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# Designing a Virtual Embedded Scenario-Based Military Simulation Training Program using Educational and Design Instructional Strategies

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# DESIGNING A VIRTUAL EMBEDDED SCENARIO-BASED MILITARY SIMULATION TRAINING PROGRAM USING EDUCATIONAL AND DESIGN INSTRUCTIONAL STRATEGIES

by

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# ABSTRACT

The purpose of this dissertation in practice was to develop and implement a new training program for designers of military intelligence simulation scenarios used to train soldiers. The use of education and design instructional strategies assisted in the ability for designers to gain mastery skills in creating realistic, high-fidelity scenarios that are applied in the training process. The use of simulation scenarios to train adult learners has increased significantly with improvements in technology and its fidelity to engage learners in a realistic way. Despite these advances, the lack of effective design, implementation and analysis of military simulation training programs in the military intelligence community has led to a decrease in simulation utilization, as in the case of the organization examined in this problem of practice. The current training program's increasing difficulties with consistent use by military intelligence simulation scenario designers were discovered in the results of a gap analysis conducted in 2014, prompting this design. This simulation design aimed to examine: (1) a research-based design methodology to match training requirements for the designers, (2) formative assessment of performance and (3) a research-based evaluation framework to determine the effectiveness of the new training program. For the organization's training program, a Simulation-Based Embedded Training (SBET) solution using scenarios was conceived based on research grounded in cognitive theory and instructional design considerations for simulations. As a structured framework for how to design and implement an effective and sustained training program, the educational instructional design model, ADDIE, was used. This model allowed for continual flexibility in each phase to evaluate and implement changes iteratively. The instructional model and its techniques were used with fidelity, specifically for training the designers of the simulation system. Industries will continue to increase the use of simulation as advances in technologies offer more realistic, safe, and complex training environments.

A detailed strategy was provided specific to the organization using a research-based instructional approach integrated into program requirements set forth by the government. This proposed solution,

supported by research in the application of instructional strategies, is specific to this organization; however, the training program design differs from other high-fidelity military simulator training programs through its use of dispersed training to the simulation scenario designers using realistic scenarios to mimic the tasks that the designers themselves must create. The difference in the solution in this dissertation in practice is: 1) that the simulation scenarios are designed without the help of subject matter experts by using the embedded instructional strategies and 2) the design is to the fidelity of realism required for military intelligence training exercises.

# TABLE OF CONTENTS

# LIST OF FIGURES

## LIST OF TABLES

# LIST OF ACRONYMS

| | |
|---|---|
| ADDIE | Analysis, Design, Development, Implementation, and Evaluation |
| AI | Artificial Intelligence |
| GUI | Graphical User Interface |
| ID | Instructional Design |
| IMI | Interactive Multimedia Instruction |
| I/O | Instructor/Operator |
| MI | Military Intelligence |
| NET | New Equipment Training |
| SBET | Simulation-Based Embedded Training |
| SBT | Simulation-Based Training |

# CHAPTER ONE: UNDERSTANDING THE PROBLEM, THE ORGANIZATION, AND THE PLAN

## Introduction

The exploratory research question addressed by the problem of practice is whether providing Simulation-Based Embedded Training (SBET) via scenarios to designers of military intelligence simulation exercises who lack military experience increases the effectiveness of their simulation exercise design performance. The users of the military intelligence simulation system developed by the organization are considered scenario designers who design simulation exercises for military intelligence soldiers. The expert knowledge required of the scenario designers is so complex that knowledge gaps are resulting in low utilization of their systems, as established during a 2014 gap analysis. The embedded training solution allows for the ability to take the "expert" out of the trainer by using the software to guide the designer using realistic scenarios, assess their performance, and adapt to their learning level. This will ultimately improve the simulation system's utilization of military intelligence training of soldiers by the designers and provide the assistance necessary to develop realistic combat exercises.

## The Organization

The organization is a government contracting company specializing in U.S. military intelligence simulation training systems. This organization develops and implements a simulator used for training military intelligence soldiers by emulating and simulating realistic combat-like data to stimulate the soldiers' real-world systems using realistic simulation scenarios created by scenario designers who the organization is responsible for training (Yuan, Williams, Fang, & Ye, 2011). The proposed training program in this problem of practice is meant to increase the simulator's utilization by the scenario designers through effective and efficient training of the designers on how to create realistic military intelligence simulation scenarios to increase military readiness. The current training program for the simulator system is ineffective to the point that the program was unfunded in 2014 due to low utilization and poor training events for military intelligence soldiers using the simulator for their exercises.

Those affected by the possible cancellation of the contracting organization's simulation program in this problem of practice due to funding cuts associated with low utilization are ultimately the military intelligence soldiers. Military intelligence soldiers are assigned high-risk duty assignments in war-torn areas of the world. Without a training simulation system, the soldiers would be forced to conduct their live training intermittently without the use of realistic data to sustain their skills. During a training simulation, the soldiers are provided realistic scenarios with conditions that enable required skills matching those in the real-world mission environment making the contracting organization's simulator system a critical need for military intelligence training.

With simulation systems and software becoming more prevalent in the U.S. military training community, soldiers rely on simulations to train on their combat tactics and equipment without the dangers and expense of being in a combat zone. Training opportunities for military intelligence soldiers are even more limited, even with simulations, so the training scenario must provide complete and correct conditions for realism. Due to the limited opportunity and its requirement to be effective, the organization and all trainers of military simulation systems are affected when the scenarios being designed for the training do not provide the realism necessary to meet their training objectives. The training for the military intelligence simulator must allow the designers the ability to operate their simulation software to build relevant simulation scenarios for soldier training exercises.

The organization's training team works collaboratively with scenario designer teams that create realistic and relevant simulation scenarios used during training exercises for military intelligence soldiers using the organization's simulator system. The organization is responsible for the training program design and implementation for the simulator's scenario designers.

The organization, contracted by the U.S. Army, is the material and training developer of a virtual simulation and gaming system, the specific system for implementing this design plan. There are six core technologies in Virtual simulation and gaming systems today: a three-dimensional (3D) gaming engine, a Graphical User Interface (GUI), Artificial Intelligence (AI), persistence with the software, a network for integrated training support systems and other simulators/real-world systems, and physical virtual world models (Smith, 2010). This type of simulation used for training is defined by some researches as an educational tool or application where the learner physically interacts with the software or simulator to practice an aspect of the training task for teaching the objective or for assessment purposes (Cook, Brydges, Hamstra, Zendejas, Szostek, Wang, Erwin, & Hatala, 2012).

The simulation system for this design has capabilities that consist of four types of applications that use simulation, stimulation, emulation, and Artificial Intelligence Avatar technologies for all disciplines within the military training community. For the purposes of this design, the military intelligence disciplines are not relevant. What is relevant is the complexity of the environment that the simulator must create and that the training of such a complex system requires a training solution that can accomplish the training objectives and positive performance outcomes for the operators and maintainers, referred to as trainers in this design (Georgiou, 2014; Zendejas, Brydges, Wang, & Cook, 2013). The organization's training program is part of the Integrated Training Environment, which combines all aspects of live, virtual, constructive, and gaming environments linking multiple simulators, and live players interacting in a collective training exercise. This training environment is bridging the gap for wide-range exercises between multiple players in military intelligence training modeling and simulation conducted at individual commands or simulation centers at each military base. The goal of military and government officials is that this collaborative training environment will help allow for interoperability between simulation systems and real-world systems that present time and money savings during training events.

The simulator produced by the organization is a system that enables and enhances realistic training of military intelligence soldiers in both standalone and collective exercises as part of the Integrated Training Environment driving mission command functions. The system stimulates soldiers' real-world equipment at a high fidelity to drive soldiers' operational job tasks, military intelligence critical tasks, and collective training objectives.

To support the integration of the proposed solution the organization must be able to accommodate the training program in its' current structure. It can be derived from the structure of this organization, as defined by Bolman and Deal (2008) that it is a divisionalized organization. Based on multiple departments with individual programs producing for their own set of customers, the various levels of department and corporate management, and the separation of work completed within the "quasi-autonomous units" (2008, p. 83) the organization fits a structural frame. As a structural organization, the departments have multiple layers of management with operating teams responsible for completing customer requirements. As the software developer, the organization can integrate Simulation-Based Embedded Training (SBET) into the software for relieving the amount of expertise required of the simulation scenario designers to operate the system. The current contract won by the organization in 2017 specified the requirement by the government for the organization to design and implement a more user-friendly and less expert-driven training program for the simulator's scenario designers. The operating team responsible for this requirement is the Training Department. This department is made up of two instructional designers and three additional subject matter experts in military intelligence. This department is also responsible for training the dispersed scenario designer teams across the world at specific military training locations where soldiers receive simulation training prior to deployment to combat areas.

## The Problem

The goal of military modeling and simulation is to create a realistic, synthetic training environment that mimics real-world, combat scenarios (Page & Smith, 1998, Raybourn, 2013). Training simulators are often used to overcome dangerous, expensive, inaccessible real-world equipment and/or operational scenarios used during live training (Salas, Bowers, & Rhodenizer, 1998). The goal of scenario use in simulation-based training in the military is to assist users with knowledge acquisition and refinement of technical and cognitive skills to build expertise in a particular area (Lammers, Davenport, Griswold-Theodorson, Fitch, Narang, & Robey, 2008;

Cristancho, Moussa, & Dubrowski, 2011; Zendejas, Brydges, Wang, & Cook, 2013). There are multiple benefits in using scenarios in conjunction with embedded instruction: 1) scenarios assist in acquisition, transfer, and sharing of knowledge when tied to short and long term cognition, 2) scenario-based learning makes the instructional event active rather than passive, and 3) allows for the learner to associate the series of tasks within the scenario directly to their experience (Gunter, Kenny, & Junkin, 2018). The embedded training "walks" the designer through the process of recreating these realistic combat scenarios as part of a scenario itself. If the simulator's designers cannot make the transfer of knowledge and skills necessary to develop and execute realistic scenarios when being trained using a similar realistic scenario in the embedded instruction within the simulator, then the military intelligence soldiers will not receive the level of fidelity required of a training exercise prior to deployment into combat areas. The ability to use a realistic scenario as an instructional tool for the designers enables their ability to perceive the embedded training as active learning rather than passive which then motivates the learner to acquire the knowledge into long-term cognition (Gunter, Kenny, & Junkin, 2018).

A gap analysis of the Army military intelligence training simulator's contracting organization's current training program conducted in 2014 showed that the low utilization of simulation was due to a lack of military intelligence and simulation expertise among the system's scenario designers. This deficiency in expertise resulted in a lack of self-efficacy experiences among scenario designers, contributing to diminished efforts toward knowledge attainment and productivity (Gjerra, Moller, & Ostergaard, 2014). The organization also lacked a lead instructional designer to create a new training program design meant to address the issue. This is addressed within the current problem of practice. The organization is responsible for developing the training solution for the simulation program's scenario designers. As the software develops, the organization has the ability to integrate training into the software for relieving the amount of expertise required of the designers to create realistic scenarios using the simulator. The inability of the organization's trainers to train the scenario designers effectively led to a decrease in utilization of the system causing the organization to lose government funding for the program.

## How the Problem Affects the Organization

In 2014 a gap analysis was conducted by the government program office to identify any gap in the training program used to train the designers, correct any lack of knowledge in simulation, and assist in realistic design of simulated combat scenarios. Government stakeholders placed pressure on the organization to increase the system utilization numbers. The decrease in utilization is what led to the need for the gap analysis on the program. The analysis found that there was a gap in the designers' knowledge due to no military intelligence backgrounds. As a quick solution, the training department within the organization was tasked with implementing a mobile training unit. The creation of the mobile training unit identified the organization's lack of subject matter expert resources available due to layoffs and budget cuts in government contracting. Additionally, the increasing demand for training and scenario design assistance requests coming in from the designers is minimizing the subject matter expert trainers' availability. The knowledge problem with the designers that was discovered during the gap added to the stress on the organization's mobile training unit due to the designers' lack of creating simulation scenarios on their own (Locke & Latham, 2002).

Because of this strategy, the organization and program have suffered significant problems. It has led to complete dependence on the organization's trainers by the scenario designers, the designers' experience severe decay in their skill performance as well as knowledge of new system capabilities between training events. Additionally, their self-efficacy is impaired. These problems have resulted in a costly and inefficient program in the eyes of the shareholders. The dependence on the organization's trainers and the costs associated with their continual deployment has forced the government and program proponent to cut funding from other areas to supplement the cost of this mobile training unit support strategy.

The increase in demand for the organization's subject matter expert trainers has been extended not only by funding resources, but personnel's availability as well as the ability to consistently provide follow-on training for new software features and/or designer turnover. The fact that increased support requests for assistance from the program's trainers to the designers often come from the sites that have lower utilization numbers shows a lack in the ability of the scenario designers to conduct its own simulation exercise. Without the ability of the designers to conduct their own simulation exercises, the site must turn down any training opportunity with the soldiers when the organization's subject matter experts are not available. This decreases that site's utilization numbers since training cannot be provided to the soldiers. The organization and its government program shareholders have a viable interest in the training goals of military intelligence soldiers since funding is based on their utilization of the simulation system.

Secondary to the resource problem, the system itself is complex and requires a multitude of expert knowledge in military intelligence and the simulation system's software. The complexity and fidelity level of the simulation software has been shown to affect the ability for trainees to learn to operate the system and design effective simulation scenarios (Georgiou, 2014). It is common to find military training simulation systems engineered without the incorporation of instructional design methodology or universal principles of design (Kirkley & Kirkley, 2005). Trainers in the industry of military simulation systems find the systems and its' documentation difficult to use and even harder to train (Kirkley & Kirkley, 2005). Due to the lack of instructional design input and design principles that coincide with the training objectives for the users, the training needs are often not met (Salas, Wilson, Lazzara, King, Augenstein, Robinson, & Birnbach, 2008; Lidwell, Holden, & Butler, 2010). Common knowledge in the industry is that most systems' scenario designers must be trained numerous times and, due to the overwhelming difficulty of the simulation system itself, often do not make the necessary long-term knowledge transfer. This becomes an even greater issue when soldiers are put through a yearly training cycle that includes simulation training only when they deploy to their area of operation.

## How the Problem Affects the Military Training Community

Within the Department of Defense (DoD) simulation programs, generally referred to as Modeling and Simulation, is the use of models, emulators, simulators, and stimulation to mimic realistic data as a basis for making technical and tactical decisions (Page & Smith, 1998; Raybourn, 2013). Military and government use of simulations, gaming and multimedia instruction has steadily grown as well as the need for effective use of simulation scenario environments that provide the opportunity for realistic training in a low-cost, safe environment. The military uses simulations due to the reduced cost compared with live training. Also, the relatability to young soldiers who grew up with advanced technology and gaming increases their motivation to learn and leverage the capabilities of simulation prior to real-world deployments (Raybourn, 2013).

Prior to budget cuts to the military's training programs, the Army's training cycle consisted of live training events held at National Training Centers around the world. This type of training was required by all units within the Army and at the very expensive cost of sending each unit to the training center with all of their deployable equipment and personnel at least twice a year. Smaller, less expensive training events were held a few months prior at the home station training facility where the unit is stationed when not on deployment in combat areas. Once live training no longer fit into the Army's budget, training via simulations became a requirement and a new training approach was necessary. This approach only allowed for live training events to be funded intermittently for military intelligence personnel.

The organization's problem is relevant to the overall issue within the military intelligence training community and the contracting companies that provide the training solutions to this highly sensitive and complicated field. The organization, as a government contractor responsible for multiple simulation systems' training programs, is faced with the continuous problem of advanced technology in simulation software with increasing complexity. This makes it challenging to provide training solutions across all similar programs where the designers are lacking knowledge and expertise in the job tasks that the simulator is meant to train (Zendejas, Brydges, Wang, & Cook, 2013).

Traditionally, military intelligence training programs include lecture-based or presentation-based solutions as the soldiers' real-world systems cannot receive real-world data while operating within the United States without difficult legalities and authorizations. These training program solutions are not appropriate for the advanced technology and complexity inherent to simulation systems (Georgiou, 2014; Proctor, Silmere, & Raghaven, 2011). Therefore, a proper simulation training program equal to the complexity of the training objectives for military intelligence soldiers and their systems is required. With the lack of baseline knowledge in the military job tasks and simulations, the designers of the simulation scenarios will continue to have knowledge acquisition and retention problems if the amount of expert knowledge required operating the software remains high. This problem is persistent across the organization as well as all other government contractor organizations responsible for training simulation systems and software to under-qualified or less-knowledgeable designers of the simulation scenarios.

## How the Problem Affects Military Readiness

Military training is often among the most advanced in the world and encountered by soldiers with high-risk assignments as part of their daily professional tasks. The Army has embraced adult learning in its development of the Army Learning Concept for 2015 which calls on advanced technology and adult learning principles in the development of all military training programs contracted to government contracting companies for training supportability (Cornell-d'Echert, 2012). The military has used an extensive amount of limited resources to train and educate soldiers on how to execute their military duties. Military training commands recognize the greater complexity and overall scope of the duties of soldiers and the need to address the skills, knowledge, and attributes required through training development before exposing them to real-world military operations (Cornell-d’Echert, 2012).

Although this is a large-scale problem in training and simulation in the military intelligence community, the contracting organization’s specific problem is the inability to train the scenario designers possessing little to no military intelligence or simulation expertise. This problem in practice will address this problem with a training program design for scenario designers that utilize Simulation-Based Embedded Training (SBET) through scenario replication to reduce the need for the expertise and increase the designers’ self-efficacy. This approach will increase utilization of the system keeping the organization funded to provide military intelligence training to soldiers around the world, increasing military readiness during combat operations.

The significance of the lack of effective simulation scenario designs for military intelligence soldiers directly relates to military mission readiness. Mission readiness is when deployed soldiers in combat areas are trained to a specific standard that warrants the title of “mission ready” for their specific job title (Thompson & McCreary, 2006). When the simulation scenario design is ineffective in its ability to train military intelligence soldiers during exercises, the soldiers waste valuable time and effort during limited training opportunities. When soldiers are not able to use the limited training opportunities to practice their job tasks effectively, it allows for critical and sometimes deadly mistakes during actual combat operations. Enabling effective and efficient training exercises for soldiers, by ensuring the simulation system’s designer training is meeting scenario realism standards, significantly increases the probability that soldiers will receive the training they need (Thompson & McCreary, 2006).

If the scenario designers, during their training program, cannot make the transfer of knowledge and skills necessary to develop and execute realistic scenarios on the simulation system then the military intelligence soldiers are not receiving the level of training they require to be "mission ready". This leaves a void in a commander's unit when operating in combat areas. Here, they are expected to integrate the skills practiced through their individual and crew training exercises using the simulation training. The example of how simulation system training difficulties affect the soldier training can be generalized to having the same effectiveness issues as other high-technology, high-fidelity trainers.

## The Plan

The design of the training program is to increase the effectiveness of performance of designers who lack military experience through Simulation-Based Embedded Training. The training program solution was to embed training materials into the simulator's software using a flexible instructional design: Analyze, Design, Develop, Implement, and Evaluate (ADDIE). The basis for the design is the result of a gap analysis performed in 2014, which showed that the designers lack the knowledge and background in the simulation subject, military intelligence, and the proper execution of developing scenarios using the simulation software. To address the lack of knowledge of the designers, the training program will provide embedded training materials and operational tasks into the simulation software that "walk" the designer through the development and execution of scenario design. This embedded training is guided learning in the form of help overlays in the software that step the learner through every operational task. This reduces the need for expertise on the subject. In addition to addressing the knowledge gap, the government shareholder has determined specific requirements that the organization in this problem of practice must also address.

1. The training program solution must provide persistent, 24/7 accessibility to training
2. Increase the proficiency of the trainees in planning
3. Develop and execute military intelligence training exercises consistently and without assistance
4. Reduce the amount of the organization's subject matter expert trainers augmenting scenario designers

The primary aim of this design is to present a new training program where the SBET solution allows for the ability to take the "expert" out of the designer by: 1) using the software training solution to guide the learner, 2) assess their progress, and 3) adapt to their learning levels with the application of instructional design principles. According to a study conducted with undergraduate nursing students using a pretest/post-test experiment, a comparative analysis of the results showed that students in the experimental group received higher grades than those in the control group as shown in (Alinier, Hunt, Gordon, & Harwood, 2006). The significance of this study for our program is that it provides quantitative evidence of a positive impact of Simulation-Based Training (SBT) as a tool for training complex, dynamic skills where the adult learner is evaluated on their ability to perform objective tasks using a high-fidelity simulation (Alinier et al., 2006; Garrett, Macphee, & Jackson, 2010).

This problem of practice investigated military utilization of high-fidelity simulators in their training programs where complex skills and mimicking realistic environments were required. Comprehensive studies and systematic reviews showed improvements in trainee self-efficacy and skill performance on simulation trainers (Wood & Bandura, 1989; Issenberg, McGaghie, Hart, Mayer, & Gordon, 1999; Wayne, Butter, Siddall, Fudala, Wade, Feinglass, & McGaghie, 2006; Rockstraw, 2006; Vogel-Walcutt, Fiorells, & Malone, 2013; Franklin & Lee, 2014), which supports the implementation of Simulation-Based Embedded Training (SBET) where the training is embedded within the system. In addition, SBET includes the use of learner analytics to assist in performance evaluation and improving system capabilities. (Proctor et al., 2011). The combination of these methods allows designers who are less knowledgeable and lack the expertise to receive assistance within the system and without the use of the organization's subject matter expert trainers.

Proponents for simulation as a training tool argue that simulation provides a safe, supportive environment for learning and promotes learning at all levels, from beginner to advanced (Bradley, 2006). Learners are encouraged to develop and practice skill acquisition through experience in a realistic environment creating an operational situation (Bradley, 2006; Brooks, Moriarty, & Welyczko, 2010). The benefits of simulation training are: learners develop at their own rate, there is facilitation of on-demand learning and the transfer of skills and knowledge to a real world operational environment, and the use of a valuable formative and summative assessment tool (Bradley, 2006). Table 1 lists the benefits of using simulation for complex training tasks.

Table 1: Benefits of Simulation with Features of High-fidelity Simulation
Source: Bradley (2006)

| **Research-based benefits of simulation** | **Features of high-fidelity simulation** |
|---|---|
| Risks to learners are avoided | Provides feedback |
| Undesired interference is reduced | Allows repetitive practice |
| Tasks/scenarios are created to training demand | Integrates with curriculum |
| Skills have the potential to be practiced repeatedly | Provides a range of learner-difficulty |
| Training can be tailored to individuals | Adapts – allowing multiple training strategies |
| Retention and accuracy are increased | Provides a range of scenarios |
| Transfer of training is enhanced | Active learning based on individual needs |
| Standards for evaluation of performance and training needs are enhanced | Defines outcomes |
| | Simulator validity as a realistic replication of complex operational situations |

The organization's experience provides a unique understanding of the challenges the training and military intelligence community faces in conducting consistent, high-fidelity, multidisciplinary, cross-modality exercises. It requires the generation of scenarios that provide realistic operational environments, with large sets of multi-discipline data to simulate real-world situations into military systems. The activities created through this integrated environment using a simulation scenario must enable the learner to meet the training goals.

## The Research

It was discovered during the search for relevant literature and research on simulation-based training (SBT) with the use of scenarios in military intelligence simulator training programs was that there was very little published work on the subject. There was more literature on the use of SBT in the medical and aviation communities, which demonstrates its effectiveness as a training tool. Although these industries seem to be quite different in the eyes of the public, the organization's experience in training complex, dynamic, and dangerous tasks to military intelligence soldiers, have provided the insight that the same challenges exist between multiple industries and disciplines (e.g., military, aviation, medical). For this reason, this dissertation in practice relies on the research conducted in the medical and other communities to provide grounded, research-based information to form training program strategies for simulation-based embedded training using scenarios to train simulator scenario designers.

Simulation-based training (SBT) is an instructional technique to advance the user's technical expertise by providing a realistic, dynamic environment where they can develop, practice, and receive feedback on their skills and cognitive processes (Kluger & DeNisi, 1996; Decker, Sportsman, Puetz, & Billings, 2008; Weaver, Salas, Lyons, Lazzara, Rosen, & King, 2010). With a well-developed simulation scenario, users typically demonstrate the ability to transfer cognitive processes required for performing the tasks under normal operating conditions (Weaver et al., 2010). Simulation-based Training (SBT) is reported to be well received within the medical community due to the incorporation of multiple learning modalities through static information, demonstration of skills, and practice of those skills (Weaver et al., 2010; Brooks, Moriarty, & Welyczko, 2010).

Simulators are by no means a new technology. However, the complexity and ability to emulate, simulate, and stimulate realistic, real-world situations is making it an obvious choice for more dangerous, costly and error-prone training tasks (Salas et al., 1998). Flight simulators are one of the earliest types of simulators to be invented starting back in the early 1900s (Smith, 2010). The idea of SBT has been increasing not only in its use for military training but just as quickly in healthcare. Much like the dynamic, high risk nature of a medical clinical environment, the military, including simulation scenario designers, must be able to function individually as well as a part of a team environment.

The increased use of simulation as a training solution across multiple industries is mostly due to the need for trainee safety, new training models to address the adaptability and complexity of the learner in their operational environment, learning availability on-demand, and the persistent need to practice and master skills in a controlled environment (Motola, Devine, Chung, Sullivan, & Issenberg, 2013). There are several points that researchers in the medical industry have outlined to ensure that simulation-based training should be utilized to replicate learner experiences but requires integration into the training program with well-developed, outcome-driven objectives and comprehensive evaluation of performance (Decker et al., 2008; Motola et al., 2013; Zendejas et al., 2013). The accessibility of simulations has also led to its increased demand as a training tool for the military. Since technology is now less expensive and easier to access, it is desirable for mobility and operational tempo of the military units. Additionally, an increase in demand from military units has resulted in an increase in the need for the government to contract organizations to develop training materials in the form of software and hardware.

Specifically, the purpose of the proposed training program in this dissertation design is meant to examine if training materials and innovations embedded within the simulator software using scenarios and instructional interventions could train a novice designer to effectively train military intelligence soldiers (Franklin & Lee, 2014). This would be demonstrated by comparable outcomes from those who received the new training program to those who have received their initial training in the form of traditional lecture (Grief, Becker, & Hildebrandt, 2015). A comparison of traditional methods to simulation, specifically, supports the idea that learners retain and transfer knowledge through activities that require active participation with increased retention with each repetitive practice situation (Devitt, Kurrek, Cohen, & Cleave-Hogg, 2001; Kneebone, Scott, Darzi, & Horrocks, 2004; Alinier et al., 2006).

To ensure that a level of skill is attained from the proposed training program in this dissertation design, we must consider the varying levels of skill between designers. There is also a need for instructional strategies to adjust the curriculum accordingly making it more adaptive to the learner (Bell & Kozlowski, 2002). Further, scenario designers may have no prior knowledge or skill, a moderate amount, or be a considered a subject matter expert already. The skills required to develop and execute the simulation environment must be attained through the training model delivered by the subject matter expert trainers as well as their own self-regulation to reach program completeness (Schunk, 1990; Issenberg et al., 1999). The research conducted during this problem of practice assists in the development of instructional strategies that take cognition necessary to complete program-defined objectives and a certain level of skill mastery into consideration.

There are many other approaches: discovery learning, inquiry-based, and constructivist (Vogel-Walcutt et al., 2013). These approaches assume that learners of all levels can reach their training objectives by solving problems and acquiring knowledge on their own without the assistance of any instructional materials or actual instructor (Kirschner, Sweller, & Clark, 2006; Vogel-Walcutt et al., 2013). These approaches contradict the grounded theory, systematic review of literature Vogel-Walcutt et al. conducted in 2013 on instructional strategies for military training systems where the team reviewed a large amount of cognitive approaches. The research supported the known limitations of human cognition and found empirical data showing the discovery-based approaches to training are inferior to more direct or guided instructional approaches (Vogel-Walcutt et al., 2013). Another determination from the literature reviewed was that the design of a training system will be most effective and efficient when instructional guidance is provided to the lower or less-skilled learners and when that learner gains expertise, or starts with a higher level of expertise, that the guidance is gradually adapted in conjunction with their learning objectives (Vogel-Walcutt et al., 2013).

## Dissertation Design

The format for this dissertation in practice follows the tradition of action research. Herr and Anderson (2015) explain action research and its impact on the dissertation.

> Because of the ongoing nature of action research, it may not be possible to write up the whole undertaking, but rather just a piece of the understanding or intervention that has come about through the inquiry. The doctoral student may be well aware that the inquiry continues to unfold but may make the decision to write up just a part of it for the dissertation. It is not that the research is not finished, rather, the doctoral student bounds it for purposes of the dissertation (p. 106)

This dissertation in practice proposes a training program where the design and implementation methodologies are grounded in research-based theory that examines the challenges of training the designers of a simulation system. The design also considers the workings of the organization, its' training challenges, and the large-scale military training community's challenge of training simulation.

Chapter one is an overview of military training and its challenges, the organization and its approach to those training challenges, and the issues with the current training program for the organization. Chapter two is an in-depth review of the design methodology and the research literature. Chapter three is an implementation and supportability plan for the proposed training program design model, including a framework for evaluating the effectiveness and efficiency of the design. Chapter four is a brief discussion of recommendations and limitations of the development and implementation of the program design.

# CHAPTER TWO: THE DESIGN METHODOLOGY OF SIMULATION-BASED EMBEDDED TRAINING (SBET)

## The Training Program Model

To address the lack of military intelligence and simulation knowledge of the scenario designers, a training program design is needed that will allow for limited expertise in these fields while assisting the designer in proper development of a simulation training scenario. This training program design uses simulation-based embedded training (SBET) as an intervention with the use of scenarios as the instructional strategy that allows the software to incorporate training into the everyday use of the simulation's scenario design applications. This embedded training will assist the designers in all the steps necessary to accurately and efficiently create military intelligence simulation training scenarios. This training program design follows an instructional design model that includes components of Analysis, Design, Development, Implementation, and Evaluation (ADDIE).

The ADDIE model is used flexibly to allow each phase of instruction to be evaluated and refined iteratively. The Design phase enables the instructional designer to use the information about the learners identified in the Analysis phase in conjunction with learning theories and principles of learning for a complete learner-centered solution (Becker & Parker, 2012). The Analysis phase is where the Needs Analysis is conducted. The outcome of the Needs Analysis identifies the organization's performance gap to be filled by the training solution. The organization's design takes into consideration the difficulties of training complex skills in operating a military intelligence simulation system within the scope of realistic scenarios, the lack of self-efficacy experiences among scenario designers and its contribution to the low utilization of the simulation system for military intelligence exercises. Through thoughtful use of the ADDIE model as the structured process for the design, the instructional designers are able to implement the proper instructional strategies to overcome the organizations current training gaps through the use of scenarios with embedded guided instruction to assist the learner in response over recall opportunities in conjunction with the model's task-oriented approach (Becker & Parker, 2012).

Simulation-Based Training (SBT) is an instructional design technique to advance the user's technical expertise by providing realistic, dynamic environments where they can develop, practice, and receive feedback on their skills and cognitive processes (Kluger & DeNisi, 1996; Decker, Sportsman, Puetz, & Billings, 2008; Weaver et al., 2010). With a well-developed simulation scenario, users typically demonstrate the ability to transfer cognitive processes required for performing the tasks under normal operating conditions (Weaver et al., 2010). SBT is reported to be well received within the medical community due to the incorporation of multiple learning modalities through static information, demonstration of skills, and practice of those skills (Weaver et al., 2010; Brooks, Moriarty, & Welyczko, 2010).

One of the training problems recognized in military intelligence training programs is the lack of empirical data on the proper methods for training the complexity of the systems when the users aren't able to use the systems due to the nature of their sensitive information. Using subject matter experts in each of the military intelligence disciplines, the organization in the problem of practice understands the Army's goals in its training strategy. Much of the research is associated with technicians of other communities of learners outside of military intelligence (i.e., infantry soldiers, nurses, doctors, pilots, etc.); the simulation scenario designers must possess the same knowledge and skills to facilitate the development of realistic scenarios for the simulation training event that would mimic the realistic combat environment of the military intelligence community. This is an important consideration as it pertains directly to the designers of those simulation systems' scenarios, not the soldiers receiving the simulation data since they are on their real-world systems without the knowledge that it is simulated data. This is the consideration that connects the ability of the organization's subject matter expert trainers to train the scenario designers to the fidelity necessary for a realistic training exercise.

Most U.S. military training and education, as practiced since World War II, was largely instructor-centric, task oriented, and evaluated through performance measurement based on tasks (action), conditions, and standards (Cornell-d'Echert, 2012). After the war, leaders noticed the shortcomings in their methodology and the need for change from static delivery and training to more experiential learning practice (Cornell-d'Echert, 2012). An increasing reliability exists for simulation to provide training tools for practicing complex skills in a controlled, safe, and forgiving environment. This increases their knowledge and enables the acquisition of complex skills through immediate feedback (Kluger & DeNisi, 1996; Wayne et al., 2006). This type of practice in conjunction with a complex problem such as a realistic scenario, presented to the learner in real time, makes simulation a highly effective, research-based solution for the type of training that this problem in practice must address in the military intelligence community (Wayne et al., 2006). In most approaches to SBT, developers have lacked the research-based cognitive processes needed for effective and efficient training solutions, which would also be the case in military intelligence systems (Vogel-Walcutt, Fiorella, & Malone, 2013). Table 2 summarizes the attributes and processes of the ADDIE model. The table describes each phase of the model, the product produced during that phase, and the cognitive framework as it applies to that phase regarding SBET.

Table 2: ADDIE application to SBET program

| ADDIE Model | Products | Cognitive Framework |
|---|---|---|
| Pre-Analysis | Self-Report Pre-test: Conducted during New Equipment Training for comparative analysis to the Post-test conducted during evaluation. | Self-regulation Theory: Wood & Bandura, 1989 |
| Analysis<br><br>Identifies the problem, impacting contextual factors. Explains current context and possible constraints. | Needs Analysis: Determined by the initial skill performance of the learners and their ability to self-regulate.<br>Task Analysis: Determined by the complexity of the skill and the efficacy of the learner. | Self-efficacy Theory: Bandura, 1991 |
| Design<br><br>Provides overview of problem, identifies research, identifies strategies for addressing the problem, presents model for solution building. | Simulation-Based Embedded Training (SBET): Embedded help overlays, 24/7 access via a web portal, immediate feedback | Learner Centered Approach: Vogel-Walcutt et al., 2013<br><br>Self-Regulation: Wood & Bandura, 1989 |
| Development<br><br>Expands on identified resolutions, transitions into action model, identifies specific strategies applied to resolution, synthesizes research and application. | Web portal with SBET in designers' system | Experiential Learning: Alinier et al., 2006 |
| Implementation<br><br>Provides action plan for resolution, explains application of research, explains how each strategy will be put into action, explains quality control measures. | Delivery Method: Web portal access with intervention plan for learner support/re-training upon completion of Capstone exercise | Skill Mastery: Vogel-Walcutt et al., 2013 |
| Evaluation<br><br>Includes evaluation of each phase, explains how each phase of ADDIE aligns with implementation, includes standards of assessing each measure, explains summative assessment measures at each interval. | Post-test learner analytics: Provide the results automatically during performance of Capstone exercise | Immediate feedback: Chen et al., 2012 |

The ADDIE model provides a sense of "order" to the complexities of the training program and its' goal or outcome expectations. A flexible model is best for this training plan as the repetitive evaluation of each step of ADDIE will provide a timely snapshot of effectiveness of that phase's outcomes.

New Equipment Training for Designers

Each simulation designer must attend New Equipment Training (NET) provided by an instructor or subject matter expert at their location. During this NET, the designers will perform during a pre-test and self-report their performance outcomes. Prior to conducting the Needs Analysis, this pre-test is necessary to provide comparative data to what the User Analytic reports will provide at the end of program evaluation. Once the pre-test is complete, the simulation designers' performance will be used to conduct the Needs Analysis. The results of the Needs Analysis lead to the ability of the instructional designers to complete the Task Analysis. During the Task Analysis, the instructional designers will determine the learning goals. These learning goals will be used in the Design phase as the driving factor for what information is provided in the embedded help overlays on the system. The design framework is described in detail in Table 3. Once all of the simulation-based embedded training (SBET) is added into the simulation designers' systems, it will provide the necessary instruction for skill mastery in simulation scenario design. SBET will be integrated using a web portal, called the Knowledge Base, accessible by the designers on their simulation system. After the embedded help overlays assist the designer through their system applications, a formative evaluation is conducted using a Capstone exercise. With User Analytics, the system automatically reports the performance outcomes of the designers based on the learning goals input into the SBET by the instructional designers. The reports are sent directly to the subject matter experts at the program office to compare to the designers' pre-test during NET.

Figure 1 provides a visual representation of how the use of the ADDIE model is maximized with the implementation and evaluation plan techniques and technologies.

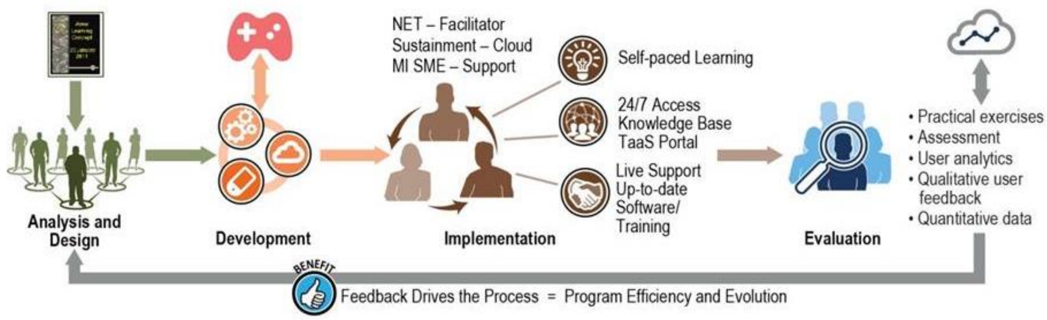


Figure 1: ADDIE for SBET program

In this figure, based on the work in this dissertation in practice, the Army doctrine on training is used as an input into the Analysis and Design phase of the model. This doctrine regulates what is considered in each program as the training requirements for any Army system or that system's training device. The Development portion of the figure displays the simulation/gaming and cloud technologies used during this phase of the model. Effectiveness of the Design is enhanced with the integration of learning principles to form the foundation for the Implementation of the training solution. These principles are explained in the figure as well as in the implementation plan in Chapter three. The Evaluation phase of the figure explains the evaluation of the scenario designers during their training. Efficiency is improved by taking that evaluation data as an immediate feedback loop from evaluation to design, keeping the program design current with technological advancements in evaluating user and software interactions (Bandura, 1991; Kluger & DeNisi, 1996).

## Analysis

Because of the analysis phase of the training model, a detailed set of requirements is generated to guide the training needs of the designers tasked with creating the simulation scenarios. The developed analysis products, Needs Analysis and Task Analysis, will be validated by the organization's subject matter experts. These experts ensure that all necessary user tasks are addressed and that the appropriate technical solutions are being used. During the Analysis phase of the ADDIE framework, developers identify and document the needs of the program resulting in a requirements list or document from the analysis team for transformation into a visual form during design (Lidwell, Holden, & Butler, 2015). This portion of the training program's instructional design process was performed by the government organization using what Lidwell et al. (2015) call a Design by Committee. Their book, *The Pocket Universal Principles of Design* (2015) defines Design by Committee as being a preferred method of decision making when the requirements of the program are considered "complex, consequences of error are serious, and stakeholder buy-in is important" (p. 37). The proposed design described in this dissertation fits the definition and this approach to their analysis resulted in a requirement's list from the shareholders (see Appendix A for the training program's requirements) which provides a more superior list than a single dictator-like decision making process would provide, given the considerations for this approach (Lidwell et al., 2015).

## The Current Model

The belief within the organization is that the cause of the decline in training events is due to the inability of the scenario designer teams to generate realistic and complex simulation training scenarios for military intelligence exercises. There is a lack of consistency in the ability of the designers in this program to provide valid, effective training meant to address the training need for military intelligence soldiers across the Army. The current training program's strategy is conducting a New Equipment Training (NET) event where a subject matter expert trainer from the organization travels to the designers' base locations and provides lecture from PowerPoint slides with embedded videos and trainee guides. The only practice available to the designers is via practical exercises as assignments to be performed on the simulation system well after the training is complete. Evaluation is provided with end-of-course surveys for qualitative feedback. This feedback will be used as the Pre-test data for the new Simulation-Based Embedded Training (SBET) program using scenarios with guided instruction over a web portal for dispersed learning across all designers' locations. The current methods are not supported by cognitive or research-based technologies with instructional interventions to improve skill mastery and knowledge acquisition (Luo, Liu, Kuo, & Yuan, 2014). This is perceived as the cause for the lack of effectiveness of the current program's designers' scenarios.

The Needs Analysis, prior to the new model, was conducted using the following list of training products provided to the scenario designers. The organization is required to use this Needs Analysis in the new model:

- a complete review of training assessments collected after each NET event
- current training program evaluation surveys

- an assessment conducted by the government field representative tasked to collect scenario designer requirements in the field
- the gap analysis conducted a few years ago to investigate low system utilization
- input of the organization's subject matter experts as experienced practitioners

The training needs were delivered to the organization in the form of requirements that were expected to be addressed. This solution was selected as the appropriate approach for the training program. The list of requirements, analyzed and broken down from the contractor organization, will be recognized as the needs assessment from the government program office and is provided in Appendix A.

## The Design Framework

### Self-regulation

In order for deeper learning to occur, self-regulation and self-efficacy are essential in the design.

Self-regulation theory is iterative where the learner is kept in a state where cognitive and behavioral processes lay the groundwork for increasing effective skill acquisition on a complex system such as a simulator (Wood & Bandura, 1989; Kozlowski & DeShon, 2004). Here, simulated, complex environments provide the ability to complete multiple iterations of decision-making processes which, according to one of two major concepts of ability, learners seek challenging tasks to increase their knowledge and skill acquisition (Wood & Bandura, 1989).

The decision-making process involved in acquiring complex skill acquisition is a motivational, cognitive process (Wood & Bandura, 1989; Karoly, 1993). Wood and Bandura (1989) noted that people approach complex tasks with a certain level of ability which has an impact on the self-regulatory factors that influence ongoing motivation and goal outcomes in complex decision-making environments. Self-regulation theory has a long, rich research history as an effective model used in skill performance tasks (Karoly, 1993; Kozlowski & DeShon, 2004).

Self-regulation theory has empirical support as an effective model contributing to learning and skill performance (Schunk, 1990; Kozlowski & DeShon, 2004). In this design's instructional strategy, the simulation scenario designers concentrate their efforts on the realistic scenario performance tasks that are influenced by the SBET. Where the direct instructional support is necessary for novice designers and as expertise within the learner's domain is enhanced, the instructional support is optional and prompted upon new performance objectives or benchmark introductions during the designers' scenario training (Vogel-Walcutt et al., 2013; Franklin & Lee, 2014).

## Self-efficacy

The motivational influence of self-regulation works hand in hand with self-efficacy. Self-efficacy is how the learner perceives their own abilities when it comes to skill performance or meeting a learning goal (Schunk, 1990). Studies indicate that the level of self-efficacy a learner has when approaching performance-based skills impacts the amount of effort towards goal completion they set for themselves (Wood & Bandura, 1989; Rockstraw, 2006; Franklin & Lee, 2014). Rockstraw (2006) discusses the works of Tompson and Dass (2000) that said that when "a person's self-efficacy enhances or improves their task interest, persistence, ability and desire to exert effort, and in the end, task performance" (p. 4). He continues to acknowledge that self-efficacy is a perception from the learner of their own capabilities as Wood and Bandura (1989) confirm; not only reflecting their perceived abilities but also a motivational component as well. For this design consideration, this component is self-regulation that influences ongoing motivation. The combination of complex skills, simulations, and the level of self-efficacy as a self-regulated learning process can be a strong predicator in performance outcomes (Wood & Bandura, 1989; Kozlowski & DeShon, 2004; Rockstraw, 2006).

To ensure a level of skill is attained from the training program, an essential consideration is that there are varying levels of skill between designers. Consequently, there is a need in the instructional strategies to adjust the curriculum accordingly making it more adaptive to the learner (Bell & Kozlowski, 2002). The designers responsible for creating the training scenarios may have no prior knowledge or skill, a moderate amount, or be a subject matter expert already. The skills required to develop and execute the simulation scenario must be attained through the training model delivered by the simulation-based embedded training (SBET) as well as their own self-regulation to reach program completeness (Schunk, 1990; Issenberg et al., 1999). The literature review and research assist in the development of the instructional design considerations, which incorporates the cognitive influences necessary to complete program-defined objectives and a certain level of skill mastery.

Although the simulation creates an environment where high-fidelity context removes barriers that impede knowledge and skill acquisition, there must be a cognitive framework within the instructional strategy that leads to active learning, specifically for the designers (Kozlowski

& DeShon, 2004; Garrett, Macphee, & Jackson, 2010; Dunbar-Reid, Sinclair, & Hudson, 2011). This strategy is a key component of a learner-centered approach to instructional design which is based on the selection of instructional strategies that coincide with learner cognition in learning new material based on prior knowledge (Vogel-Walcutt, Fiorella, & Malone, 2013). There are many cognitive theories a majority of which are combined to make a well-rounded foundation for instructional strategies, especially in simulation-based training (SBT). A comparison of several of these principles was done to ensure the ones selected are appropriate for the design and promote effective instructional design.

The goal of the new training program is to examine if a scenario designer would be able to create an appropriate military simulation training scenario using embedded training aids in the simulator software (Franklin & Lee, 2014). This would be evidenced by comparing outcomes of those who received this new training program from the organization to those who received the New Equipment Training (NET) in the form of traditional lecture and review materials provided during the old training program (Grief, Becker, & Hildebrandt, 2015).

The design fit best with the social cognitive theory of self-regulation to implement the Simulation-Based Embedded Training (SBET). Bandura (1991) defines self-regulation as a cognitive theory that is heavily motivated and regulated by self-influence consisting of monitoring of the learner's own behavior, what determines the behavior, and what the effects of the behavior are. Since this theory is heavily supported by the learner's self-efficacy, it fits the program's desire to develop mastery skills in the simulation scenario designers. Bandura explains the cognitive impacts stating "…perceived self-efficacy contributes to the valuation of activities. People display enduring interest in activities at which they judge themselves to be self-efficacious and from which they derive satisfaction by mastering challenges (p. 258). This process is supported by the design, which includes persistent practice and skill-building based on the learner's current domain promoting skill mastery and maintained interest in the next goal (Bandura, 1991; Wood & Bandura, 1989; Kozlowski & DeShon, 2004).

The research reviewed provides a foundation for the organization's Simulation-Based Embedded Training (SBET) methodology, which examines the effectiveness of the program's design and implementation. The primary aim of this design is to present a new training program grounded in research and theory with applications of relevant instructional design principles and tools to provide to designers of simulation systems' scenarios for military intelligence soldiers. Comprehensive studies and systematic reviews showed improvements in trainee self-efficacy and skill performance on simulation trainers (Wood & Bandura, 1989; Issenberg et al., 1999; Wayne et al., 2006; Rockstraw, 2006; Vogel-Walcutt, Fiorells, & Malone, 2013; Franklin & Lee, 2014). Therefore, the proposed program supports an implementation method of SBET where training materials are embedded within the system and used in realistic scenarios as the instructional strategy in conjunction with the use of learner analytics to assist in performance evaluation (Proctor et al., 2011).

## The Design Using ADDIE

The Design phase of ADDIE uses instructional design strategies in the training program to enable goal completion as well as the methods and technologies used to deliver the materials (Peterson, 2003). The goal of the design strategy for the training is to combine instructional interventions with cognitive considerations for the designers to become proficient. The training program must also consider learner-centered principles of design and what their impact is on learning. The principles apply to all learners and become the foundation for determining methods for using and evaluating training programs (McCombs & Vakili, 2005).

During the Design phase of the ADDIE framework, developers transform the requirements generated during the analysis phase into specific design elements within the program being developed (Lidwell et al., 2015). Learner-centered design principles provide a framework to guide program reform and redesign to increase effectiveness and efficiency (McCombs & Vakili, 2005). Within the design phase an application of learner-centered principles was applied to the software's Simulation-Based Embedded Training (SBET). The instructional strategies discussed below benefit not only the program shareholders, but also Army soldiers as a community of experts. The list below shows the application of the design principles selected matched with the SBET instructional strategies with supporting research backgrounds. Only the requirements found to be pertinent for the design and implementation of the organization's training program were listed in the instructional strategy and media/instructional element selection plan. Also shown is the connection to the design principle considered after a literature review of research provided evidence to support each requirement. Table 3 summarizes the design principles used in the ADDIE design phase to develop and implement the SBET program with its' supported research.

Table 3: Design Principles and Instructional Strategies for SBET

| Design Principles | Instructional Strategies | Research Basis |
|---|---|---|
| The successful learner, over time and with support of instructional guidance, can create meaningful, coherent representations of knowledge.<br><br>The successful learner can link new information with existing knowledge in meaningful ways. | Embedded learning steps/activities and objective benchmarks in the user interface will be based on actual designer activities within the simulation system and the introductory knowledge provided during NET and with the Knowledge Base (web portal) training support materials.<br><br>Recognition over Recall | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.<br><br>The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals. | Practical exercises will be building their operational products on their actual system to be included in the Rapid Intelligence Scenario Generation repository and shared with their peers. | McCombs &<br><br>Vakili, 2005<br><br>Learner-Centered Psychological Principles |
| What and how much is learned is influenced by the learner's motivation.<br><br>Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control. | Guided learning within the embedded training will be automatic with novice learners and will promote them to advanced once all benchmark objectives have been met, once an advanced learner, their profile can prompt guidance and they are able to add content (scenarios) that they build into Rapid Intelligence Scenario Generation tool. | McCombs &<br><br>Vakili, 2005<br><br>Learner-Centered Psychological Principles |

| Design Principles | Instructional Strategies | Research Basis |
|---|---|---|
| Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely. | 24/7 accessibility and guided instruction provide persistent practice opportunities, enhance self-efficacy motivation and concentrated effort on training tasks/objectives<br><br>Accessibility, Hierarchy of Needs<br><br>Motivational/Affective | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| Learning is influenced by social interactions, interpersonal relations, and communication with others | Designers create scenarios and are provided immediate feedback on their assessment to then share the scenario via a social/peer repository (RISG) as well as providing insight and guidance via the Knowledge Base (web portal) to other designers world-wide and the program Subject Matter Experts<br><br>Feedback Loop, Gamification, Iteration<br><br>Developmental/Social | McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| Setting appropriately high and challenging standards and assessing the learner and learning progress-including diagnostic, process, and outcome assessment are integral parts of the learning process. | Learner analytics will capture the progress from novice to mastery-skilled within the UI between trainers and the simulation's interactions<br><br>Expectation Effects<br>Individual-Differences | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |

Enhancing self-efficacy with a system that provides embedded training techniques for continuous goal achievement, 24/7 accessibility to training in the realistic operating environment, immediate feedback, and learner sharing lends the conditions necessary for positive learning outcomes (Kluger & DeNisi, 1996; Motola et al., 2013). There are many conceptualized ideas of the definition of embedded training in military systems. According to the

Army Simulation, Training & Instrumentation Command's authors, Burmester, Stottler, and Hart (2005), embedded training provides effective training anytime, anywhere and must allow for training in a simulated operational environment where persistent practice of skills and application of knowledge can be achieved. The authors conclude the embedded training requirements with stating that the instructor is not normally available or present during the training and that the benefits of embedded training will require that training objectives be met and that the simulated scenarios would monitor the learner's progress (Burmester, Stottler, & Hart, 2005).

Embedded training system requirements have been previously researched in the military (Witmer & Knerr, 1996; Cheikes, Geier, Hyland, Linton, Riffe, Rodi, & Schaefer, 1998; Burmester, Stottler, & Hart, 2005). Once of the reasons why their implementation was rarely completed is that most operational (i.e., "go-to-war") systems would require a complete software and possible hardware install that would be expensive and time consuming. The Army struggles with its training opportunities due to the high deployment demands on their resources. The characteristics of an embedded training capability are listed in its early conception as a total training system that provides not only persistent practice opportunities but also provides initial skill acquisition as well as sustainment (Witmer & Knerr, 1996). According to the guidance provided by the Army, there are several advantages of embedded training: the training is fielded concurrently with the system, refresher and sustainment training already exist on the system upon deployment, training is standardized across all units, and is potentially cost effective due to the high price of live training (Witmer & Knerr, 1996).

The integration of embedded training technologies within the simulation system will enhance the self-regulation in the simulation designers. Since self-regulation is a cognitive strategy that corresponds with a level of skill and ability to learn complex tasks, iterative practice will enhance the self-efficacy of the learner and enable mastery of the skills desired. With an embedded training solution, practice would be available to the learner whenever they needed it and would provide complex situations where they could practice without having a negative effect on any real work that may be done on the system (Kozlowski, Toney, Mullins, Weissbein, Brown, & Bell, 2001; Slotte & Herbert, 2008). Self-regulation in this context would be the ability of the learner to assess their skill from their objective and push their attention and effort towards their goal completion in each objective (Kozlowski et al., 2001).

The SBET program also provides the designer with the ability to assess his/her own skill from their objective and maintain their engagement causing them to strive for more complex training situations eventually reaching their goals (Kozlowski et al., 2001).

The operational system that is in place now produces training for soldiers in the form of simulated data. Systems that produce simulated scenario data musts meet the same requirements for what constitutes embedded training (Cheikes et al., 1998; Witmer & Knerr, 1996; Burmester et al., 2005). Cheikes et al. (1998) provide a visual representation of a study conducted on a military intelligence software application where the training strategy was to incorporate embedded training on the application instead of developing a costly simulator as seen in Figure 1. This figure shows the process of the ability to conduct operational tasks on the system as well as the ability to conduct training on the same system without the logistical and timely complications of finding opportunities for practice and/or formal instruction (Cheikes et al., 1998).

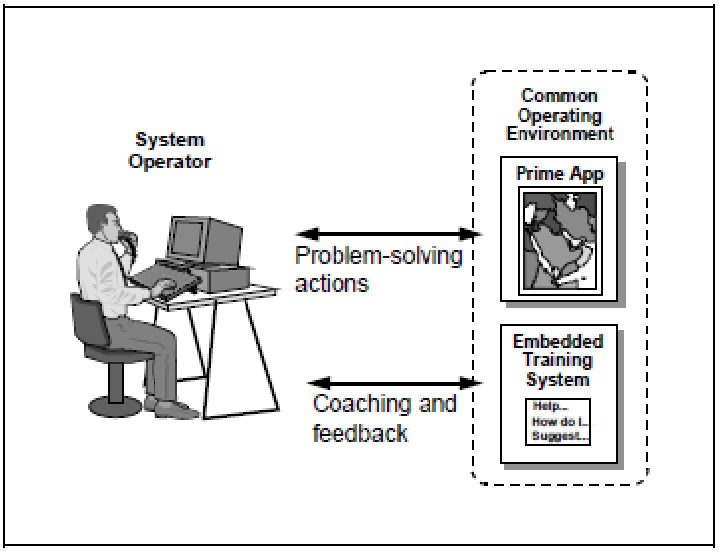


Figure 1: Embedded training process
Source: Cheikes et al. (1998)

Context-Specific Instruction

Research supports the use of context-specific training embedded in a system as an approach to mastery skill acquisition as well as an effective training solution that can overcome challenges involved with mastery skill attainment (Wu, Hwang, Su, & Huang, 2012). Context-specific (i.e., context-aware) instruction embedded in software has been used in many learning strategies across multiple industries. The goal is to find the best delivery of instruction and help at the "point-of-need" assisting the learner in immediately locating the information to acquire the knowledge or skill necessary to complete their training or operational objectives (Kimok & Heller-Ross, 2008; Hong, Suh, & Kim, 2009). "Point-of-need" refers to the ability of a user to access information at the exact time they need it (Hong, Suh, & Kim, 2009). With the rise in mobile technology, context-specific information is available to use at the point-of-need making the user experience more value by giving them information that is relevant and timely (Walsh, 2010; Wu, Hwang, Su, & Huang, 2012). In the same use of point-of-need information, videos have also been used to link context-appropriate information to the information being sought after by the user (Walsh, 2010). This is important for this program's instructional design strategy as videos will be part of the supporting training materials to the embedded training.

In Walsh's (2010) study on the use of point-of-need information for learners, the university library conducted a pilot study where they used Quick Response codes around the library that link to resources and information appropriate to subject areas. Like the simulator's previous training solution, informational videos were created and used as training materials although their users much like the simulator's designers were unaware of their availability and did not use them as designed. The library linked the videos to specific Quick Response codes so that at any point the users needed additional information, all they had to do was scan the Quick Response code and the video would be provided via a link to the video repository (Walsh, 2010). These videos provided information skills to users when and where it was needed, which is the premise behind point-of-need information as an instructional intervention. During their pilot, they encountered an issue with being able to track usage since none of their interventions tracked information on whether the videos or embedded training resources were used or if there was an assessment of their reliability (Walsh, 2010). The barriers seen described in the library's pilot were considered in the design of this program. Not only was utilization not tracked, but this pilot did not take into consideration the users' motivation to access the library's training materials while showing no clear benefits to the users. The ability to motivate and track utilization in the scenario designers help ensure a well-rounded training design for evaluating the effectiveness of the organization's Simulation-Based Embedded Training (SBET) strategy.

Research expanding on the concept of context-aware technology has studied the development of a learning environment where the inexperienced learners are guided to practice a skill with step-by-step guidance and feedback (Wu, Hwang, Su, & Huang, 2012). Guiding the scenario designers to practice their skills based on their objectives has fundamental impact on cognition, such as self-regulation and efficacy when practiced continually (Bandura, 1991; Karoly, 1993; Wu, Hwang, Su, & Huang, 2012). Mastery learning is an organizational goal for the simulator program. It is difficult to obtain when relying on one-on-one instruction between the Subject Matter Expert trainer and the designer with enough time and access to practice the skill to be proficient to the mastery level.

To overcome the challenge of distributed designers in the organization and throughout the world, the program is moving the designers' system and its' SBET to a cloud-based infrastructure. This enables the program to have Subject Matter Expert trainers and designers virtually present on the simulator applications that concurrently monitor, assist, and assess designer interactions with immediate feedback provided by the software (Kluger & DeNisi, 1996). This distributed training solution allows for designers to engage in complex, scenario-based learning to advance their knowledge and skill acquisition and to develop the more coveted adaptive skills necessary to design their own simulation scenarios (Fujimoto, 2001; Wu, Hwang, Su, & Huang, 2012). SBET through its' design considerations enables scenario designers to be proficient.

## Design Methods

This design's methodology promotes cognitive processing, effective learning strategies, and positive training outcomes. Research in training strategies or program implementation plans is based on a singular instructional design model with specific instructional tools and techniques common to the model. The following instructional design considerations were applied to the Simulation-Based Embedded Training (SBET) model:

- Simulation is in high demand in military training for its ability to effectively teach cognitive performance skills (Burmester, Stottler, & Hart, 2005).
- Simulation training provides a safe, controlled environment, with persistent opportunities for practice (Kluger & DeNisi, 1996).
- Persistent practice on simulation-based trainers enables mastery-skilled performance and retention (Motola et al., 2013).
- Embedded, guided learning based on the learner's prior knowledge proves to be superior to traditional training methods (Vogel-Walcutt et al., 2013).
- Immediate and deliberate feedback is critical to the effectiveness of the simulation-based training (McCombs & Vakili, 2005).
- Evaluation of the training program is critical to embed training improvements and system usability as well as the ability to assess learning outcomes without having to use traditional observational techniques (Chen et al., 2012).

Research-Based Solutions

There are several ways to incorporate the theoretical and research-based solutions discussed above. This solution uses experience within the organization's Subject Matter Expert trainers and our understanding of the requirements from the government shareholder as the knowledge foundation for our SBET program. The ability for the scenario designers to practice their skills on their simulation systems enables experiential learning (Alinier et al., 2006; Dunbar-Reid, Sinclair, & Hudson, 2011). According to a study conducted on undergraduate nursing students using a pretest/post-test experiment, a comparative analysis of the results, (indicated in Figure 2), showed significance that students in the experimental group received higher grades than those in the control group (Alinier et al., 2006). In the study, the experimental group was exposed to simulation training integrated into their normal curriculum and increased their post-test scores over the control group using the normal curriculum with no simulation training. The significance of this study for this design is that it provides quantitative evidence of a positive impact of simulation-based training as a tool for training complex, dynamic skills. The adult learner is evaluated on their ability to perform objective tasks in an operational or real-world situation using a high-fidelity simulation (Alinier et al., 2006; Garrett, Macphee, & Jackson, 2010).

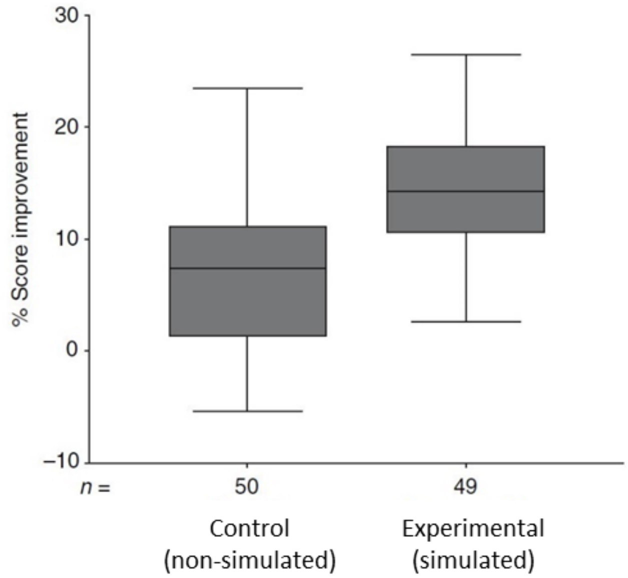


Figure 2: Students' score improvement using SBT
Source: Alinier et al. (2006)

A review of research on knowledge and skill improvement using high-fidelity SBT showed effectiveness or positive performance outcomes were only moderate when using SBT (Yuan, Williams, Fang, & Ye, 2011; Dunbar-Reid et al., 2011). When compared to traditional methods of training (e.g., lecture, Web-based, videos), SBT has shown evidence of enhancing user's procedural performance, most likely since the complexity of many operational procedures is not fully comprehended without experience performing those procedures (Raymond et al., 2007; Lammers et al., 2008). Figure 3 shows the comparative analysis of demonstration and lecture (Phase 1), Web-based (Phase 2), simulation (Phase 3), and videos (Phase 4) as methods of training. Phase Three demonstrates a significant, positive performance outcome when using Simulation-Based Training.

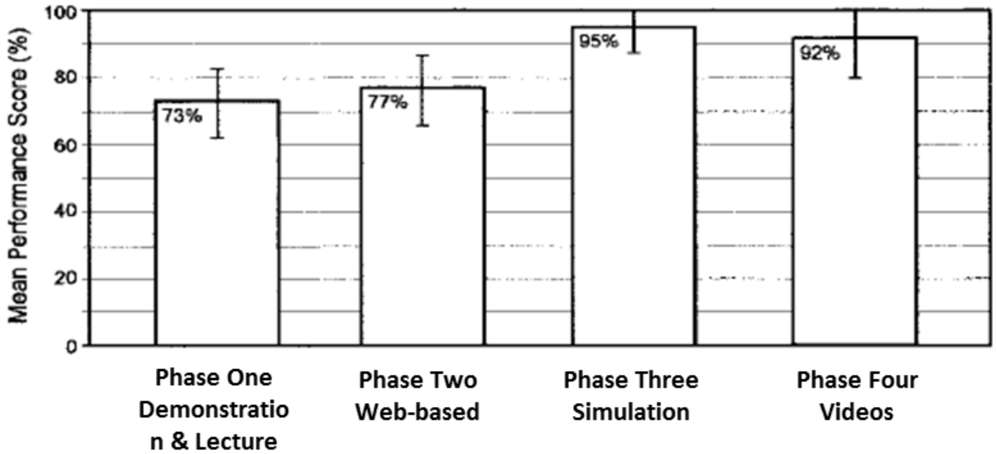


Figure 3: Simulation-Based Training (Phase Three) comparison to traditional methods
Source: Raymond et al. (2007)

This comparison of traditional methods to simulation supports the idea that learners retain and transfer knowledge through activities that require active participation resulting in increased retention (Devitt, Kurrek, Cohen, & Cleave-Hogg, 2001; Kneebone, Scott, Darzi, & Horrocks, 2004; Alinier et al., 2006; Raymond et al., 2007).

Solutions incorporated into New Equipment Training (NET)

The development of the training program's New Equipment Training (NET) is with the use of a social cognitive theory of self-regulation framework. SBET provides multiple learning platforms, simulations, problem-based learning and accessibility for all designers. Essential to the knowledge transfer in designers and integral to the model is a supporting subject matter expert (SME) trainer available to facilitate instruction during all NET events at the fielded location. This directly supports the research where direct instructional support is necessary for novice learners, especially during a NET where they are completely unfamiliar with the system or its capabilities (Vogel-Walcutt et al., 2013). As the designers build on their expertise, their goals will become more complex and will foster a desire to obtain mastery skills on the system (Kozlowski & Deshon, 2004; Rockstraw, 2006). Once the designer has hit the automatic benchmarks (i.e., objectives) in the system and has been prompted with practical exercises, for their performance assessment, he/she will be promoted to an advanced user. Once the designer is an advanced user, upon login they will be notified that they have been promoted and the once automatic instructional support is now optional and prompted upon new performance objectives or benchmark introductions during the designers' training they have not yet experienced; most likely this will be in new software releases where new capabilities will need to be learned. This process is made possible by software that allows developers to mark specific buttons within the graphical user interface (GUI) or a combination of buttons to track in what order and to what extend the user has interacted with the software. This is a portion of what User Analytics software can do and allows the Subject Matter Expert trainers to see, remotely via the web, what objectives have been accomplished during their self-regulated training interactions.

## Guided Learning

After NET, Simulation-Based Embedded Training (SBET) resides within the simulation system to assist in directed guidance and instruction for the novice designers. SBET also provides a sustainment of skills through practice and a variety of instructional support materials to accommodate all learners' proficiency levels. We approach NET, new capability training and skill sustainment with the consideration and understanding that current designers lack enough previous design knowledge necessary to use their simulation system during an exercise. As a design principle, SBET considers limited prior knowledge and allows for training interactions to build upon the level of knowledge in designers (Vogel-Walcutt et al., 2013).

The designers' tasks are augmented with software-embedded technologies: help overlays, automated comprehensive practical exercises, automated assessments, and a cloud-enabled or exported standalone repository of self-paced Interactive Multimedia Instruction, video tutorials, and training support materials (e.g., tech pubs, manuals, job aids, etc.).

The guided learning help overlays and practical exercise assessments embedded in the software user interfaces, enable training to different levels of designer experience (i.e., leveled learning) (Salas et al., 1998). A new or novice designer is first oriented to the simulation system capabilities with:

- A beginner-level login with context sensitive help overlays
- Automated help overlay prompts with learning steps to complete each task
- Interactive Multimedia Instruction (IMI) links within benchmark tasks
- Linked Military Intelligence (MI) resources providing domain knowledge and application steps for all scenario design tasks.
- Automated practical exercises that are spontaneously presented to the designer once a TLO benchmark has been reached
- Immediate feedback on all objective tasks and the scenario-based performance assessment.

Beginner-level designers complete the learning tasks, automated practical exercises, and automated assessments. They are directed to create a complete set of reusable scenarios in the simulation system as their capstone exercise. In this capstone, designers are assessed on their ability to produce exercise-relevant data and products necessary to execute their tasks necessary for designing military intelligence simulation system-enabled scenarios (Damewood, 2016).

The literature revealed that to effectively engage the learners' domains, a highly realistic learning situation must be provided (Damewood, 2016). Once the beginner-level capstone event is complete, the designer is dynamically upgraded to an advanced-level login with no objective-based tasks or automated help overlay prompts. At this point, this designer is now a regular day-to-day user. An advanced user will still be able to access the New Equipment Training (NET) materials by activating specific help sections based on their need. This meets the program's goal of minimizing reach-back support from the designers to the subject matter experts by increasing mastery skills in the scenario designers (Shannon, 2003).

The expectation is that the designers will retain and transfer knowledge through the practice opportunities presented to them via the training program's design and embedded training assets that allow for increased retention each time (Devitt, Kurrek, Cohen, & Cleave-Hogg, 2001; Kneebone, Scott, Darzi, & Horrocks, 2004; Alinier et al., 2006; Raymond et al., 2007; Gunter, Kenny, & Junkin, 2018). Figure 4 provides a visual representation of how the design considerations were incorporated into the training development for the designers. The figure describes each phase of the training program as it pertains to the type of instructional strategy incorporated into the design as well as the benefits of the strategy. The first phase of the training program is NET or New Equipment Training where the designers, indicated as I/Os in the figure, are provided self-paced embedded help overlays for a guided training technique using a realistic scenario. After NET, the designers would apply the same realism received during their scenario-driven instruction with SBET to the military intelligence simulation scenarios they develop during their practical exercises on the system. The cloud platform is the accessibility to the Knowledge Base (web portal) that provides a repository of all of the training materials as well as the simulation software where designers develop the scenarios. The development of the scenario during the training program is used to assess the designers' performance on the simulation system. Once the training program has been delivered, the designers are assisted during their military exercises by the subject matter experts and embedded help overlays in the system's software. The final phase of the training program, also seen in Figure 4, is the evaluation of the user and the program through the use of User Analytics providing qualitative data on performance and usability of the system by the designers.

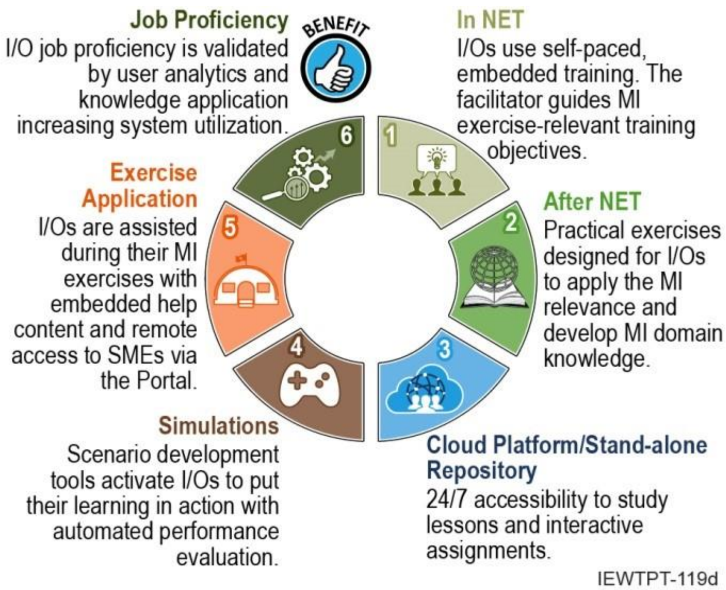


Figure 4: Designer training program

This figure best summarizes the Design of the training program for the organization. Designers are provided with New Equipment Training (NET) using Simulation-Based Embedded Training (SBET) as their training method. The training is accessed in the cloud via a web portal called the Knowledge Base. Based on the research, SBET is an effective training solution for the complex skill and performance objectives expected of the designers of the simulation scenarios. Chapter three discusses how to implement this design using the appropriate instructional strategy as well as the evaluation of the designers and their training program.

## Development: Instructional Design Considerations

The research on cognitive theory, as it pertains to instructional design considerations, is also important to understand. Cognitive processes impact the proper design of the training program moving from a singular, instructional model- and technology-based approach to a learner-centered approach. This learner-centered approach is based on the ideology that integrating instructional strategies consistent with cognitive theory into a training program enables skill mastery and positive learning outcomes (Vogel-Walcutt et al., 2013). Although there is research that validates the use of cognitive theories to drive the selection of instructional strategies, the contracting companies developing systems of this nature are often not designing them accordingly (Vogel-Walcutt et al., 2013). These developers are hastily designing simulation systems due to high demand. However, there is a lack of instructional design and cognitive considerations, which results in minimally guided approaches that do not promote effective or efficient training (Vogel-Walcutt et al., 2013).

Instructional design encompasses the front-end analysis of knowledge and performance problems in learning, in the design and development of the training, in the implementation of the program, and in the evaluation of the effectiveness of the overall training program (Reiser, 2001). For instructional designers, this means they must generate a plan based on the considerations found, to result in a transfer of knowledge for the user from the training to the real-world (Salas et al., 2008). This process, along with the requirements set forth by the shareholder determined the training strategy for the program. There are many benefits to simulation technology, but instructional design compared to traditional lecture focuses its use in improving technical skills and retention of knowledge by addressing proficiency through deliberate practice (Issenberg et al., 1999).

In this adaptive and technology-driven industry there is a need to validate instructional design approaches and models appropriate to the fidelity of the technology and the learning outcomes desired. During development of the guided instruction within the SBET, schema theory is applied with the use of scenarios as the embedded guided instruction to assist the designers in thinking about the information provided to them in terms of repetitive tasks which group information into relatable categories for later recognition (Gunter, Kenny, & Junkin, 2018). The use of scenarios as the instructional tool creates a framework that allows the designers to receive mimicked aspects of their real-world tasks and transform it through perception, collection, and organization as established by the cognitive schema theory into new knowledge or skills (Gunter, Kenny, & Junkin, 2018). Scenarios are a fundamental aspect of how a cognitive schema assists in attaining the desired training outcomes especially in such a demanding and dynamic industry like military intelligence:

> Schemata can help in understanding the world even in rapidly changing environments. People can often organize new perceptions into schemata if those situations do not require too complex of a thought process. Even the more complex situations can be quickly internalized when using schema, once thought becomes more automatic through repetition (p. 106)

The use of realistic training scenarios provide the repetition and organization of provided information using the embedded guided instruction to step the designers through their performance tasks without too complex of a thought process. Therefore the use of scenarios to enable schemata in the designers was selected as the most reliable instructional design strategy, founded by research, to be used during the development phase of ADDIE for this training program design.

# CHAPTER THREE: MODEL IMPLEMENTATION, ANALYSIS, AND EXPECTED OUTCOMES

The implementation plan is imperative for the successful deployment of this training program design. As one of the instructional design model (i.e., ADDIE) phases, an implementation plan must consist of specific factors that incorporate the design methodology and principles for supporting effectiveness and efficiency as the organization's goal. This chapter will discuss how the design is to be implemented and then evaluated for its' effectiveness. High-fidelity simulation requires remaining congruent with the latest technologies producing a long-term cost savings for the government. However, the implementation plan can be generalized to simulation programs throughout the military that are tasked with training scenario designers on how to generate simulation scenarios. It is a complicated and often compromising relationship between a government contracting company such as this organization and the government program office that contractually restricts them in their solution set. This should be considered when piloting this design and implementation plan due to the mandated requirements, which have implications in design choices and implementation options. Although the requirements were applicable to the needs of the program, it left little variability in expanding evaluation options and perhaps impacted the design effectiveness by using only the requirements provided as the guiding strategy.

Once the needs, requirements, design principles, and technologies are determined in the Analysis phase the program is developed using the results of the analysis. Once the implementation methodology is introduced as the next phase in the ADDIE model, developers must focus on what type of implementation theory or framework they will use.

The aim of the theoretical approach of this design's implementation plan is to describe the process of transferring the research-based foundation for instructional design into a process methodology. It is also meant to explain what instructional techniques and technologies promote positive implementation outcomes. Finally, it aims to evaluate the implementation of the program through an evidence-based evaluation framework. To develop a successful implementation plan, developers have increased their use of theories, models and frameworks in multidisciplinary industries. It was determined that the social cognitive theory of self-regulation, made famous by Bandura (1991) and decision-making considerations will act as the evidence-based solution for the implementation of the Simulation-Based Embedded Training (SBET) program.

## Program Intent

The organization's training methodology is Simulation Training plus Evaluation results in Performance (STEP). The STEP concept is conceived from the knowledge that using simulation systems for military training is a current requirement for many programs, is effective in its use within complex systems, and will continue to increase in use as software and technologies offer more realistic, safer training environments for military personnel (Weaver et al., 2010; Motola et al., 2013). However, the concept must also match the cost benefit approach of military organizations who want effectiveness with efficiency at a cost advantage. Figure 5 shows a visual representation of the organizations' STEP training methodology, which will drive the development of the design methodology detailed in the previous chapter. In the figure, Interactive Multimedia Instruction (IMI) is combined with military intelligence content as embedded information and training content within the simulation system. All of this training content is provided to the designer via New Equipment Training (NET) instruction, guided help overlays in the software application in the form of realistic scenario events, and all at the point-of-need in the Knowledge Base (web portal). Once the training content has been developed and provided to the designers, the evaluation is occurring throughout all of the interactions with the system using User Analytics. With the combination of the system training strategies and the evaluation techniques the goal is for maximum performance from the designers. Figure 5 summarizes this STEP concept for this organization and is a product of this dissertation in practice.

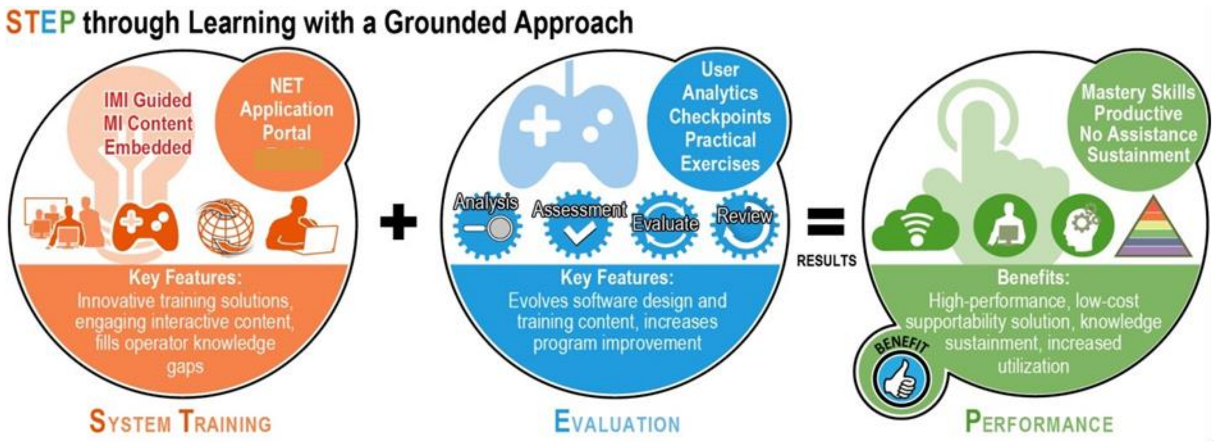


Figure 5: STEP training methodology

As the contractor, the organization's simulation system's capability must be accompanied by a training program that applies this approach and engages scenario designers for successful completion of simulation-enabled exercises that mimic real-world, combat scenarios (Page & Smith, 1998; Bradley, 2006; Cristancho et al., 2011). With little to no knowledge of the system's capabilities or what the designers need to know to create these realistic, operational-like environments, the result could be negative training. This match is best defined by its problem-based relevance, learner-centered interactivity, and overall practical application of skills while performing the learning tasks on the actual system itself (Salas et al., 1998).

As stated in the design and implementation plan, the government defines effectiveness of the program as the ability of the scenario designers to acquire knowledge and performance skill to a level six or a Creating level of proficiency in Bloom's revised taxonomy (Anderson & Krathwohl, 2001). The training program design is expected to achieve this skill mastery for all scenario designers through its use of embedded training technologies. The scenario designers benefit from the incorporation of the embedded training by using it during all operational tasks, not only in their training tasks but during the simulation scenario development they are required to complete for exercise events.

To determine the effectiveness of Simulation-Based Embedded Training (SBET), the analytical data from learner analytics will be used to evaluate the interactions and behaviors of the scenario designers and report back that information for usability and design updates. The organization's STEP approach to the development of the training program results in enhanced self-regulatory processes within the designers and increased motivation through self-efficacy (Wood & Bandura, 1989; Kozlowski & DeShon, 2004; Rockstraw, 2006). The SBET solution improves system utilization and performance outcomes as a whole-package solution. For the shareholders, the solution supports the ideology within the military simulations industry that as skill mastery is attained supportability costs decrease from the program's contractor, thus, enhancing efficiency.

Due to the increasing demand on the Subject Matter Experts to continually train the designers; their availability to the software engineers was diminished leading to a decrease in newly developed system capabilities. Through successful completion of mastery skills by the scenario designers, the anticipated change in the structure of training is that the subject matter expert trainers would no longer be required to assist the designers in the field. This would allow for an increase in their availability to the program's software development team to increase the capabilities of the simulation system.

## Implementation Plan

Implementation science is a field that investigates implementation theories and frameworks to ensure successful implementation of a program. The government defines effectiveness of the training program in its requirements (see Appendix A for the complete list) as the ability to acquire knowledge and performance to a level three, Applying, proficiency in Bloom's revised taxonomy (Anderson & Krathwohl, 2001). Although the government requirement is assessed at a level three proficiency within the taxonomy, our design has the ability to generate mastery skills and support a level six, Creating, as the learning outcome for the scenario designers (Anderson & Krathwohl, 2001). This is determined by the learner-centered and cognitive theory approach taken when designing and implementing instructional strategies (see Table 3 for the supporting evidence) that enable skill mastery (Vogel-Walcutt et al., 2013). By using embedded training technologies in the system, without the constant support of a subject matter expert, the designers become more efficient, saving the government money on the training footprint and alleviating the need for multiple retraining events (Witmer & Knerr, 1996; Motola et al., 2013). The ability to determine whether the SBET program was effective, analytical data from learner analytics will be used to better evaluate the interactions and behaviors of the designers without the inconsistency in data from traditional quantitative evaluation methods (e.g., self-report, pre-/post-test, observation) (Chen et al., 2012; Luo et al., 2014). In order to ensure a more effective training program, integrating cognitive theory through instructional techniques is required. By using this as the foundation for the implementation plan, the scenario designers should alter their behavior in their learning towards achievement and goal setting.

### Training Delivery to Designers

The training delivery approach is to train scenario designers as the Army trains their soldiers, with adaptability as the goal. The designers should be connected, on their system, and provided the flexibility to learn from multiple methods and in various forms enhancing adaptability and learning needs of the designers. Since the design's solution attains this goal, the designers will have increased proficiency enabling a significant drop in their need for Subject Matter Experts' support. The goal of Simulation-Based Training (SBT) is enabling trainees to succeed at their operational tasks by assisting in the acquisition and refinement of technical and cognitive skills making them adaptive in their practice/training (Cristancho et al., 2011).

The training delivery is a combination of a New Equipment Training (NET) instruction to provide goals/objectives and program conceptualization to novice scenario designers as well as the opportunity to collect Pre-test data from new designers. The training program design and development approach is based on multimedia design principles for training high-fidelity, simulation systems using leveled learning for designers' varying level of prior knowledge (Vogel-Walcutt et al., 2013). By incorporating embedded training content into the designers' simulation software, training products are available at the point-of-need, thus, filling gaps in their domain knowledge with comprehensive, interactive content (Proctor et al., 2011). This content is based on each scenario designer's interactions with the simulation system's capabilities. It is validated through monitoring designer activity with learner analytics, and is supplemented by linked interactive products in the system's web-based training page (Mattingly et al., 2012). This monitored data captures designer interactions with the software, objective completion progress, practical exercise opportunities taken, and assessment of performance skills with the software user interfaces and embedded training content. The analytic reports are pushed via the cloud to the organization's training department for analysis by Subject Matter Experts and the instructional design team for evaluation of the designers' skill accomplishments and performance outcomes.

The training materials themselves are inherent to the system, accessible through the training webpage. Each of the ADDIE model tasks are based on the feedback from Subject Matter Experts who support scenario design events and the incorporation of the scenarios during exercises in the field. Throughout the government's military simulation industry, there is rarely the time and funding to conduct full front-end analysis for program development. This is an implication that impacts the program with the lack of content, learner, and task analysis. The organization in this problem of practice relies heavily on the teams of Subject Matter Experts to represent the end-users for design tasks to overcome this challenge. Most of this front-end analysis was not conducted for the new Simulation-Based Embedded Training (SBET) program.

However, with Subject Matter Experts who conduct the same operational tasks as the designers would allow for the development of the pertinent information that would be derived from such analytical data. The ability to quickly and concisely develop the information produced during the Analysis phase internally helped minimize time and cost for the training program design and implementation. The developed training products are then validated using the Subject Matter Experts and government shareholders verifying that all necessary learning objectives match government requirements and are not only addressed but also productive.

The expertise to achieve the outcome will be a minimum of one month design experience and little to no simulation experience. The contractual agreement with the designers' contracting company will include a Statement of Work that dictates the final minimum requirements set forth by the government. To train the new designers to a level of efficiency to successfully create an exercise simulation scenario is one week of New Equipment Training (NET) by a Subject Matter Expert with the system-embedded training content as a follow-up solution until the designer is trained to proficiency. This proficiency will then be captured using learner analytics and be reported back for incorporation into the simulation system's usability design and training content.

### Intervention and Re-training

Any designer requiring intervention and re-training will access the Knowledge Base (Web Portal) and be automatically provided with performance steps to re-train skills that were performed unsuccessfully based on missed performance steps or incorrect order of steps. The designer will repeat a Capstone exercise, which is a final summative performance assessment. If intervention is still necessary, the designer will be asked to allow a Subject Matter Expert to remotely access their simulation system through the Knowledge Base and communicate the performance tasks again via the Portal's chat function. In an effort to afford the designer with multiple intervention methods, a final re-training opportunity is available as "on-demand" training. This training is conducted by a Subject Matter Expert at the designer's location using their simulation system. The Subject Matter Expert uses the User Analytic reports from the latest Capstone performed by the designer. With this report, the Subject Matter Expert puts together an individual-centered instructor-led product to address the specific gaps in the designer's performance. This is the final intervention or re-training opportunity for the designer.

## New Capability Training

All designer logins are provided with automated help overlays and context sensitive pop-ups on new capabilities released in the software. Automated performance assessments and feedback to each designer upon receipt of the new capability ensures proficiency. A video tour and tutorial of the capability, as well as any new relevant content resides as new information within the training program's website as a Wiki or IMI. Whether during this training or the designers' exploration of new capabilities, Subject Matter Experts are available via live help in the website to answer any questions or concerns about the function or usability of the new capability or the simulation system as a whole. This immediate assistance provides the guided learning necessary for novice learners (Vogel-Walcutt et al., 2013; Franklin & Lee, 2014).

Training's Knowledge Base (web portal)

Upon completion of a designer New Equipment Training (NET) event, the program would provide a cloud-based (i.e., webpage or web portal) technology that sustains skills via on-demand training accessed through the program's Web Portal where designers "Jump-In and Train" in validated, ongoing, recurring exercises. It is a comprehensive training knowledge portal with training tracked in the military's Learning Management System (LMS). This would also be the entry point for the program's scenario designers to practice their skills using the embedded training and practical application by generating the scenarios that would be running in the portal. The goal of the organization is to eliminate unnecessary instruction via Subject Matter Expert support requests and system retraining. The supplemental, interactive training opportunities within the portal support maximum efficiency which provides a shift from resource-intensive classroom training to point-of-need facilitation and remote sustainment (i.e., disbursed learning) (Luo et al., 2014).

The ability for scenario designers to access the training portal at any time provides them with not only the practice they need to meet performance goals but it also means that the designers can stay current on simulation processes, scenario design objectives and updated system capabilities. The training portal provides a "crowd-sourcing" Wiki essential for both 24/7 access to knowledge and access to live assistance/technical support to ensure learner needs are met (Bradley, 2006; Weaver et al., 2010).

## Evaluation Plan

The most commonly known application of learner analytics software is commercially in products such as Google Analytics. This software tracks users to provide information back to the commercial companies to assist in marketing, user interface fixes, capability development, etc. Data analytics are becoming a significantly popular solution for business and academic industries as one of the top trends as reported in software and technical publications (Chen, Chiang, & Storey, 2012; Mattingly, Rice, & Berge, 2012). The most common usages of the data produced from learner analytics software is its ability to track all the user's activities and provide their browsing and utilization patterns on whatever website or application they are operating (Chen, et al., 2012). Although finding research on the effectiveness of its application in commercial business is more abundant, such as internet and social media sites for product placement and sponsor ads, it has grown very little in its implementation into training software and remains in its infant state in its applications for training. Chen et al. (2012) list some of the benefits of learner analytics: sensor-based content, information retrieval and extraction, statistical analysis, person-centered and context-relevant analysis, and predictive modeling and data mining. These characteristics provide a quick glimpse into the breadth and depth of learner analytics as a software solution to provide instructional designers, software engineers, and organizations with an overwhelming amount of data on the user. In the context of this program design the ability to provide more evaluation and assessment opportunities than traditional observational methods used in the previous training program will allow for a higher chance of immediate feedback and intervention (Chen et al., 2012; Mattingly, Rice, & Berge, 2012).

Higher education has also begun incorporating the use of learner analytics (i.e., user and academic analytics) to predict learner outcomes. This is accomplished by identifying what is learned by the measurement, collection, analysis, and reporting of how the students interact with technology, for example (Mattingly et al., 2012). The incorporation of learner analytics has added efficiency to observing many of the difficult tasks of evaluating training outcomes. Specifically, the results of interactions between the learner, instructors, other learners, and the content or course materials all while capturing behaviors within the applications that enable completion of learning objectives (Mattingly et al., 2012). Typically, especially in simulation systems for teaching complex skills as seen by the limited amount of quantitative data on its effectiveness, most evaluations are qualitative in nature and self-reported resulting in data that can be biased, incomplete, and delayed (Mattingly et al., 2012). Mattingly et al. (2012) explains the impact of learner analytics on course evaluation by saying:

> …the amount of data available about these interactions delivers opportunities to examine, analyze, design, and deliver materials that can be used to make predictions about course and program effectiveness that respond to changing demands from students, instructors, and the administration. This is particularly true… where most interactions are facilitated and mediated using computer-assisted technologies… where data about these interactions can be captured about when, with whom, and with which content learners are engaging (p. 237)

The challenges to be overcome by the use of learner analytics in higher education are the same challenges considered in this problem of practice for the design and implementation of such an evaluation capability. Once all of the training content, embedded training, and distributed learning have been implemented, it would be unknown how the designers interact with the new SBET without the use of learner analytics. With the incorporation of learner analytics, the simulation training program will most likely not experience the evaluation challenges seen in other industries forced to collect data through traditional methods providing a positive effect on the ability to gauge the effectiveness of the program's implementation (Luo, Liu, Kuo, & Yuan, 2014). The connection of the program's learner analytics to the Army's Learning Management System would lead to other organizations within the government simulation industry to deploy similar training solutions. Software capable of predicting user interactions, recording past actions, and the use of statistical techniques to improve teaching, learning and user success on these complex systems much like the organization in this dissertation's problem of practice (Mattingly et al., 2012).

To provide the organization with the quantitative data necessary to assess the designers' performance outcomes, while conducting their tasks in the system's operational mode, the assessment protocol is applied to any scenario design task taking place. This enables the collection of analytical data during real-world operations and provides data back to the organization on whether the designers are performing at the expected performance level. Training completion is assessed by the system automatically. A new designer will be provided a beginner user account on the system until the advanced-level learner is accomplished via completion of benchmarks and building scenarios. The incorporation of automatically collected quantitative data is necessary for successful evaluation of a program, especially a complex, high-fidelity system (Chen, Chiang, & Storey, 2012).

Qualitative data is collected during the New Equipment Training (NET) event using self-report surveys for all of the designers to provide back to the organization's Subject Matter Expert trainers for comparison to the post-test data. Appendix D provides the documentation on the evaluation of the SBET program during its' NET event. This data is then combined with the automatically-generated quantitative data for a complete, valid, and effective evaluation of the training program.

## Performance Evaluation of the Designers

To ensure proficiency, evaluations must be conducted in a continuous loop as new capabilities, new designers, and new requirements for supporting the organization's simulation system are released (Mattingly et al., 2012). To reduce costs, evaluations are typically self-reported or observational. Neither of these methods provides valid system usability metrics without the possible introduction of bias or lack of sufficient data (Luo et al., 2014). Therefore, the organization will incorporate learner analytics (i.e., commercial User Analytics) capture software, the latest in evaluation technology, for tracking user interactions in the simulation system's software (Chen et al., 2012; Mattingly et al., 2012).

User Analytics software provides an automated monitoring and reporting capability that gathers defined metrics on designers and learners in a way that makes sense for the simulation program. This allows evaluation of the performance of all designers without the expense of the organization's Subject Matter Experts' support via observation or one-to-one training (Chen et al., 2012; Luo et al., 2014).

In this design's Evaluation phase of the ADDIE model, data analytics and reporting are segmented and filtered to reflect evaluation needs. This occurs with real-time views of which content is most popular (a usability factor), how much usage is coming from the designers, and which tools draw the best results in performance (Mattingly et al., 2012). The organization is focused on designers' task completion and what tools and training products within the operating system are used the least. This information drives User Interface and training content improvements as well as what tools are being used the most without the automated assistance which provides proficiency data on each designer. Per-designer, tracking provides insight into skill retention and allows for focus of efforts on deficiencies. Once identified, the organization can provide immediate support or coaching to the designers that are found to be struggling with goal completion. By doing this, the program earns more high-value, loyal designers increasing system utilization without the manual labor and cost associated with reach-back support. Reach-back support is the field support provided by the organization's subject matter expert trainers to the designers to assist them in creating their simulation exercises. Not only does it help the program maintain funding but it manifests efficacy in the simulation designers beyond what traditional, time constrained training provides to them in the current program (Chen et al., 2012; Mattingly et al., 2012; Luo et al., 2014).

To optimize the Knowledge Base (web portal) capabilities, User Interfaces, and their training support knowledge of how designers utilize the simulation system is needed. With the incorporation of this evaluation software, automated analysis improves how designers interact with each page of the Knowledge Base (web portal), User Interfaces in the application, etc. assessing and ensuring proficiency (Mattingly et al., 2012). This methodology provides the organization with the knowledge of what designers are really looking for, spot any missed opportunities, and speed up time to develop and implement any needed improvements to the simulation. The organization's subject matter expert training team receives the automated reports from the system and reaches out to designers offering supplemental training options and coaching. Figure 6 shows a visual representation of how User Analytics assists in evaluation and training improvement for this problem of practice and is a product of the process.

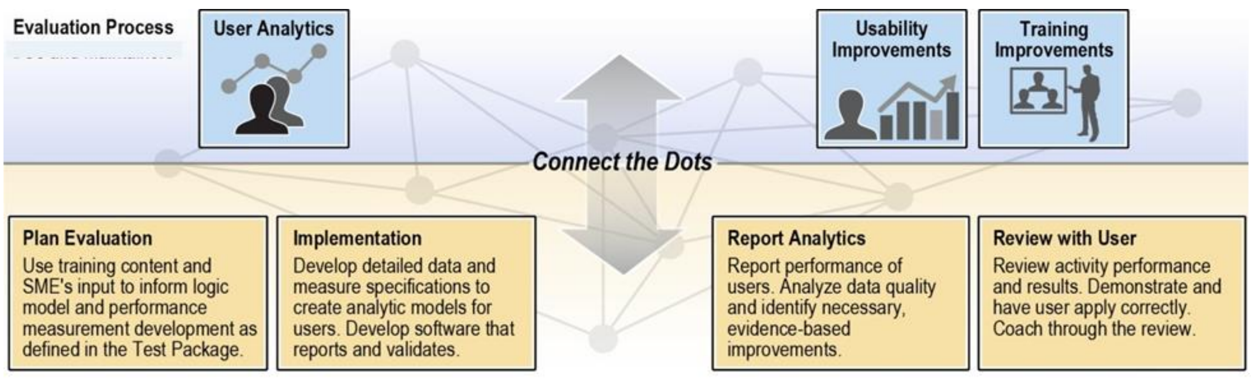


Figure 6: User Analytics in the evaluation process

Challenges of evaluating performance

One challenge for many programs, especially simulation training systems, is how to assess performance tasks (i.e., performance evaluation). Evaluation data in assessing simulation training outcomes for its learners is currently qualitative, meaning it describes specifically how the learner experienced the training rather than quantitative or statistical data showing improvement. As mentioned, research on simulations has shown qualitative validity in simulations as an effective training solution that most learners feel engaged with (Wayne et al., 2006; Alinier et al., 2006). This is helpful to justify the motivational aspects and overall enjoyment of the training. Learners who approve of their own learning will thrive on the intrinsic and extrinsic motivation necessary to continue to seek knowledge in their field (Wood & Bandura, 1989; Kozlowski & DeShon, 2004; Rockstraw, 2006). This consideration was acknowledged when examining the evaluation framework for assessing the effectiveness and efficiency of the organization's Simulation-Based Embedded Training (SBET) program.

Automated assessments within the software User Interfaces are based on learning objectives and evaluated performance with practical exercises. The integration of User Analytics capture software allows continuous monitoring and feedback loops on system usability and user performance. This innovative technology allows the organization's subject matter expert training team to improve training content and software usability based on a thorough, automatic evaluation of designers' performance (Mattingly et al., 2012). The continuous feedback and analytics loop results in program efficiency and evolution of its Military simulation capabilities.

## Designer Assessment and Feedback

Upon completion of a set of performance benchmarks automatically embedded in the help overlays in the simulation software, the system will automatically start the assessment protocol while the designer builds a section of a scenario using the simulation system. This occurs without the designers knowing they are in an evaluation or assessment phase of their training. When the designer is finished building that section of the scenario (i.e., product), the assessment protocol immediately calculates the degree of mastery by comparing designers' performance with the expected performance of an expert learner. If a specific performance benchmark is incomplete, skipped, or takes more than the expected amount time, the system will give feedback to the designer immediately to allow repetition of the skill again. This type of feedback is provided immediately during the entire learning process with the use of learner analytics and embedded training content (Chen et al., 2012; Mattingly, et al., 2012). The designer can view, at any point in their learning, mistakes or missing steps, and repeat the benchmark task to reach a particular degree of mastery through reflection and then iterative application. As a result of repeated practice and assessment, the designer's operational tasks and decision-making process gradually become immediate responses supporting mastery skills. Once the designer has completed all of the benchmarks in a single section with the frequency of mistakes reduced to nearly none, the system will automatically graduate the novice user to an advanced user. Advanced users experience limited embedded help overlays, guided instruction, or training support materials. The assistance or help can be reestablished upon the learner's request. Now, the designer will independently complete the assessment protocol by building a scenario to be included in the simulation system and shared with other locations.

## Expected Learning Goals

Simulation-Based Embedded Training (SBET) is a technical, system software capability approach combined with a research-based training approach. The review of the literature showed that comprehensive studies have been conducted on the effectiveness of embedded training, mostly from military disciplines (Burmester et al., 2005). Embedded prompts during performance tasks coupled with guided instruction keep the designers' attention on their current skill and what their immediate goal is to complete that objective. Immediate feedback provided by the system indicates any discrepancy between their performance and what the system expected the actions to be. Any small discrepancy may be taken lightly by the designers whereas any large discrepancy may require the system to promote additional effort since the designer may want to withdraw their attention and effort away from the task. Feedback will be provided in a positive prompt to allocate attention and skill to another goal, this time in a smaller learning step to build up to the previously attempted skill. In addition to immediate feedback, additional help is provided by a library of embedded training materials to include Interactive Multimedia Instruction (IMI) and video libraries to assist the designers' individual learning needs. The techniques incorporated in SBET provide effective training anytime and anywhere for designers on their actual simulation systems (Burmester et al., 2005; Motola et al., 2013).

There are four sections to the training program's analysis that must measure skill acquisition both effectively and efficiently at the level prescribed by the government requirements. The following is a breakdown of the skill acquisition requirements by the government:

- New Equipment Training (NET) for Scenario Designers - The Contractor developed NET shall provide – at a minimum - instruction/training on system familiarization and comprehension to ensure designers are able to perform basic tasks and support simulation-enabled exercises with minimal reach-back assistance to the program's Subject Matter Experts.
- Sustainment and New Capability Training for existing or new designers - The Contractor shall develop, deliver, and maintain a training curriculum as well as supporting products and documents to ensure all designers achieve and maintain proficiency at a level no lower than Bloom's Taxonomy Level III, Apply.

Within the training events to be conducted by the contracting organization's subject matter experts are guidelines for the types of products, technologies, and formats used. These standards are listed in Appendix A.

To maintain proficiency, access to knowledge and learning is a key enabler in ensuring all designers are proficient in their ability to understand the adaptability of Military operations while creating simulated scenarios (Cristancho et al., 2011). Upon implementation of the Knowledge Base (web portal), designers will have 24/7 access to training materials via the cloud as well as the ability to export the Portal content as a standalone repository. Here, training resources are continuously updated live with new capabilities and improved content. This includes the latest operational best practices, new and updated Military requirements, and instructional methods on how to integrate these tasks into the organization's simulation system (Salas et al., 1998).

## Training Program Evaluation

Using the analytical reports from the learner analytics software embedded in the simulation system, cyclical formative assessments can be conducted. The data is captured when the designers use the scenario development software and it tracks the learners' utilization sequence and behaviors while conducting their operational tasks. Nyre and Rose (1979) evaluated multiple evaluation models and compared them in their study where they support our theory of cyclical formative assessments. They state that Glaser's framework is best suited for the evaluation of instructional programs, specifically for the purposes of Simulation-Based Embedded Training (SBET). Though it is not traditional instruction it is still instruction via technology-enhanced means. Nyre and Rose (1979) described Glaser's paradigm as “effective in specifying the conditions necessary for the evaluation of instruction” (p. 191) which was particularly focused on the analysis of participant or learner entry behaviors and considered a goal-attainment model. The model had its share of critics. However, the main criticism was the questioning of the quality of the goals of the program. This should not be a challenge in the design or implementation of this training program design since Subject Matter Expert trainers are practitioners in the field. Though all of the objectives are being developed from internal sources, the gap analysis and needs assessment conducted by the government shareholder provides an external, non-biased position for determining the quality and effectiveness of the training objectives. Appendix C provides a list of objectives developed for one of the simulator applications to be used for the Simulation-Based Embedded Training (SBET) program. Glaser's goal-based model will be implemented once developments of the SBET features are complete. This is due to the complexity of the software applications being used by the scenario designers and the extremely high chances that some of the design will be affected by those complexities.

The program’s evaluation is based on the research available within the simulation and embedded training communities. It is important to reiterate that there is not a wealth of empirical data available on the effectiveness of simulation training implementations as a training solution for complex skill mastery. This design generalizes most of the gaps in the research in the organization’s industry with other industries and/or other like data. An evaluation framework in simulations must consider the cognitive and learning process involved in creating a transfer of knowledge from the training to the learners’ real-world tasks. The evaluation framework is comprised of methods to conduct an evaluation of a program of instruction. Once the program has been evaluated, the statistical data can be gathered to determine its effectiveness. The evaluation perspective would be a mixed-method assessment with qualitative data to ensure an impact will be made on the political agendas within the organization and shareholders as well as quantitative data to address the more positivist approach (Birckmayer & Weiss, 2000). The evaluation strategy seeks to provide qualitative and quantitative data and follows a goal-based model that excludes summative evaluation and supports the iterative evaluation and design cycle in the ADDIE flex model (see Figure 6 for this process). The most appropriate model for this program's evaluation, based on the review of literature for this problem in practice, is Robert Glaser's model (as cited in Nyre & Rose, 1979, p. 191). Nyre and Rose (1979) explain that Robert Glaser's goal-based evaluation schema consists of six steps that provide a continuing cycle of formative evaluation:

> (1) Specify the outcomes of learning in measurable terms; (2) Analyze the learners' entry behavior – the level of, knowledge, skill, or ability already in the students' repertoire relevant to each task specified in the objectives; (3) Provide students with various learning alternatives; (4) Monitor students' progress toward objectives; (5) Adjust the instructional program according to the level of students' performance as they progress towards attainment of the objectives; and (6) Evaluate the program for on-going feedback and program improvement. (p. 191)

This schema works best for this program evaluation since summative evaluations are seen as having less effect on improvements than formative assessments.

During formative assessments, the program would adjust the products, or in this case, the Simulation-Based Embedded Training (SBET) accommodates the designers. A summative assessment would be completed if the program were going to remains in its state for an extended period of time and would no longer yield the ability to adjust the training program. This would result in outdated software and mismatched training content since the training is embedded within the simulation system. A summative evaluation would be more beneficial to shareholders or customers who need a traditional or static training program, not one embedded in ever-changing, adaptive software applications or simulators.

The evaluation would be completed by internal evaluators. However, this includes a mix from the three different offices (i.e., shareholders) responsible for the Army program. In the organization's case, an internal evaluator would be more appropriate than an external evaluator since they rely heavily on the relationship with the shareholders to be able to impact program improvement assessments. This would be accomplished by conducting formative assessment iterations performed by the SBET and User Analytics software. If an external evaluator were to provide program improvement feedback that requires programmatic changes, the organization may be less inclined to accommodate the changes. However, an internal evaluator who knows the industry, designers, and politics involved in programmatic changes would be more trusted and possibly have a higher success rate for change.

The evaluation plan would be sent to the government shareholders for approval prior to its implementation. Since the formative assessment is conducted anonymously within the software, which has not yet been developed, a formal evaluation on the training materials accompanying the NET instruction will be provided. This will then be compared to the amount of information and data collected during the previous and current training iterations on the organization's simulation system. The limitation to the evaluation framework would typically be limited funding for conducting an extensive, formal evaluation. However, the plan is to build all of the assessment tools into the evaluation protocol within the Simulation-Based Embedded Training (SBET). That being said, software programming is expensive but has already been approved as part of the contractual requirement to reduce support to the sites from the organization's subject matter experts and provide a more technologically advanced instructional program.

# CHAPTER FOUR: DISCUSSION, FUTURE RESEARCH, and CONCLUSION

## Discussion

Proficiency in training the military intelligence community is no easy task. The organization's experience in supporting over 400 military simulation exercises keeps its subject matter experts at the forefront of planning, developing, and executing these exercises. The training program designed for this dissertation's problem of practice includes instructional strategies as a foundation for developing mastery skills of those who develop simulation exercises. Through the use of the instructional design model, ADDIE, which includes analysis, design, development, implementation, and evaluation, the program is structured to provide the appropriate instruction to the designers based on their learning needs. Since each phase of the ADDIE model is evaluated formatively, the training program can evolve into a complete training solution for any Simulation-Based Training system. The idea of overlaying educational instructional strategies over rigid military training design methods leads to more effective and efficient training program development for military simulation programs (e.g., medical, aviation, etc.). This training program methodology leads to mastery-skilled personnel brought together via web portals and collaboration in a faster, more efficient timeline due to the specific focus on individual learners' needs. The successes of this methodology can increase the use of SBET in other industries seeking training solutions for complex simulation systems.

The clearly defined stages of the ADDIE instructional design process allows for effective implementation of the training by using the products produced in each stage, as seen in the tables provided in chapter two, to ensure that the emphasis was on the learner and their needs instead of a more teacher-centered approach (Peterson, 2003). The analysis of the learners is the initial building block of the process that carries from the design of the materials all the way through the evaluation of the learner and the training program. The results of the Analysis phase of ADDIE are used to identify objectives that align training goals with learning needs as well as the identification of the appropriate corresponding instructional strategies (Peterson, 2003). The alignment of the resulting products from each phase of the ADDIE model ensures that the learners stay engaged as their training goals and how they are assessed match their learning needs. These products stay in alignment since ADDIE provides the ability to conduct formative assessments throughout each phase of the process. The summative assessment of the program in the Evaluation phase also lends itself to be flexible with its results being iteratively placed back into the process in the Analysis or Design phase.

The research for this organization's problem of practice showed that simulations are an effective and efficient training solution for the designers (i.e., learners). By using the ADDIE model to produce the simulation materials in alignment with the learner's needs shows the lack of dependence from the designers on the subject matter experts. The ADDIE process, a learner-centered instructional model initiated by the need analysis in the Analysis phase, instead of instructor-focused, is justification for this lack of dependence but with keeping the training goals in line with the organization's program requirements.

## Future Research

The search for research on how to properly design and implement a training program for users of military intelligence simulation training programs for scenario designers, or any military intelligence simulation system, did not return ample results for this dissertation in practice, specific to the type of system the organization develops. However, a comparison can be made by comparing the difficulties of training complex skills using Simulation-Based Training (SBT) to the level of fidelity needed in designing scenarios for those simulations to properly create realistic military intelligence conditions. There remains a need for empirical data on the validity of embedding SBT through the use of scenarios in military intelligence simulator programs. This problem of practice is experienced by this organization every day with little guidance, especially in military systems that are integrated as part of a much larger training solution for soldiers. The development of simulation technology has advanced more quickly than the development of evidence-based and research driven training solutions for users. The possible consequence is that plans for the designing and implementing simulation training using instructional strategies could "stay behind the curve."

Throughout the examination of research, there was a gap in research on the effectiveness of Simulation-Based Training (SBT) and Simulation-Based Embedded Training (SBET) on performance outcomes in military intelligence simulator systems and training the simulation scenario designers. Currently, quantitative research is needed on the performance outcomes of soldiers in their operational environment who attend exercise events using simulation scenarios created by designers who used the process of SBET on the military intelligence training simulator. This is especially important since soldiers are deploying more frequently and their ability to find time to properly train is reduced each time they return home with the possibility of re-deployment within a short period of time. The dangerous conditions in the real operational environment could prevent this type of data collection. A new approach to collecting data, other than observation by a subject matter expert as the current method shows to be unsuccessful, is needed. User Analytics software, with successful studies of its' effectiveness in performance evaluation, allows for a newer approach to assist in this data collection by its ability to remotely evaluate the learner's performance outcomes without the requirement of a subject matter expert to be available during the training event.

## Conclusion

The organization has a continuous record of maintaining the highest standards in providing realistic training to military intelligence soldiers using a simulation system's capabilities to stimulate real-world intelligence systems using simulation data. The training program described assists the organization in fostering a community of mastery-skilled designers brought together by crowd sharing via the web and collaboration with the knowledge, tools, and resources needed to maintain their proficiency. This simulation training approach reduces lengthy processes and development costs, increases designer proficiency and system utilization, and minimizes the need for subject matter expert support during exercises by using scenario-driven instruction remotely via a web portal.

Previously, the program provided a traditional, formal instruction model where novice designers attend lecture-based training without access to their simulation systems. This training involved a two-week course using outdated training techniques. There were multiple failed yearly trainings, demonstrated by poor reviews of military intelligence soldiers on the realism of their simulation exercise and low utilization by the designers. Consequently, a second implementation model was put into action. The second and current implementation of this training program deploys subject matter experts to each of the sites to assist in the development and execution of simulation scenarios.

Across the Army subject matter experts, who provide traditional instruction coupled with hands-on practical exercises, use technologies such as PowerPoint slides and trainee guides. This model of traditional instruction has several issues: 1) there are a limited number of subject matter experts who can train others in realistic, high-fidelity simulations, 2) subject matter experts are costly to employ and costly to deploy on a continuous basis due to the complexity of system capabilities and 3) continuous support by subject matter experts during actual development of a simulation scenario as well as during the training events causes a lack of expertise to assist system capability design. This model has led to an excessive increase in support requests and the inability for some designers to generate the necessary exercise scenarios required of them after training. The designers should be able to, after being instructed during New Equipment Training (NET), develop a simulation scenario effective enough that the soldiers receive a realistic scenario to mimic their combat environment. During the current model, the utilization numbers have increased. However, this has been considered by the program office to be directly related to the excessive deployment of the subject matter experts resulting in increased cost and limited availability.

The Training Doctrine office of the military discusses the need for adaptability in combat operations. This adaptive, critical thinking can be supported by the training strategy proposed in this problem of practice with its research-based foundation. The design and implementation of this training program is multilayered to provide an overall strategy combining cognitive and instructional strategies to promote performance skills critical to the effectiveness of the designers. The strategy must be able to be generalized throughout simulation training devices while providing both individual and team knowledge as well as skill acquisition. There are two layers to this strategy: basic social-cognitive theory and research-based instructional design. This combination provides a framework for determining how to take an individually learned task and performance effort, seen in the current model, and develop it into effective and efficient individual and team-focused outcomes. Instructional techniques embedded into the software will allow for adaptive thinking and promote the psychological aspect of motivation and efficacy in the designers.

The foundation paradigm in this training strategy is the social-cognitive self-regulation theory. Self-regulation theory has empirical support as an effective model contributing to learning and skill performance (Kozlowski & DeShon, 2004). The instructional design layer to this framework relies on a fundamental instructional model, ADDIE, to generate a learning environment where learning and skill performance provide effective training outcomes through the use of the model's processes. When used in conjunction with educational instructional strategies, it shifts training from basic knowledge to strategic skills and advances the learner to mastery-skill outcomes (Kozlowski & DeShon, 2004). The ability for instructional designers to use a learner-centered model such as ADDIE allows for a systematic process where the resulting products of each phase are folded into the steps of the next. This alignment and continuous loop back to the needs analysis allows for proper design and assessment of the learners. This increases efficiency and reduction of errors in the instructional design of the training program (Peterson, 2003).

# APPENDIX A:
# TRAINING PROGRAM REQUIREMENTS

The following instructions were provided by the organization on how to analyze and breakdown the requirements of each section of the contract requirements by the government shareholder.

The questions below are tools to help you organize your thinking so that you can create a high-quality RFP compliant proposal product. Spend some quality time thinking about how you want to answer these questions and present your case to the customer. You may add pages if necessary for a sketch or more info. Be prepared to defend your messages, features and benefits. If a question does not apply to your module so indicate.

**RFP**. Proposal Preparation Instruction (L), Evaluation Factors (M) and applicable sections of SOW and Spec. Copy verbatim or provide on separate sheet. (Expand spaces as necessary)

| **Section** | **Requirements** |
|---|---|
| SOW 3.3.2 Training and Training Products | The Contractor shall implement an efficient training program for Instructor/Operators and System Maintainers in accordance with TRADOC Regulation 350-70, Army Learning Policy and Systems, following the Analysis, Design, Development, Implementation and Evaluation (ADDIE) Process for training and training products. |
| SOW 3.3.2 Training and Training Products | The Contractor shall design, develop and deliver complete and distributable training support packages in accordance with MIL PRF-2961B, Performance Specification: Training Data Products that include all training products, materials, and all pertinent information necessary to train program site personnel to proficiency. |
| SOW 3.3.2 Training and | When interactive multimedia instruction (IMI) is identified as a training |

| Section | Requirements |
|---|---|
| Training Products | solution, the training products shall be Shareable Content Object Reference Model (SCORM) 2004 and Section 508 compliant to ensure interoperability, reusability, durability, and accessibility. |
| SOW 3.3.2 Training and Training Products | The Contractor shall deliver all training products to the Government for review prior to the conduct of New Equipment Training (NET), new capabilities training, and other major training events. |
| SOW 3.3.2 Training and Training Products | The Contractor shall provide all instruction, training materials and system documentation in the English language. |
| SOW 3.3.2 Training and Training Products | The contractor shall conduct the training courses on location at the government site where the system is to be installed or at another mutually agreed to location. |
| SOW 3.3.2 Training and Training Products | The Contractor shall provide all required classroom equipment and training equipment for courses conducted at the Government's facility. |
| SOW 3.3.2 Training and Training Products | Training shall include classroom and practical exercise and shall total no more than eight hours per day. |
| SOW 3.3.2 Training and Training Products | REF: CDRL C00B (DI-SESS-81519C) Instructional Media Requirements Document<br>REF: CDRL C00C (DI-SESS-81517C) Training Situation Document<br>REF: CDRL C00D (DI-SESS-81520B) Instructional Media Design Package |

| **Section** | **Requirements** |
|---|---|
| | REF: CDRL C00E (DI-SESS-81526C) Instructional Media Package<br>REF: CDRL C00F (DI-SESS-81523C) Training Conduct Support Document<br>REF: CDRL C00G (DI-ILSS-80872) Training Materials<br>REF: CDRL C00H (DI-SESS-81525C) Test Package |
| SOW 3.3.2.1 Instructor/Operator Training | The Contractor shall develop, deliver, and maintain an Instructor/Operator (I/O) training curriculum and supporting products and documents to ensure all I/O's achieve and maintain proficiency at no lower than Bloom's Taxonomy Level III. |
| SOW 3.3.2.1 Instructor/Operator Training | The Contractor developed NET shall provide – at a minimum - instruction/training on system familiarization and comprehension to ensure site I/O's are able to perform basic tasks and support program-enabled exercises with minimal reach-back assistance. |
| SOW 3.3.2.1 Instructor/Operator Training | The Contractor shall provide leave-behind material and follow-on material (e.g. enhanced or added capabilities) to support the attainment of the desired end-state including, but not limited to, Operator and Maintenance manuals, and job aids. |
| SOW 3.3.2.1 Instructor/Operator Training | The Contractor shall apply those approaches and provide those materials to support the attainment of the desired end-state utilizing the most effective and efficient training program as identified by their training |

| Section | Requirements |
|---|---|
| | needs analysis. |
| SOW 3.3.2.2 Maintenance Training | The Contractor shall develop, deliver, and maintain a maintenance training curriculum and supporting products and documents to ensure all maintainers achieve and maintain proficiency at no lower than Bloom's Taxonomy Level III (Reference Bloom's Taxonomy revised edition). |
| SOW 3.3.2.2 Maintenance Training | The Contractor-developed NET shall provide – at a minimum - instruction/training on system familiarization and comprehension to ensure site Maintainers are able to perform basic tasks and support program-enabled exercises with minimal reach-back assistance; i.e. troubleshooting and maintenance, diagnostics to fault isolation, calibration, adjustments, remove and replace procedures, and the use of built in tests. |
| SOW 3.3.2.2 Maintenance Training | This training will include the requisite knowledge, skills, and abilities to achieve and maintain the simulation system and supporting equipment and network connectivity and accreditation. |
| SOW 3.3.2.2 Maintenance Training | The Contractor shall provide leave-behind material and follow-on material (e.g. enhanced or added capabilities) to support the attainment of the desired end-state including - but not limited to - Operator and Maintenance manuals and job aids. |
| SOW 3.3.2.2 Maintenance | The Contractor shall apply those approaches and provide those materials |

| Section | Requirements |
| --- | --- |
| Training | to support the attainment of the desired end state utilizing the most effective and efficient training program as identified by their training needs analysis. |
| | |
| Section L. | The Offeror shall describe their approach to develop and implement an efficient proficiency training program for Instructor/Operators and Maintainers at fielded sites |
| Section L. | The Offeror shall describe the methods to be employed to deliver New Equipment Training (NET), training for new I/O's and maintainers and the training of new and/or enhanced capabilities. |
| Section L. | The offeror shall describe their plan to ensure and maintain proficiency, thereby minimizing the need for I/O’s and Maintainers to request reach-back support during program-enabled exercises |
| Section M | The Government will evaluate the Offeror’s approach to provide an efficient, comprehensive training program that ensures Instructor/Operators (I/O’s) and Maintainers at fielded sites are able to support program-enabled exercises with minimal reach-back assistance. (SOW 3.3.2, 3.3.2.1, 3.3.2.2) |

# APPENDIX B:
# RESEARCH-BASED SOLUTIONS

Only the requirements found to be pertinent for the design and implementation of our organization's program were listed in the instructional strategy and media/instructional element selection plan. We have also shown the connection to the design principle considered after a literature review of research provided evidence to support each requirement.

| **Design Principles** | **Instructional Element/ Theory** | **Research Basis** |
|---|---|---|
| The successful learner, over time and with support of instructional guidance, can create meaningful, coherent representations of knowledge.<br><br>The successful learner can link new information with existing knowledge in meaningful ways. | Embedded LSAs and objective benchmarks in the UI will be based on actual trainer activities within the simulation system and the introductory knowledge provided during NET and with the Knowledge Base Wiki/training support materials<br><br>Recognition over Recall<br><br>Cognitive/Metacognitive | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| The learning of complex subject matter is most effective when it is an intentional process of | Practical exercises will be building their operational products on their actual system to | McCombs & Vakili, 2005 Learner-Centered |

| **Design Principles** | **Instructional Element/ Theory** | **Research Basis** |
|---|---|---|
| constructing meaning from information and experience.<br><br>The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals. | be included in the RISG repository and shared with their peers<br><br>Cognitive/Metacognitive | Psychological Principles |
| What and how much is learned is influenced by the learner's motivation.<br><br>Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control. | Guided learning within the embedded training will be automatic with novice learners and will promote them to advanced once all benchmark objectives have been met, once an advanced learner, their profile can prompt guidance and they are able to add content (scenarios) that they build into RISG | McCombs & Vakili, 2005<br>Learner-Centered Psychological Principles |

| **Design Principles** | **Instructional Element/ Theory** | **Research Basis** |
|---|---|---|
| | Motivational/Affective | |
| Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely. | 24/7 accessibility and guided instruction provide persistent practice opportunities, enhance self-efficacious motivation and concentrated effort on training tasks/objectives<br><br>Accessibility, Hierarchy of Needs<br><br>Motivational/Affective | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| Learning is influenced by social interactions, interpersonal relations, and communication with others | Trainers create scenarios and are provided immediate feedback on their assessment to then share the scenario via a social/peer repository (RISG) as well as providing insight and guidance via the Knowledge Base Wiki to | McCombs & Vakili, 2005 Learner-Centered Psychological Principles |

| **Design Principles** | **Instructional Element/ Theory** | **Research Basis** |
|---|---|---|
| | other trainers world-wide and the program SMEs<br><br>Feedback Loop, Gamification, Iteration<br><br>Developmental/Social | |
| Setting appropriately high and challenging standards and assessing the learner and learning progress- including diagnostic, process, and outcome assessment are integral parts of the learning process. | Learner Analytics will be capturing the progress from novice to mastery-skilled within the UI between trainers and the simulation's interactions<br><br>Expectation Effects<br><br>Individual-Differences | Lidwell et al., 2015 Universal Principles of Design<br><br>McCombs & Vakili, 2005 Learner-Centered Psychological Principles |
| | | |

# APPENDIX C:
# TRAINING MODULE OBJECTIVES

This appendix provides an example of one module's objective list for an understanding of the knowledge and performance tasks a trainer must complete.

**Instructional Format**

New Equipment Training:

Throughout the lesson plan for the training modules, the training audience is referred to as operators instead of students or trainees.

Software Requirements:

Operators are required to access the Intelligence Low Overhead Driver (iLOD) system software via the Technical Control Cell (TCC) Lower Enclave (LE) High Performance Workstation (HPWS) for hands-on activities, practice, and assessment.

**Username and Password Requirements**

Initial system user names and passwords are provided in the Software Version Description (SVD) document. The instructor will guide the operators to change the passwords to be unique and to create a backup password should the accounts get locked out.

**Objectives**

- Terminal Learning Objective (TLO) 1 – Understand the purpose and navigation of the iLOD application.
    - Enabling Learning Objective (ELO) A – Explain the basic capabilities of the iLOD application in regards to Military Intelligence (MI) exercises and training.

- ELO B – Identify specific functions within the iLOD application.

- TLO 2 – Generate the baseline setup data necessary to develop a problem-based training scenario within the iLOD application.
    - ELO A – Demonstrate knowledge of the Scenario Setup functions by establishing a Scenario Timeframe for a problem-based training scenario.
    - ELO B – Demonstrate knowledge of the Scenario Setup functions by importing and exporting preexisting, scenario-specific data for a problem-based training scenario.
    - ELO C – Demonstrate knowledge of the Scenario Setup functions by establishing conventional and unconventional forces and their associated equipment, identifying or biographical information and associated activities for a problem-based training scenario.
- TLO 3 – Generate the scenario unconventional and conventional events and maneuvers necessary to develop a problem-based training scenario within the iLOD application.
    - ELO A – Demonstrate knowledge of the Counter Insurgency (COIN) Assistant functions by creating Unconventional events for a problem-based training scenario. Setup functions by establishing a Scenario Timeframe for a problem-based training scenario.
    - ELO B – Demonstrate knowledge of the COMBAT Operations (OPS) Assistant functions by creating Conventional maneuvers and combat events for a problem-based training scenario.

- TLO 4 – Plan the intelligence collection and establish the reporting systems necessary to develop a problem-based training scenario within the iLOD application and the connected Army Mission Command Systems (AMCS).
    - ELO A – Demonstrate knowledge of the Intelligence, Surveillance, and Reconnaissance (ISR) Assistant functions by creating the collection plan parameters necessary for generating reports for a problem-based training scenario.
    - ELO B – Demonstrate knowledge of the Army Intelligence Reporting Cycle, Operations Order and AMCS by establishing a connection in the iLOD application with networked systems for intelligence report dissemination for a problem-based training scenario.
- TLO 5 – Operate the iLOD application during exercise runtime tasking for a problem-based training scenario.
    - ELO A – Demonstrate knowledge of the LIVE PLAY Assistant functions by generating Distributed Interactive Simulation (DIS) traffic, historical and exercise reporting for dissemination into the TCC LE and AMCS to be processed and redistributed as raw intelligence for a problem-based training scenario.
    - ELO B – Demonstrate knowledge of the iLOD application receiving Distributed Interactive Simulation (DIS) traffic from a network simulation game.
    - ELO B – Demonstrate knowledge of the REPORT Routing functions by setting the proper report routing and dissemination parameters necessary for a problem-based training scenario.

**Teaching Points**

Not Applicable

**Equipment Requirements**

| Quantity | Equipment |
|---|---|
| 1 per classroom | Television Monitor or Projector and Screen |
| 1 per classroom | Workstation with Microsoft PowerPoint |
| 1 per classroom | IEWTPT LE HPWS |
| 2 per classroom | User client laptops for the HPWS |

**Instructional Aids**

| Quantity | Materials |
|---|---|
| 1 per Instructor | Lesson Plan |
| 1 per classroom | iLOD Capabilities and Operations Visual Aid– the visual aid is found in the TCC\ iLOD folder in Appendix C. To launch the presentation, double-click runILODTraining.html |

Example of SME Trainers' surveys for qualitative data collection on the new SBET program: NOTE: This survey has not been implemented or approved by the government and therefore an Internal Review Board (IRB) request cannot be completed until the government approves. Since this SBET program has five years before it is completely developed, the IRB approval would no longer be valid.

## **SBET SME Trainer Survey**

You have been selected to take part in this survey due to your status as a Mobile Training Unit (MTU) team member for the new Simulation-Based Embedded Training (SBET) program for a Military Intelligence (MI) simulation program. We are interested in your responses to this list of statements. Below is the consent process. Once you consent to participate in this research, you will be presented with the survey. We anticipate this survey will take no more than about 15 minutes of your time. Once you begin the survey, you cannot leave and return to it. Please be sure to allot your time carefully and only begin once you are able to spend the time to complete the survey fully.

You are being invited to take part in a research study. Whether you take part is up to you. The purpose of this study is to determine potential areas of growth in organizational processes and motivational development for MTU team members training and supporting the simulation system. Participation in this study will require approximately 15 minutes of your time. You will be asked to take an electronic survey that includes 36 statements to which you will provide a response using provided scales. There are 6 demographic questions that we would like you to answer about your position as a MTU team member. All responses will be kept strictly confidential; however, your voluntary participation in a phase two brief interview will be solicited at the conclusion of the survey. The interviewing phase is completely voluntary and you need not feel obligated to participate. You do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks. You must be 18 years of age or older to take part in this research study. Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt you, contact *(to be filled in once approved by the government and an IRB approval is requested)*.

- YES, I consent to participate in this research.
- NO, I do not consent to participate in this research.

If NO, I do not consent to par... Is Selected, Then Skip To End of Survey.

| **SBET SME Trainer Survey** | | | | | |
|---|---|---|---|---|---|
| Q1 Answer the following: | Never (1) | Rarely (2) | Sometimes (3) | Often (4) | All of the Time (5) |
| Financial support "contractor" allocates for attending professional development training to operators and maintainers (1) | • | • | • | • | • |
| Time allocated to allow for attending professional development training as a trainer or Subject Matter Expert (SME) (2) | • | • | • | • | • |
| Incentive, pay, or recognition for my attendance at professional development training as a trainer or SME (3) | • | • | • | • | • |
| The team lead puts forth an effort | • | • | • | • | • |

| | | | | | |
|---|---|---|---|---|---|
| to provide professional development training to trainers or SMEs (4) | | | | | |

Q2. Considering any job-specific professional development or training provided to you by your team lead or other team members, how often have the following occurred?

| | Never (1) | Less than Once a Month (2) | Once a Month (3) | Several times monthly (4) | Once a Week (5) | Several times weekly (6) | Daily (7) |
|---|---|---|---|---|---|---|---|
| I attended group discussions on system specific content led by the team lead or other team members. (1) | • | • | • | • | • | • | • |
| I attended a demonstration of system specific content, utilization, or skill (2) | • | • | • | • | • | • | • |
| Assisted in developing system specific curricula or lesson plans with the team lead or other team members (3) | • | • | • | • | • | • | • |

Q3 As a MTU team member or SME, how much time have you spent engaged in professional development activities focused on system architecture or capability competency?

| | Never (1) | Less than Once a Month (2) | Once a Month (3) | Several times monthly (4) | Once a Week (5) | Several times weekly (6) | Daily (7) |
|---|---|---|---|---|---|---|---|
| Workshops or on-the-job training about system capabilities or learning your specific job tasks (1) | • | • | • | • | • | • | • |
| Yearly training events or conferences about the SBET program or system capabilities (2) | • | • | • | • | • | • | • |
| Attended training events at other site locations related to your system job tasks or skills (3) | • | • | • | • | • | • | • |
| Participated in program training groups, networks, or collaboratives (4) | • | • | • | • | • | • | • |
| Used | • | • | • | • | • | • | • |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| organization resources such as trainers or materials to enrich your knowledge and skills (5) | | | | | | | |
| Worked on a team or mobile unit focused on training and instruction on the SBET system (6) | • | • | • | • | • | • | • |
| Engaged in informal self-directed learning (7) | • | • | • | • | • | • | • |

Q4 Thinking about ONLY the other faculty who perform the same skill(s) as you do. Rate these statements for their overall competency with the following job tasks of training or supporting the simulation system.

| | Not Observed (1) | Unsatisfactory (2) | Developing (3) | Competent (4) | Proficient (5) | | |
|---|---|---|---|---|---|---|---|
| Grasps central concepts of military intelligence (1) | • | • | • | • | • | • | • |

| | | | | | |
|---|---|---|---|---|---|
| Develops appropriate exercise content (2) | • | • | • | • | • |
| Scenarios are related to objectives and provides for assessment which is linked to objectives (3) | • | • | • | • | • |
| Shows content specific understanding in exercise design and material (4) | • | • | • | • | • |
| Understands need to engage in professional practices (5) | • | • | • | • | • |
| Uses professional literature, the wisdom of colleagues and other resources to support own growth as a MTU trainer or SME (6) | • | • | • | • | • |

Q5 Thinking about ONLY your own MTU career, as a trainer or SME, rate the following statements for your own overall competency with the following job tasks of operating the IEWTPT system.

| | Not Observed (1) | Unsatisfactory (2) | Developing (3) | Competent (4) | Proficient (5) |
|---|---|---|---|---|---|
| Grasps central concepts of military intelligence (1) | • | • | • | • | |
| Develops appropriate exercise content (2) | • | • | • | • | |
| Scenarios are related to objectives and provides for assessment which is linked to objectives (3) | • | • | • | • | |
| Shows content specific understanding in exercise design and material (4) | • | • | • | • | |
| Understands need to engage in professional practices (5) | • | • | • | • | |
| Uses professional literature, the wisdom of colleagues and other resources to support own growth (6) | • | • | • | • | |

Q6 As a MTU team member, rate the following statements for overall satisfaction with your team lead.

| | Very Dissatisfied (1) | Dissatisfied (2) | Satisfied (3) | Very Satisfied (4) |
|---|---|---|---|---|
| The way my team lead sets clear work goals (1) | • | • | • | • |
| The way my team lead helps me to get the job done (2) | • | • | • | • |
| The way my team lead gives me clear instruction (3) | • | • | • | • |
| The way my team lead informs me about work changes ahead of time (4) | • | • | • | • |
| The way my team lead understands the problems I might run into doing the job (5) | • | • | • | • |

Q7 As a MTU team member, rate the following statements regarding your psychological attachment to the organization.

| | Strongly Disagree (1) | Disagree (2) | Agree (3) | Strongly Agree (4) |
|---|---|---|---|---|
| How hard I work for this organization is directly linked to how much I am rewarded (1) | • | • | • | • |

| | | | | |
|---|---|---|---|---|
| Unless I am rewarded for it in some way, I see no reason to expend extra effort on behalf of this organization (2) | • | • | • | • |
| My private views about this organization are different from those I express publicly (3) | • | • | • | • |
| I am proud to tell others that I am a faculty member in this organization (4) | • | • | • | • |
| I feel a sense of ownership for this organization rather than just being an employee (5) | • | • | • | • |

Q8 Which type of faculty member are you?

- Long-term Faculty with less than 5 years experience (1)
- Long-term Faculty with 5 to 9 years experience (2)
- Long-term Faculty with 10 or more years experience (3)

Q9 How many years have you been operating the IEWTPT system (excluding the current year)?

- 2 years or less (1)
- 4 years to 3 years (2)
- 5 to 9 years (3)
- 10 to 14 years (4)

Q10 Would you be interested in completing a brief face-to-face or phone interview about this study and your role as a MTU team member?

- Yes (1)
- No (2)

Answer If Would you be interested in completing a brief face-to-face or phone interview to elaborate on some of the responses to these questions? Yes Is Selected

You have indicated that you would be willing to complete a brief face-to-face or phone interview to elaborate on some of the responses you provided to these questions. Please provide your name and preferred contact information below. Please note that we will keep all responses strictly confidential. No identifying information will be reported, and reporting will utilize pseudonyms.

First Name (1)

Last Name (2)

Phone (3)

Email Address (4)

# APPENDIX D:
# EVALUATION DOCUMENTATION

This appendix provides the supporting documentation for the evaluation of the SBET program. The documents were produced for the NET instruction only, provided by traditional means: a subject matter expert instructor, lesson plan, trainee guide, observational assessments, and qualitative surveys from the trainees.

The content validity will be assessed by a team consisting of a subject matter expert instructor from the contractor organization, an active duty military intelligence soldier from the schoolhouse stakeholder, and a government stakeholder representative that collects program requirements.

## Evaluation Design Document:

<u>Rating Information:</u>

*Rater:*

Subject matter expert instructor, instructional design personnel

*Lesson from:*

Subject matter expert instructor

<u>Title of application being evaluated:</u>

Military intelligence Simulation-Based Training (SBT) Program

**Subject Matter:** Assessment criteria – Scoring system (Needs work, Acceptable, Not Evaluated)

(Instructions: Evaluate the content of the lesson plan, trainee guide, and visual aide for this application during the instructional program using the scoring system above.)

Objectives are appropriate – Level of outcome (score)

Objectives can be measured – Level of outcome (score)

Content is structured/ordered according to performance steps – Level of outcome (score)

Content is accurate – Level of outcome (score)

Language, style, and grammar are appropriate – Level of outcome (score)

Table of contents, acronyms, and glossary are sufficient – Level of outcome (score)

Comments:

(Instructions: All evaluators must provide comments on any level of outcome other than "Acceptable".)

Example:

Subject Matter: Content is structured/ordered accordingly – Needs work

The setup steps of the application are listed below the login steps. The login steps should be introduced first to provide the ability for the user to access the application.

**Auxiliary Information:** Assessment criteria – Scoring system (Needs work, Acceptable, Not Evaluated)

(Instructions: Evaluate the auxiliary information in the Lesson Plan, Trainee Guide, and Visual Aide for this application provided during the instructional program using the scoring system above.)

Administrative data/instructions is correct – Level of outcome (score)

Plan of Instruction (POI) is appropriate – Level of outcome (score)

Introduction is applicable – Level of outcome (score)

Conclusion is summative of content – Level of outcome (score)

Comments:

(Instructions: All evaluators must provide comments on any level of outcome other than “Acceptable”.)

Example:

Auxiliary Information: POI is appropriate – Needs work

TRADOC mandates a 10 minute break every hour. The POI states up to an hour and a half without providing the learner a break. This accommodation must be provided.

**Usability of the Application:** Assessment criteria – Scoring system (Needs work, Acceptable, Not Evaluated)

(Instructions: Evaluate the usability and User Experience (UX) factors of the application provided during the instructional program using the scoring system above.)

Application is appropriate for adult learners (Androgogy) – Level of outcome (score)

Application seems to motivate learners – Level of outcome (score)

Application matches lowest level of required complexity – Level of outcome (score)

A novice learner could use application – Level of outcome (score)

Comments:

(Instructions: All evaluators must provide comments on any level of outcome other than “Acceptable”.)

Example:

Usability: Application matches lowest level of required complexity – Needs work

The application seemed unnecessarily complex for a novice adult-learner. Adding tool tips and examples to the application can assist in their ability to understand what information they are supposed to be putting into the GUIs throughout the application.

**User Interface (UI):** Assessment criteria – Scoring system (Needs work, Acceptable, Not Evaluated)

(Instructions: Evaluate the UI of the application provided during the instructional program using the scoring system above.)

Regular use/repetition of "like" symbols/controls – Level of outcome (score)

Aesthetically pleasing/engaging – Level of outcome (score)

Animations and graphics – Level of outcome (score)

Input forms – Level of outcome (score)

Navigation – Level of outcome (score)

Consistency across pages/GUIs – Level of outcome (score)

Comments:

(Instructions: All evaluators must provide comments on any level of outcome other than "Acceptable".)

Example:

UI: Animations and graphics – Needs work

The graphics throughout the application blend in with the background color chosen for most of the UI. Contrasting the graphics, especially the descriptive ones, with the background will allow users to see them clearly without straining to understand their content/context.

The following Instructional Treatment Plan was developed during this problem of practice to mimic what would be developed on the SBET since the applications remain the same and the traditional methods, materials, and media selection will be presented during the SBET NET. However, the SBET will have additional features due to the embedded nature of the instruction and may change this document, especially for the media selection.

## Military Intelligence Simulation Program Technical Control Cell (TCC)

## Lower Enclave (LE) Instructor Lead Training

Prepared by: Christina Cook

Prepared for: Technical Support Specialist (TSS) Operators

**Course Title:** TCC LE

**Terminal Objective:**
1] 1.0 Create a new exercise in the TCC Management Console in the TCC LE server stack.

**Enabling Objectives:**
Using the TCC system's hardware and software, you will be able to:

- 1] 1.1 Start the TCC Enclave server stacks and log in to the High Performance Computer (HPC)
- 2] 1.2 Navigate to the TCC Management Console graphical user interface (GUI).
- 3] 1.3 Launch the TCC Management Console
- 4] 1.4 Using the Exercise Wizard create the new TCC LE exercise

**Terminal Objective:**

1] 1.0

**Enabling Objectives:**
Using the TCC system's hardware and software, you will be able to:

1] 1.1 Start the TCC Enclave with the iLOD application installed
2] 1.2 Navigate to the iLOD application
3] 1.3 Create a new training exercise name and date time group (DTG) for exercise start
4] 1.4 Protect classified information

**Terminal Objective:**
2] 2.0 Identify and demonstrate the functionality of the Network tab in the iLOD application.

**Enabling Objectives:**
Using the iLOD application software, you will be able to:

1] 2.1 Create the Opposition Forces (OPFOR) Red Network in the application
2] 2.2 Create the Friendly Force Blue Network in the application
3] 2.3 Assign the Blue Network reporting Unit to the OPFOR
4] 2.4 Create Bio Reports for each Red Network player with their assigned Blue Network reporting Unit
5] 2.5 Export and Save the Red Network Bio Reports
6] 2.6 Export and Save the Red Network diagram layout
7] 2.7 Export and Save the Blue Network diagram layout
8] 2.8 Protect classified information

**Terminal Objective:**
3] 3.0 Create the Exercise playbox and corresponding Synthetic Aperture Radar (SAR) imagery box in the Map tab in the iLOD application.

**Enabling Objectives:**
Using the iLOD application software, you will be able to:

1] 3.1 Create the Red Network Area Of Reporting (AORs)
2] 3.2 Create the Blue Network AORs
3] 3.3 Create the Blue Forward Operating Base (FOBs)
4] 3.4 Create Routes for Blue Network Units
5] 3.5 Create OPFOR, Friendly and Neutral places (buildings, farms, water sources, etc.) in the exercise playbox
6] 3.6 Plan historical SIGACTs in the exercise playbox
7] 3.7 Plan runtime SIGACTs in the exercise playbox
8] 3.8 Create Auto-generated SIGACTs using the Calendar option for Blue Network patrols
9] 3.9 Protect classified information

**Terminal Objective:**
5] 4.0 Validate generated SIGACTs in the Reporting tab in the iLOD application.

**Enabling Objectives:**
Using the iLOD application software, you will be able to:

1] 4.1 Validate Historical SIGACT, IIR, and DIR reports
2] 4.2 Correct Errors discovered during validation on Historical reports
3] 4.3 Validate Runtime SIGACT, IIR, and DIR reports
4] 4.4 Correct Errors discovered during validation on Runtime reports
5] 4.5 Export Historical reports
6] 4.6 Export Runtime reports
7] 4.7 Protect classified information

**Terminal Objective:**
5] 5.0 Demonstrate exercise Runtime operations and reporting dissemination rules in the iLOD application.

**Enabling Objectives:**
Using the iLOD application software, you will be able to:

1] 5.1 Create a new Runtime version of the exercise scenario
2] 5.2 Setup report dissemination routes using CSV, Blue Force Tracker, Email, TIGR, PASS, CIDNE
3] 5.3 Play Runtime exercise
4] 5.4 Verify SIGACTs are being produced on the Runtime exercise timeline
5] 5.5 Verify reports are being disseminated through designated channels
6] 5.6 Protect Classified Information

**Prerequisites:** TSS Operator at MTC sites, reads and writes English, experience with the TCC hardware and software prior to utilizing the iLOD application.

**Time Requirements:** 8 hours

## Instructional Strategy and Media Selection

The instructional strategy used for the iLOD application training is the Independent Study strategy that consists of multiple instructional components. Each instructional component then consists of consistently designed independent learning objects. The components used for this strategy are Introduction, Main Idea, Explanation, Interaction, Examples/Demonstrations, Practice, and Feedback.

| EVENT | DESCRIPTION | INTERA-CTION | MEDIA & MAP TOOLS |
|---|---|---|---|
| 1] Introduction | *The introduction will orient the TSS operator to the purpose and value of the content in regards to their employment as a contractor on the contract.*<br><br>To meet training demand, MTCs have moved to scripted injects with few supporting tools. However, creating the inject products still takes several weeks/months, and modifications are tedious and error prone.<br><br>Tools are needed to provide large amounts (30-90 Days) of historical data, facilitate generation of scripted reports, and allow easy modification of products for steering training or for preparing for next training rotation.<br><br>Multi-user Web Based Collaboration Environment to Create and Dynamically Update Correlated, Intel Products for Warfighter Training Events<br>Activity Based, Correlated Intel Product Generation<br>– Schedule patrols and drop activities on map to create reports<br>– Draft IIRs, Bio Reports, Patrol Debriefs, SIGACTs<br>– SIGINT & IMINT Data and Reports (future)<br>Integrated Data Integrity Checking<br>– Change a fact, all related products are updated<br>– Visual depiction of status of | Learner | Web-like interface (or skin) with the captivate sessions, help, and introduction embedded. |

| | | | |
|---|---|---|---|
| | data (complete/incomplete)<br>Interfaces to Battle Command and Intel Information Systems (under dev)<br>– CIDNE, DCGS-A, Axis Pro, CPOF, TIGR, Analyst Notebook<br>Exports data to MCTC Battle Command Staff Trainer<br>– Routes, AORs, FOBs, etc.<br>Supports Brigade staff to Company level training | | |
| 2] Main Idea | *The main idea will state the content contained in the learning object/module in a concise form. This will be the topic slides after the legend in each module.*<br><br>**Terminal Objective:**<br>1] 1.0 Create new exercise properties in the Scenario tab in the iLOD application.<br>**Terminal Objective:**<br>2] 2.0 Identify and demonstrate the functionality of the Network tab in the iLOD application.<br>**Terminal Objective:**<br>3] 3.0 Create the Exercise playbox and corresponding SIGACTs in the Map tab in the iLOD application.<br>**Terminal Objective:**<br>4] 4.0 Validate generated SIGACTs in the Reporting tab in the iLOD application.<br>**Terminal Objective:**<br>5] 5.0 Demonstrate exercise Runtime operations and reporting dissemination rules in the iLOD application. | Learner | Adobe Captivate Each Terminal objective will be an individual captivate session |
| 3] Explanation | *The explanation will elaborate on the main idea of each module by using data text boxes to explain the actions taken during the captivate recordings, providing more information on each enabling objective.*<br><br>Ex: Use the **Change Symbol** dropdown icon to select a different Type of Unit (**Military** | Learner | Adobe Captivate modules with data text boxes as narrative explanations of actions. |

| | | | |
|---|---|---|---|
| | **Intelligence** is used in this example) | | |
| 4] Interaction | *In order to engage and allow for interaction in the modules, the learner will be able to click on specific selections when directed to do so by a interactive text box which until successful will pause the training.*<br><br>Ex: Select the **Area** Tab to display the Blue Network Unit's **AOR** and **FOB** | Learner | Adobe Captivate modules with interactive text boxes as narrative explanations for the student to click on a particular item. |
| 5] Examples/ Demonstrations | *The examples/demonstrations allow the learner to experience a realistic sample of the main idea of each module without requiring extended interactions.*<br><br>Ex: each module will be captured using the specific functions of the application for that topic while the learner follows along via a swf file or video of the application being used | Learner | Adobe Captivate modules |
| 6] Practice | *The practice portion of training will be performed by the TSS operator on the actual application once the captivate modules are complete. The learners will utilize the example Road to War as their performance exercise.*<br><br>Use iLOD Road to War exercise.doc | Learner | Road to War document provided for performance exercise – self directed. |

| | | | |
|---|---|---|---|
| 7] Feedback | *The practice feedback will be supplied by the learner on the effectiveness of the captivate modules for transferring the knowledge to the actual application in the TCC system and their ability to apply the main idea of each module in a realistic setting and see how they performed.*<br><br>TSS operators will complete and return the questionnaire and the survey within five working days of the completion of the captivate training modules | Learner | Student SUS questionnaire and iLOD Survey |

## Media Selection Rationale

The subject matter expert requested leave behind training modules that required no face-to-face interaction due to the various locations of the learners across the world. Adobe Captivate was chosen because it was the most effective format to provide an opportunity to demonstrate the functionality of the simulation application and allow minimal interaction by the learner as well as provide a permanent reference to be called upon if necessary.

***Interaction/Application Tools:***

1] Adobe captivate swf files embedded in a web-like “skin” with the ability to select each module, access a help menu, and contact information for the subject matter expert team.

# Learner Assessment Alignment Table

| Sub-skill | Objective | Classification | Method | Assessment criteria |
|---|---|---|---|---|
| Identify Network tab functions | Enabling Objective: 3.0 Using the simulation application, identify and demonstrate the functionality of the Network tab. | Verbal Information and Processing | Post Test Conventional Multiple-choice answer items | |
| Create Blue Network | Enabling Objective: 3.2 Using the simulation application, create the friendly force Blue Network. | Verbal Information and Processing | Post Test Conventional Multiple-choice answer items | What of the following option buttons does the user have to create a Blue Network Unit?<br>A) +BDE<br>B) +HCT<br>C) US Army<br>D) **All of the Above**<br><br>What does HCT stand for in reference to creating a |

| | | | | |
|---|---|---|---|---|
| | | | | Unit in the Blue Network?<br><br>A) **HUMINT Control Team**<br><br>B) Hierarchy Control Team<br><br>C) Hazardous Control Team<br><br>D) None of the Above<br><br>Which of the following statements is incorrect when setting the Blue Network Unit properties under the Edit Unit Details window?<br><br>A) The FCN name cannot be edited<br><br>B) The Unit's Route and Activity Schedule cannot be created<br><br>C) The Red Network Group the unit is reporting on can be edited<br><br>D) **The Unit's Summary of Significant Activities (SIGACTs) can be viewed** |
| Import | Enabling | Verbal | Post Test | Which of the following |

| | | | | |
|---|---|---|---|---|
| and Export Blue Network diagram | Objective: 3.3 Using the simulation application, export and save the Blue Network diagram layout | Information and Processing | Conventional Multiple-choice answer items | tabs under the Edit Unit Details window does the user have available to make that unit a Headquarters (HQ)?<br>A) Structure<br>B) **Symbol**<br>C) Areas<br>D) None of the Above<br><br>Which of the following statements is correct when importing a US Army unit into the Blue Network?<br>A) Only Company level units can be imported<br>B) **The Unit selected to be imported must be assigned to a Brigade (BDE)**<br>C) The Unit selected to be imported must be a HUMINT Control Team (HCT)<br>D) All of the Above |

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