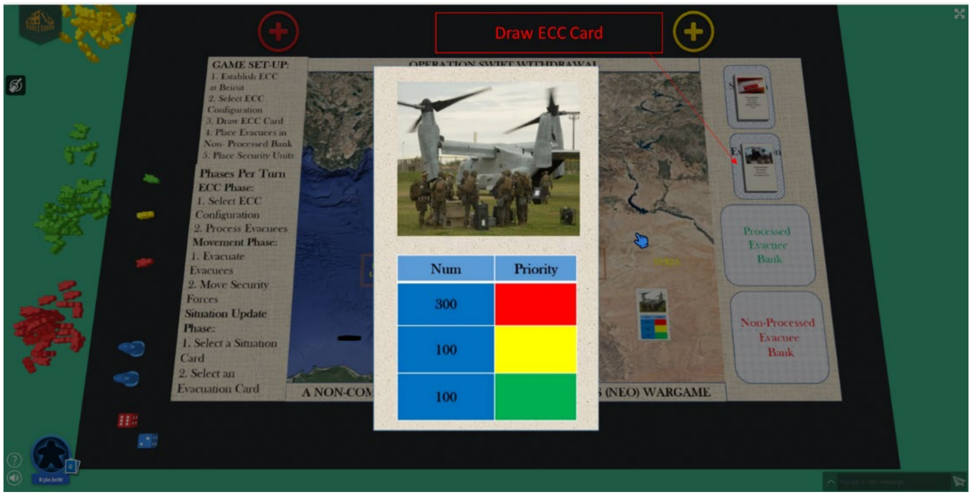

Figure 33. Drawing ECC Card

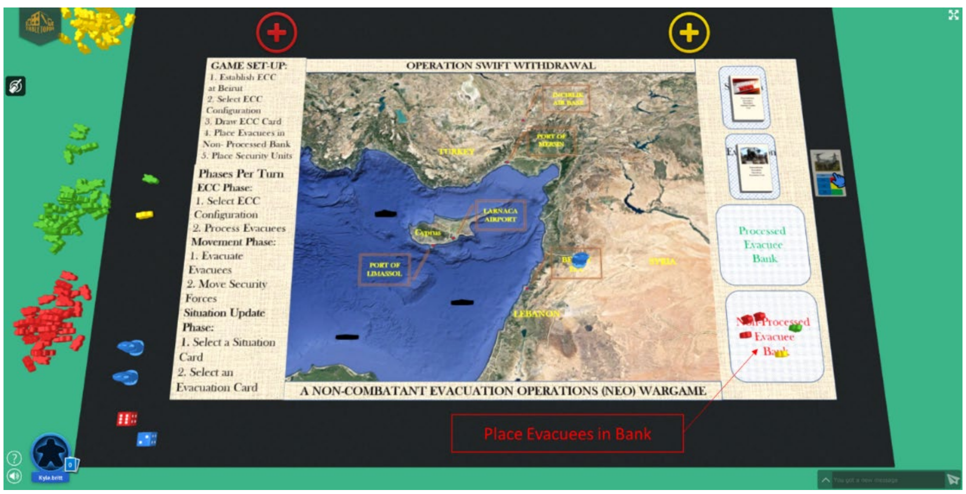

Figure 34. Placing Non-Processed Evacuees

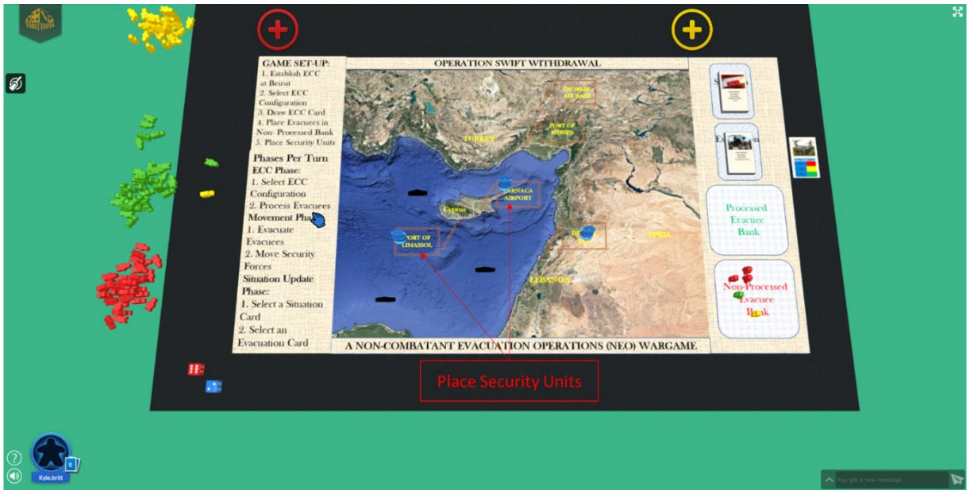

Figure 35. Placing Security Units

Figure 36. Processing Evacuees

Figure 37. Evacuating Evacuees

Figure 38. Moving Security Units

Figure 39. Select Situation Update Card

Figure 40. Selecting Next ECC Card for Next Turn

Figure 41. Rolling Die for Merchant Vessel Support

Figure 42. Removing All Evacuated Evacuees from Gameboard at the End of the Turn

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