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SANDBOX CONTRACTING: AN EVALUATION OF GAMIFIED VS. TRADITIONAL CONTRACTING TRAINING METHODS AT THE USAF ENLISTED CONTRACTING TECHNICAL SCHOOL

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December 2021

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This thesis involved an evaluation of gamified versus current (traditional) training methods employed by the instructors and faculty at the Air Force's 344th Training Squadron (344 TRS) at Lackland Air Force Base, Texas, and by the professors at the Naval Postgraduate School (NPS) in Monterey, California. For our project, we designed and developed a first-person shooter (FPS) video game, titled Sandbox Contracting, that teaches the player basic contracting skills. Over the course of six weeks, we utilized this FPS video game to conduct an experiment in which a control group received the current (traditional) training methods employed by 344 TRS and NPS and a treatment group received the gamified version of the training. We assessed each student's learning as well as their reaction to the assigned learning modality (traditional versus gaming) using post-training evaluation surveys. Traditional training methods outperformed gamified methods in most cases, but not all. We found that game design and mechanics impacted the student's reactions and ultimately, the success of using gamified methods for learning. Additionally, the results demonstrated a genuine interest in using games for learning among the Air Force contracting students, given the right game design and mechanics. Lastly, we offer suggestions for areas in which further research should be conducted in the gamified versus traditional training arena.

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ABSTRACT

This thesis involved an evaluation of gamified versus current (traditional) training methods employed by the instructors and faculty at the Air Force's 344th Training Squadron (344 TRS) at Lackland Air Force Base, Texas, and by the professors at the Naval Postgraduate School (NPS) in Monterey, California. For our project, we designed and developed a first-person shooter (FPS) video game, titled Sandbox Contracting, that teaches the player basic contracting skills. Over the course of six weeks, we utilized this FPS video game to conduct an experiment in which a control group received the current (traditional) training methods employed by 344 TRS and NPS and a treatment group received the gamified version of the training. We assessed each student's learning as well as their reaction to the assigned learning modality (traditional versus gaming) using post-training evaluation surveys. Traditional training methods outperformed gamified methods in most cases, but not all. We found that game design and mechanics impacted the student's reactions and ultimately, the success of using gamified methods for learning. Additionally, the results demonstrated a genuine interest in using games for learning among the Air Force contracting students, given the right game design and mechanics. Lastly, we offer suggestions for areas in which further research should be conducted in the gamified versus traditional training arena.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR	After-Action Report
AF	Air Force
AFICC	Air Force Installation Contracting Center
AI	Artificial Intelligence
AR	Augmented Reality
B2B	Business-to-Business
B2G	Business-to-Government
CM	Category Management
CSAF	Chief of Staff of the Air Force
DAU	Defense Acquisition University
DLI	Defense Language School
DoD	Department of Defense
FAR	Federal Acquisition Regulation
FPI	Federal Prison Industries
FPS	First-Person Shooter
IM	Intrinsic Motivation
L&D	Learning and Development
MBA	Master of Business Administration
MOBA	Multiplayer Online Battle Arena
MUD	Multi-User Dungeon
NetPS	Net Promoter Score
NDS	National Defense Strategy
NPC	Non-Player Character
NPS	Naval Postgraduate School
OJT	On-the-Job Training
PC	Personal Computer
RPG	Role-Playing Game
RTS	Real-Time Strategy
SAF/AQC	Deputy Assistant Secretary of the AF for Acquisition (Contracting)
SGS&C	Serious Games Showcase and Challenge

TDY	Temporary Duty
TRS	Training Squadron
TVG	Team Video Gaming
VR/AR	Virtual Reality/Augmented Reality

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I would like to thank my wife, Heather, for always supporting me no matter how crazy my work schedule became during this unpredictable time. It took more than my individual effort to be able to complete this program nearly 100% from home. It took a team, and Heather is the backbone of that team. Without her, none of the success I have been able to enjoy would be possible. Thanks, and I love you, babe!

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— Captain Matthew Marshall

I want to thank my family for their love and always being there for me. I also want to thank Air Force leadership for giving me the opportunity to come to NPS. The school has been great and really allowed us to take a topic and run with it. Additionally, I want to

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— Captain Lee Whitworth

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— Captain Ian Larsson

I. INTRODUCTION

> It is really essential that we understand what is different about building a contracting technician in our past to a fully capable Air Force business leader for the future.
>
> —USAF Maj Gen C. Holt,
> interview with Kraig Conrad, March 1, 2021

A. PROBLEM STATEMENT

Air Force (AF) contracting senior leadership has prioritized the need to modernize and optimize the career field's training (Department of the Air Force, 2018). However, the AF has yet to explore how gaming can enhance training. Also, there is a lack of data available on the topic to help leadership make decisions. Our methods included deploying a minimum viable product gaming training experience to students in place of a more traditional training method (e.g., PowerPoint and lecture). A six-week experiment identified learning retention results and a survey compared sentiments about each form of training between the control and treatment groups.

Shortly after his confirmation hearing in May 2020, General Charles Q. Brown Jr., the Chief of Staff of the Air Force, detailed six priorities. Air Force priority number three states:

Developing Airmen: "New Airmen are smart, tech savvy and eager to learn", which is why the AF's "classroom model has some catching up to do." We must "take advantage of emerging technology to teach Airmen the way they learn best." That will help us "move from a classroom-centered to a learner-centered model of training, which has far-reaching implications." (McCullough, 2020, para. 3)

This priority highlights the need for real change in the Air Force's approach to training. The AF contracting career field's training practices are dated and inefficient with continued use of the classroom-centered model (AFICC, 2021). A gamified approach is one way to modernize training.

Gamification is not a new phenomenon. Gamification is the addition of game elements to non-game activities (Gamify, n.d.). Commercial industry has been applying it for many years and has been able to create training games that improve knowledge retention, skill development, and elicit positive feedback from employees compared to traditional training methods. The government and military have also used games and simulation in areas such as flight training, wargaming, weapons skills training, and recruitment (Smith, 2009). However, little or no application of gaming has been applied specifically to contracting training. Senior AF contracting leadership has expressed interest in the notion and there is mention of "a fair amount of debate" (D. Carr, personal communication, May 4, 2021, para. 1) on the topic, but also an admission of a lack of data. This study attempted to fill that data gap and help AF leadership make informed decisions about where to take the future of contracting training.

The potential contributions of this research are far reaching. Primarily, it could help shape the transformation of contracting training. In line with the CSAF priority, it could stretch beyond contracting to other career fields that have yet to explore gamified training. This research could result in cost savings, increased efficiencies, and overall improved employee satisfaction levels throughout the force.

Gamification of training can provide numerous benefits for employees and the companies they work for (Basten, 2017). Industry leaders have begun incorporating gamification into their training methods with great success. Wal-Mart partnered with a game development company and created an app for iOS and Android devices called "Spark City." Within the app, employees were given the ability to experience the day-to-day activities a manager might face, from helping a customer locate an item to mentoring other employees. The feedback received from employees was extremely positive (Grill-Goodman, 2019).

B. PURPOSE

The purpose of this program evaluation is to evaluate the Air Force contracting's enlisted technical school instruction methods, comparing standard instruction methods to gamified methods from August 2021 to September 2021. Furthermore, we explore these

differences across heterogeneous curriculum and instructor delivery methods at the Naval Postgraduate School's (NPS) MBA program. This study is being conducted to assist the Deputy Assistant Secretary of the Air Force for Acquisition (Contracting) (SAF/AQC) Maj General Cameron Holt, the Air Force Installation Contracting Center (AFICC), and the Air Force enlisted contracting technical school with process improvements. It has previously been identified within the Department of Defense (DoD) that the way acquisition professionals are trained and equipped needs to change (Lord, 2020). Leaders within the acquisition community view this change as necessary to answer the call of the 2018 National Defense Strategy (NDS) (Lord, 2020). The NDS discusses how the abilities of the workforce to "integrate new capabilities, adapt warfighting approaches, and change business practices to achieve mission success," are critical to preparing for and ultimately winning a potential conflict with a near peer adversary such as Russia or China (Mattis, 2018, pp. 7-8).

The military already has a long-standing history of using games for training. In the 1900s, military leaders used miniature figures on a table when war planning. Fast forward to today, and you will find several examples of computer and console video games created for both entertainment purposes and military training (Smith, 2009).

C. RESEARCH QUESTIONS

a. Primary Questions

1. Does gamification of the Air Force's enlisted contracting training affect learning and knowledge retention?
2. What are trainees' feelings towards gamified training methods compared to traditional training methods?

b. Secondary Question

3. What features of gaming are most applicable to Air Force contracting training?

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II. BACKGROUND

Chapter II of this paper will provide background on the topic of gamification. The definition of gamification will be provided, as it relates to the intent of the research. The core features of games and their importance in contracting training will be summarized, along with a brief explanation of Bartle's taxonomy of player types. Lastly, some example use cases in both military and commercial applications of gamification will be explored.

A. DEFINITION OF GAMIFICATION

The gamification of education and training is becoming more popular. It is important to understand what gamification is and some important concepts related to the education approach, while also being aware of use cases.

"Gamification of education is a developing approach for increasing learners' motivation and engagement by incorporating game design elements in educational environments" (Dichev & Dicheva, 2017, p. 1). This definition of gamification will be used as it is most suited to the overall experiment of comparing training modalities. Many elements of games can potentially be examined, and the program evaluation could not encompass all of them. Understanding the core features of games will assist the researchers in understanding how the features impact the effectiveness of gaming modalities in contracting training and education. Core features, in this case, are those features that are most applicable to the context of the evaluation (a military training environment) as determined by the researchers.

B. CORE FEATURES OF GAMES

There are many defining features of games that can be considered in this scenario. Typically, one might call these attributes; however, the term "attribute" has been used widely in gaming to describe characters and their traits within a game. We turn to the term "feature" to describe underlying components of what a game is, including their mechanics. Games created for the primary purpose of learning may employ different features than games focused on entertainment; however, there are many features that span across both

types of games. The primary descriptor of a game is that it is "fun." The ability to evoke a sense of fun from the player is what separates games from many other activities. Good games are fun because they contain the following features that can be organized into three categories: challenge, fantasy, and curiosity (Malone, 1980). Wilson et al. (2008) attest that fantasy, representation, sensory stimuli, challenge, mystery, assessment, and control are some of the most important features. McGonigal (2012) believes that all games share four defining features: a goal, rules, a feedback system, and voluntary participation. From these three sources, commonalities emerge. The remainder of this section will explore many of these features and how they can apply to contracting training.

1. Fantasy

Fantasy involves creating make-believe environments, scenarios, or characters (Wilson et al., 2008). It allows players and learners to be removed from the real world and take on traits or identities that they would otherwise not access. Examples of fantasy include mythical creatures like dragons, far off lands such as the planets Jupiter or Neptune, or futuristic timelines in which robots rule over humans. All of these situations must be imagined by the players. One might wonder how fantastical elements may influence a contracting trainees' learning. Fantasy is a feature that engages the learner (Wilson et al., 2008). This is an important feature because typical military training methods are often delivered through traditional methods, resulting in passive and unengaging learning (Michael et. al, 2009). In a 2020 survey of Defense Language Institute students, respondents stated that they would prefer a magical setting to other settings, signifying fantasy features should at least be considered in game development (High, 2021). Trainers have limitations on how to deploy a training curriculum because a majority of the content is developed and controlled by a centralized authority. The DoD is a structured organization that inherently depends on hierarchy (as with the chain of command) to be effective. In contracting, many training lessons ignore fantasy. They are based on real world scenarios and federal regulations. Adding fantasy to contracting training increases the potential for employees to have fun with learning. Fantasy also encourages participation by removing the fear of consequences. This is a notion that is also currently missing from contracting training. In the "real world" when mistakes are made by a trainee, there are

ramifications, perhaps to the mission, or more importantly, to the perception of a trainee's capability. Gamified training can help alleviate this restrictive quality of traditional training.

2. Challenge (Goals)

The importance of challenge is a feature of games that many researchers agree upon, including Malone and McGonigal, although both refer to the feature differently. This section combines Malone's description of challenge and McGonigal's description of goals because they are interconnected. Challenge requires a balancing act of how difficult or easy a game should be. Finding the balance affects a player's motivation and desire to achieve an outcome. Usually that outcome relates to the overall goal of the game. Players that are motivated want to reach the goal and win the game. As McGonigal states, "the goal provides players with a sense of purpose" (2012, p. 31). However, if the level of challenge does not match the player's skills, it becomes too easy or too difficult, which results in players becoming disengaged or frustrated (Wilson et al., 2008). In addition to goals and subgoals, challenge also incorporates uncertain outcomes and affects a player's self-esteem (Malone, 1980). Malone (1980) explains a game diminishes in fun when the player is prematurely aware of its outcome. Players who know they are certain to win or lose become bored, but there are four ways to create uncertainty and avoid boredom. Variable difficulty level, multiple level goals, hidden information, and randomness of interactions can create uncertain outcomes (Malone, 1980). Variable difficulty involves the player being allowed to choose to play the game in "easy," "normal," or "hard" modes. This allows players to match their skill with the challenge while also encouraging them to increase the difficulty as they become more proficient in the game. One example of a multiple level goal in a golf game may be to drive the ball onto the fairway off the tee. The metagoal is to complete the hole, but additional rewards (in-game currency) can be earned by completing the "finding the fairway" subgoal. Hiding certain information from the player is another way to add uncertainty. For example, in an escape room situation the players know the goal but have very little obvious information (aside from maybe a locked exit door) to help achieve that goal. Hidden information evokes curiosity and increases the challenge of the game (Malone, 1980). Lastly, randomness contributes to uncertainty. Modern games use

sophisticated artificial intelligence (AI) to produce randomness. Enemy characters have the capacity to react in dozens of different ways based on the player's actions, further increasing engagement by the player and uncertainty in the outcomes. To expand, some interactions rely on "if, then" parameters, meaning, for example, an enemy player can react in any number of ways when engaged, but the player is unaware of all possible reactions, barring dozens or hundreds of play-throughs. The reactions are not always and completely random, but can be, and are felt as such by unaware players. Self-esteem is the final factor of challenge. Malone (1980) says that success in a computer game can make people feel better about themselves. However, it is another balancing act. If the challenge becomes too great, it may reduce a player's self-esteem. It is critical that contracting training meets learners with the appropriate challenge. Today's curriculum already employs this notion through different levels of training taught only after certain experience levels are met. Initial skills training, like what is taught at the enlisted contracting training schoolhouse, is an easier challenge than what is taught throughout a 7-level certification. This makes sense because initial skills training is for brand new employees that hope to reach 'apprentice-level' skills, while 7-level certification is for mid-level employees trying to reach 'craftsman-level' skills. One drawback of this approach is the broad categories. The newest of employees may still have different levels of experience, in contracting or otherwise, and the training is not flexible enough to cater to every individual. Gamified training may allow for more individually customizable training that can meet the challenge preferences of nearly every trainee.

3. Representation

Representation is the opposite of fantasy. It is the physical and psychological similarity between a game and the environment it represents (Wilson et al., 2008). This feature has strong ties to military training because military training is so unique. It is important for certain applications of training to mimic the real world since trainees would not experience the situation in any other facet of life, such as with war and combat tactics, techniques, and procedures. This can be factored into gamified contracting training in various ways. It may be important to learn the environment of a wartime negotiation for road construction in hostile territory. Placing a trainee into a virtual conference room (or

tent) face-to-face with a contractor's negotiation team, fit with language translators and the looming threat of potential mortar fire is a situation where representation becomes critical. Compared to fantastical environment, this approach may better help the trainee understand the "feel" of a negotiation, the tension, and the importance of communication.

4. Curiosity, Mystery, Feedback

Curiosity and mystery also add to how fun and engaging a game is. These features affect motivation, similar to challenge. Malone (1980) claims that "game environments should be neither too complicated nor too simple" (p. 165), they should be novel, but not incomprehensible. Mystery paints a broader stroke but arouses curiosity in "two forms—sensory curiosity and cognitive curiosity" (Wilson et al, 2008, p. **). Sensory curiosity attracts the attention of players through sensory feedback, such as light or sound (Malone, 1980). This can be experienced in games through offering players an audible "ding" when reaching a new character experience level. It is heard as a "buzz" noise when answering a trivia question incorrectly. Cognitive curiosity is provoked by paradoxical information (Wilson et al., 2008). In a game, learners want to complete their information by filling in any information gaps. Again, both of these forms of curiosity motivate the player to continue trying to reach the goal. In relation to contracting training, curiosity plays a role. The features of curiosity and mystery are closely linked to feedback. The feedback system informs players of their performance or how close they are to reaching the goal (McGonigal, 2012). Feedback is important for learners, and it is a concept taught from the very beginning of a military member's career. Sensory curiosity can reinforce a trainee's learning and help them stay motivated. Cognitive curiosity may be more important when learning outcomes are the primary focus. There will be predetermined learning outcomes that the trainees must attempt to achieve. Evoking cognitive curiosity through the presentation of complex, unknown information will also motivate learners through their desire to fully form the information.

5. Rules

While Wilson et al. (2008) combine rules and goals as similar features, McGonigal separates the two and clearly defines rules. "Rules place limitations on how players can

achieve the goal" (McGonigal, 2012, p. 32). Rules are critical to the effectiveness of games. Without them, reaching the goal becomes diluted, as the player can navigate through objectives free of any restriction. Rules motivate players to explore uncharted possibilities in games (McGonigal, 2012). Ultimately, rules foster increased creativity and foster strategic thinking (McGonigal, 2012), furthering levels of fun and participation. Wilson et al. (2008) agree that well established rules are necessary components of effective education games. There are three types of rules: system rules, procedural rules, and imported rules (Wilson et al., 2008). System rules are those functional parameters inherent to the game itself (Wilson et al., 2008). Procedural rules are in-game actions that control behavior (Wilson et al., 2008). Lastly, imported rules are those that originate from the real world (Wilson et al., 2008), such as physical limits of human beings. Without rules, games do not exist, as the greater goals of the game become too easy to reach.

6. Voluntary Participation

Voluntary participation is the last of McGonigal's four defining features of games. This feature means that players willingly accept the parameters of the game. The goal, the rules, and the feedback are known by all and that establishes the common ground from which all players start (McGonigal, 2012). This makes games transferrable between all players, meaning no player has an unfair advantage as a participant. Also, the ability to come and go in a game "ensures that stressful and challenging work is experienced as a safe and pleasurable activity" (McGonigal, 2012, p. 32). Voluntary participation can be critical to the success of games that are focused on training and education. Lowering or removing the consequences in a training environment allows learners to experiment in ways they may not have been comfortable with in traditional training delivery methods. Wilson et al. call this feature "safety." It is a safe way to experience reality through the disassociation of actions and consequences (Wilson et al., 2008). This feature leads directly into the next topic of how some of these features can be used in the gamification of contracting training.

7. Features Discussion

Can the features of fantasy, challenge (goals), representation, mystery, curiosity, feedback, rules, and voluntary participation (safety) be used in gamified contracting training? Some brief examples will be discussed here and further developed throughout the findings and results of the research.

Fantasy engages the learner. Each of us have experienced military training directly, including contracting training, and found that it is not always fun and engaging, anecdotally confirmed by our professional colleagues. Elements of fantasy allows learners and trainees to escape the boredom of typical contracting training and can transport them into surreal environments, detached from the office life, with the goal of increasing engagement and attention. Challenge boosts motivation, pushing players to be competitive and reach the goal. Competition is an idea that is introduced early in a military member's career. Basic military training uses competitive factors in different aspects of training, such as physical fitness, weapons qualifications metrics, and even competition between teams of trainees. This early instillment of competition can be implemented in contracting training games using scoreboards between members and contracting offices. Representation, the feature of realism, has its place in contracting training, as well. For example, a strong example would be a simulated negotiation with potential contractors. Placing a trainee in a realistic, gamified, negotiation environment could expose them to the need to think on their feet, the potential tension, and how to conduct a professional negotiation. Mystery, curiosity, and feedback are all important factors that increase engagement and fun, which again, is lacking in some military training. Mystery and curiosity could be deployed through puzzle-type games that asks players to use contracting knowledge to solve them. Rules are needed in all games and contracting training games are no exception because contracting is a regulatory profession that extends from basic commercial purchasing to complex, multiyear programs in the face of legal, budgetary, and political limits and influence. Therefore, rules are essential to evoking realistic constraints. Voluntary participation could be critical in gamified military training. Not in the sense that the workforce has an option to do training, but that the consequences of their performance in the game world is decreased or eliminated when compared to the real world. This allows players to fail a

negotiation, having both parties walk away short of a resolution, without the consequences of a strained business relationship, the humiliation of failure, or the potential reprimand from leadership. Having the ability to fail provides a certain level of safety in training and could be helpful in a military culture of success. Some of these features are further explored in the execution of the research and throughout the findings and results. We see specific features of games do matter, but games are not just about mechanics and environments. They are about players and people. Next, we explore how various types of players have been considered in the literature to inform our study.

C. BARTLE'S TAXONOMY OF PLAYER TYPES

Anytime a game is developed, it is important to consider Bartle's taxonomy of player types. Most games do not entice every type of player. That is where Bartle's taxonomy comes into play. Bartle's taxonomy helps steer the game development and marketing toward different types of players. Bartle created player types out of a debate about what people wanted out of a multi-user dungeon (MUD) game (Bartle, 1996). Bartle summarized months of discussion on the topic into four sub-groupings of player types and their desires.

Bartle (1996) found that people typically enjoyed four things about MUDs. Achievement within game context, exploration of the game, socializing, and imposition upon others. These four aspects were graphed using the source of players' interest as axes, see below. The x-axis stems from an emphasis on players to an emphasis on the gaming world and the y-axis starts at interacting with players to acting on players (Bartle, 1996).

INTEREST GRAPH

Consider the following abstract graph:

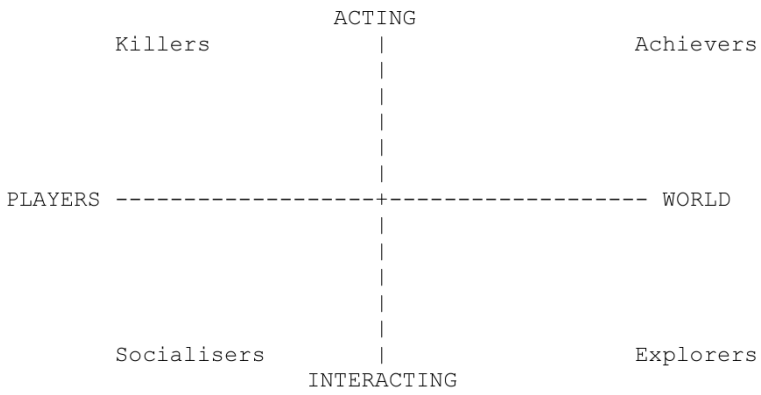


Figure 1. Bartle's Taxonomy of Player Types. Source: Bartle (1996).

The four types of players are then: killers, achievers, socializers, and explorers. To paraphrase Bartle; killers act on other players and assert dominance, achievers act on the world and amass prestige, socializers interact with players and build relationships, while explorers interact with the world and seek knowledge about it (1996).

This typology serves as a foundation for developing gamified contracting training. This taxonomy can be used to determine the overwhelming gamer types found in our study in an effort to inform future game design and studies following our work. The implications of Bartle's taxonomy of player types will be discussed in future sections of this research.

D. USE CASES: MILITARY

The use of games is not a new idea for the DoD. "The military has been using games for training, tactics analysis, mission preparation, and systems analysis for centuries" (Smith, 2009, p. 1). Also, with the ever-increasing popularity of video games, military branches have sponsored their own eSports gaming teams, such as the United States Army eSports Team and Air Force Gaming. In fact, the Army developed a first-person shooter game called America's Army and it is labeled as the official game of the United States Army. Games and video games go hand-in-hand with the military and DoD. That is just one example of how our military uses games. Wargaming is another popular use for games

in DoD settings. The Naval War College used wargaming in the 1920s to simulate a conflict with Japan in the Pacific (Mason, 2018). The RAND Corporation, supporting the Air Force, conducted wargaming to explore the "possibilities of conventional and nuclear war with the Soviet Union" (Mason, 2018, p. 88). Trivia games are often used in training sessions to help newer employees learn foundational knowledge about their jobs. Simulated office environments have been used in security training games in the Air Force. Also, as technology has advanced, simulations have been developed to prepare "Army officers for actual maneuver warfare in the *Desert Storm* war" (Smith, 2009, p. 13).

The United States Air Force has gamified various types of training, from professional development training to job skills training. The Defense Language Institute in Monterey, California has recently started development of a third person role-playing game aiming to teach Arabic to future linguist students through translation activities. As mentioned above, militaries have used wargaming and simulation for decades. Gamification has also been applied to talent management through recruiting efforts and in virtual and augmented reality. All of these activities implement some element of games into otherwise non-gaming environments, resulting in gamification.

In a video interview, MSgt Jessie High, United States Air Force, described to us an ongoing effort to bring gamification to language learning at the Defense Language Institute. The game, currently titled "Mage Duel," puts players in control of an avatar to battle other "mages" in arena combat. Learners must first translate various phrases to gain additional power that will help them in duels. Damage score and speed score are increased depending on how quickly and correctly phrases are translated. The game is being developed by CurriculaWorks and early testing and gameplay are promising, with 83% of survey respondents saying they would play a learning game at least twice a week and 47% saying they would play it daily (High, 2021).

In his book, America's Digital Army, author Robertson Allen explains the use of gaming and the game "America's Army" by the United States Army for recruitment purposes, among other objectives. The game, which can be downloaded for free and features online play, would significantly influence army recruiting (Allen, 2017). The "America's Army" platform sparked another recruitment effort with the "mobile mission

simulator," aiming to reach predominately nonwhite regions of cities as it toured the United States at air shows, fairs, and NASCAR events (Allen, 2017). This approach revolutionized recruitment for the Army and is a prime example of how the DoD implements gamification.

Gamification can also be seen in the virtual and augmented reality (VR/AR) space. The game traits of instant feedback and representation are used by aircraft maintainers at Dyess Air Force Base, Texas. The 317th Maintenance Group is using VR to transform how "maintainers are learning and perfecting their craft" (Patterson, 2020, para. 1). "One of the more impressive aspects of the lab is the direct feedback capability our instructors can use." (Patterson, 2020, para. 7). Patterson (2020) goes on to highlight the benefits of the virtual training, saying extreme temperatures can be avoided, aircraft availability is increased, and training can be completed more quickly.

The gamification of contracting training in the Air Force could potentially be another useful implementation of games because there are aspects of contracting training that need the benefit of additional engagement found in video games and there are aspects of Air Force contracting that require business acumen and critical thinking in an environment free from the risk of impacting real-world budgets, mission, or legal security, thus allowing players to explore and learn.

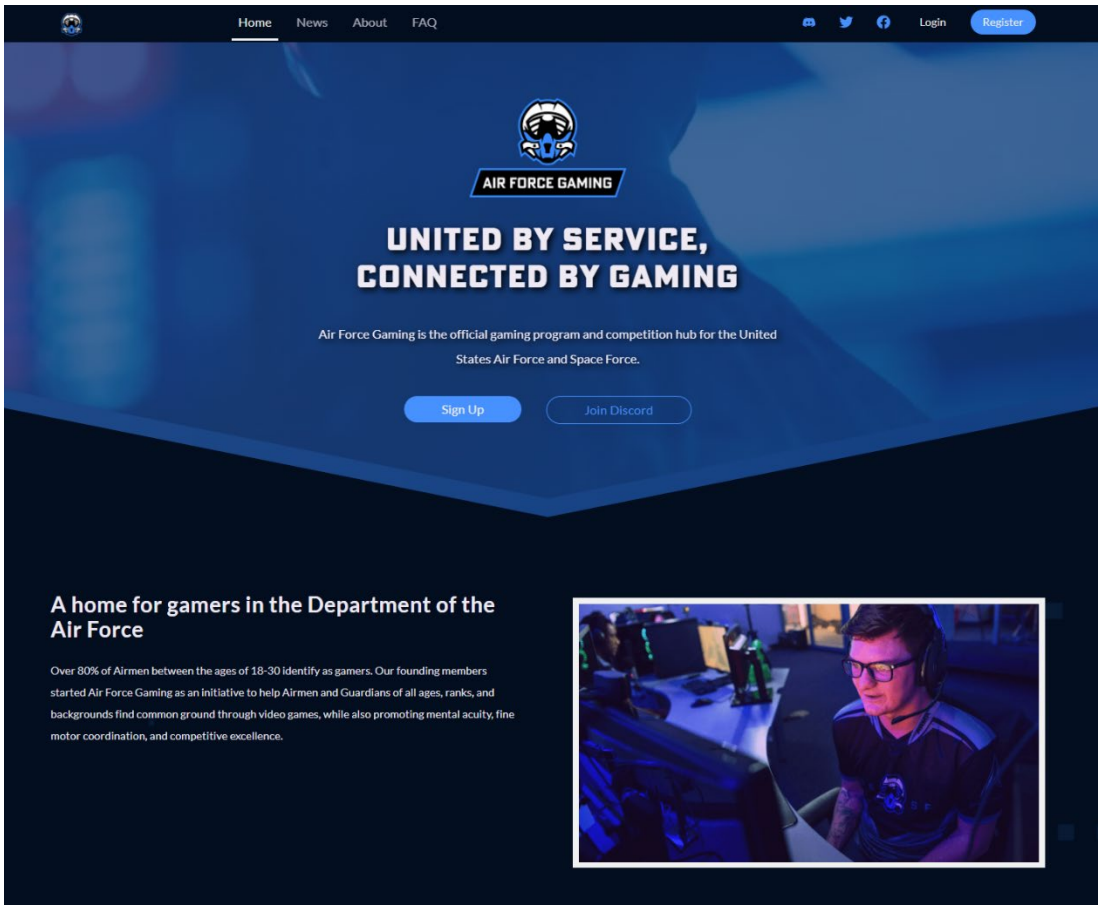


Figure 2. Air Force Gaming Website Home Page

E. USE CASES: COMMERCIAL INDUSTRY

Organizations in the commercial sector also use games to help meet organizational goals. Corporate training has been implementing gamification and the elements of games with the intent to streamline the onboarding of new employees, improve training results, and make routine training more engaging. In one example, Walmart developed a mobile application called "Spark City" to train their associates. The simulation game "puts players in charge of a Walmart dry grocery department" to help them learn the day-to-day responsibilities of the department (Walker, 2019 para. 1). The game is designed for current managers, but also associates that are not managers and want to learn more about their departments. The developer has added new department levels and features since the game's initial release (Walker, 2019). As of September 2021, the application has over 500,000 downloads on the Google Play store.

Figure 3. A screenshot from Walmart's "Spark City" Training Game

The company Deloitte partnered with Badgeville to gamify executive leadership training. They used badges, leaderboards, and status symbols to motivate executives to complete the training, which resulted in 50% faster completion rates (Bradt, 2013). Companies are also using gamification to streamline and improve compliance in business travel management. Ovation and Rocketrip, both travel-related companies, have created rewards systems in which users can earn points that can be used to make purchases and even cash (O'Brien, 2014). Lastly, while not directly tied to corporate training, one of the most successful examples of gamified training is the app Duolingo. Duolingo helps users learn new languages with easily digestible content and uses gaming elements like reward points, leaderboards, a level system, and badges (Huynh et al., 2016). Duolingo has over 500 million users and is known as one of the best free language learning software available. These are just a handful of examples of how gamification is used in commercial business training and how millions of users participate in gamified training and learning through software like Duolingo. Commercial and government agencies alike could benefit from gamifying their training. However, without experimental research that idea remains

supposition. Our research is the first of its kind to explore outcomes of gamified procurement policy training, particularly in defense acquisition and contracting.

F. SUMMARY

This chapter provided a background of gamification. Gamification was defined as adding game elements to non-gaming contexts. The characteristics of games and a summary of Bartle's Taxonomy of Player types provided information on what makes something a game and how players interact with games. Lastly, a brief exploration of use cases offered context on how both the government (particularly military) and the commercial sector use games-based training and education.

III. LITERATURE REVIEW

Chapter III of this paper will explore the literature related to the gamification of training, education, and learning. While there is very little research related to the specific topic of the gamification of government acquisitions, there is associated literature available. The different types of learning, the differences in the way adults learn compared to children, and the effects of gaming on the learning process will be discussed.

A. THE WAYS WE LEARN

Researchers have classified several different learning and teaching techniques into two main categories, passive learning and active learning. In this section, we will discuss the differences in these two types of learning and give examples, as well as discuss Malcolm Knowles' Six Principles of Andragogy, Bloom's Taxonomy, and the Kirkpatrick Model for evaluating training programs.

1. Passive Learning

Passive learning is considered the traditional learning and teaching method. This approach is mainly centered around one expert in a field passing knowledge onto others in a lecture style format. The learner is not interacting or applying knowledge learned in any way.

> Although the traditional lecture method is still predominant, some studies have shown that students fail to retain as much material after the class has been completed in comparison to classes taught in an active environment. Another drawback to this method appears to be a lack of student attention, which many educators have observed in their own classes. (Michel et al., 2009, p. 400)

Other examples of passive style learning include reading from a textbook, watching a video, or clicking through an online training.

2. Active Learning

Active learning, on the other hand, is much different than passive learning. When active learning is employed, the learner is involved with the learning process. This could

come in a variety of different forms, but ultimately active learning means that the learner is engaged. "…[A]ctive instruction involves explicitly prompting the learners to engage in learning activities (e.g., assignments, exercises, laboratory experiments)" (Sailer & Homner, 2020, p. 82). Studies have shown that active learning offers benefits that passive learning does not.

> Active learning provides the following benefits: students are more involved than in passive listening; students are engaged in activities such as reading, discussing, and writing; student motivation is increased; students can receive immediate feedback; and students may engage in higher-order thinking, such as analysis, synthesis, and evaluation. (Michel et al., 2009, p 399)

3. Adult Learning

In addition to passive and active learning, American educator Malcom Knowles claims that adults learn differently than do children. He was well known for using the term "Andragogy" to explain his theory. Knowles (1980) defined Andragogy as "the art and science of helping adults learn, in contrast to pedagogy as the art and science of teaching children (p. 43). According to Chan (2010) "Knowles' perspective on andragogy is based on six main assumptions" (p. 27).

a. Need to Know

Adult learners want to know the "why" behind what they are learning. Why do they need to know what it is you are trying to teach them? Explaining the "why" allows the learner to focus their concentration on mastering the subject matter because they can understand the importance of it.

b. Role of Experience

Adults bring their own experiences to the learning process. Sometimes these experiences are useful to themselves, but also useful to other classmates or students. Involving the class in discussions can bring these out and provide value to the learning process.

c. Readiness to Learn

Adults are ready to learn when they feel like they need to know something. For instance, someone who aspires to be a politician would in theory devote much more time and attention to learning about different policies and practicing how to speak in public, while someone else who aspires to be an engineer might spend their time focusing more on math and architecture. If the learning adult feels they need to know, they are ready to learn.

d. Orientation to Learning

Adults want to solve immediate problems. Therefore, they want to learn the specific knowledge required to solve those immediate problems. Any time spent learning things they feel are irrelevant to the task at hand is time wasted.

e. Self-Concept

Adults need to feel like they are in control of their learning. Allowing them self-direction gives them purpose, which leads to more buy-in to learning.

f. Internal Motivation

Adults learn best when they are motivated internally versus externally. External motivation is usually what happens when adults are forced to learn something they do not want to learn. For instance, say a co-worker designs a new spreadsheet to track all work tasks and your boss wants everyone to use it moving forward. Most people will be reluctant to learn the new workflow because they are used to the way things have been in the past. However, the external motivation comes from not wanting to anger their boss. Aligning the other five principles helps build the internal motivation to learn. Knowing the "why," having previous experience to draw on, feeling the need to learn something, and understanding the problem the new knowledge will help build on internal motivation.

4. Bloom's Taxonomy and The Kirkpatrick Model

"In 1956, Benjamin Bloom with collaborators Max Englehart, Edward Furst, Walter Hill, and David Krathwohl published a framework for categorizing educational

goals: Taxonomy of Educational Objectives," (Armstrong, 2010, para. 1). Figure 4 below demonstrates each of the educational goals, starting from the learner being able to remember the material they were being taught, and going up the pyramid all the way to the learner knowing the subject matter so well that they can create new knowledge on the topic.

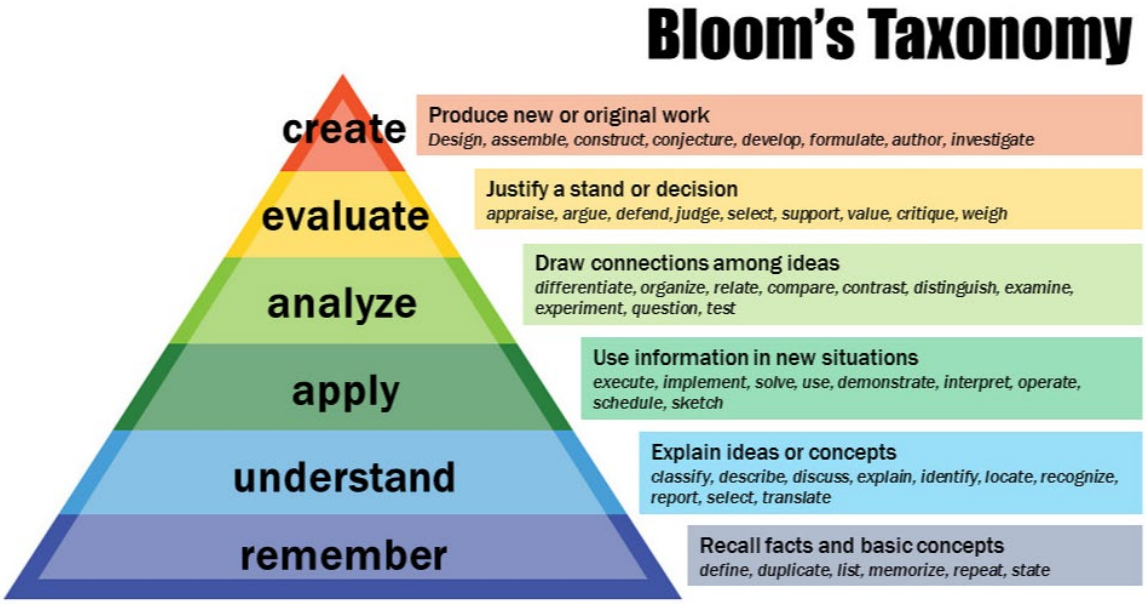


Figure 4. Bloom's Taxonomy. Source: Armstrong (2010).

Bloom's Taxonomy is an effective and useful tool for understanding what level of knowledge you want to teach to as a teacher and what level you are trying to learn to as a student.

Dr. Donald Kirkpatrick, once a president of the American Society for Training and Development, developed the Kirkpatrick Model as a method for evaluating how well a training program achieves its desired results within an organization. The Kirkpatrick Model has four levels of evaluation to consider; 1. Reaction, 2. Learning, 3. Behavior, and 4. Results (Smidt et al., 2009). First, the model records participants' reactions to the training program. Were they satisfied? Were they interested in the training? This level of evaluation does not consider whether the participants learned anything at all, but rather what their impressions were of the training. In most cases, this type of sentiment is recorded by asking

the participants questions in a survey type format. The second level of the Kirkpatrick Model evaluates the learning of the participants. Were the participants of the training program able to learn the intended material? Was the desired knowledge gained? Measuring this outcome can be done in a variety of ways, including written question and answer tests, case and role-playing guided scenarios, or simply with a discussion. The third level of the Kirkpatrick Model gets at evaluating the behavior of participants who have completed the training program. Were the trainees able to use what they learned in their work duties? Did the trainee change their behavior after completing the training? The fourth and final level of the Kirkpatrick Model evaluates the results of the program on the entire organization. What benefits did the organization receive? Were there cost savings, fewer incidents, or less employee turnover? Was the morale or job satisfaction of the employees improved (Smidt et al., 2009)? Figure 5 below demonstrates the four levels of the Kirkpatrick model.

Figure 5. The Kirkpatrick Model. Source: What is Kirkpatrick's, (2020).

For the purposes of our program evaluation, we aspired for the participants to achieve the second tier of Bloom's Taxonomy, "Understand." After playing through Sandbox Contracting, the players ideally can explain, describe, identify, and translate the key aspects of lesson presented to them. Additionally, we sought to implement the first two levels of the Kirkpatrick Model in evaluating the training. We aimed to know how the participants reacted to the idea of using games and gamification for learning government acquisitions as well as how well the participants learned using games and gamified methods. Time and resource constraints prohibited us from exploring higher levels and tiers of Blooms and Kirkpatrick models. Based on these considerations, we used a pre- and post-evaluation survey which will be discussed in further detail in Chapter IV, Methods and Findings.

B. EFFECTS OF GAMING IN TRAINING AND LEARNING

1. Benefits of Gamification

Games and gamification of learning provides numerous benefits to the learning process. Such benefits include increased engagement, providing a safe place for trial and error, letting learners play while progressing at their own pace, providing immediate feedback that can change behavior, increasing self-efficacy and intrinsic motivation, fostering healthy competition and teamwork collaboration, and finally increasing speed to competence and knowledge retention. However, no such research has been conducted to determine if gamification of training and education can work in the government acquisitions community. We seek to explore its impacts on acquisition-related learning in the DoD and determine if these benefits are found in an environment rife with strict structural regulation and competing priorities such as public trust, speed, and value.

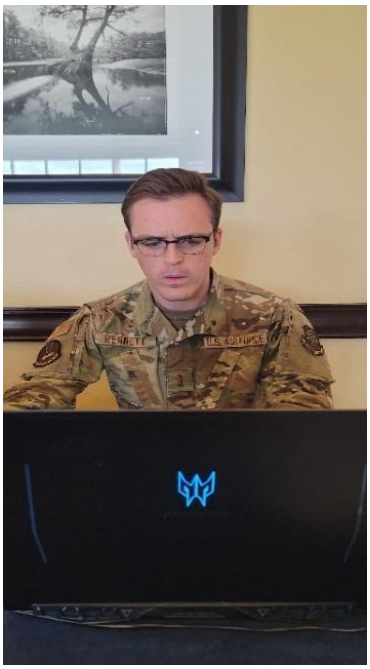
All the research to date on gamification of business training has been conducted in the non-governmental sector, with Business-to-Business (B2B) relationships in mind. However, as Brett Josephson brought to light in the empirical study "Uncle Sam Rising: Performance Implications of Business-to-Government (B2G) Relationships," there are several differences between these two markets (Josephson et al., 2019). With these

differences in mind, our goal is to explore how gamification operates/effects learning within government market settings.

a. a. Increased Engagement

Games, or gamification, can affect the learning process in many ways. One of the most obvious ways is by increasing learner engagement. We learned in the previous section that active learning is widely considered to be preferable to passive learning. By increasing learner engagement via gamification, the learning process is moved from passive to active. Games can pull you in and immerse you into the learning process. When a learner is fully immersed and focused on the task at hand, they enter what is known as a state of "flow."

Hungarian psychologist Mihaly Csikszentmihalyi coined the term "flow" back in the early 1990s. He was studying what makes people happy and ultimately concluded that, among many things, the concept of "flow" was very influential to how people felt about an activity or experience. "These investigations have revealed that what makes experience genuinely satisfying is a state of consciousness called flow--a state of concentration so focused that it amounts to absolute absorption in an activity," (Csikszentmihalyi, 1990, p. 1). He goes on to state that flow is best achieved when someone is engaging in an activity that is not too easy, but also not too difficult for a person's skills and abilities. Games are a good way to achieve flow because not everyone has the same skills and abilities. A game can adjust difficulties, to not be too difficult or too easy for varying skill levels of individuals.



USAF Second Lieutenant Robert Bennett in "flow" as he plays video game Sandbox Contracting at the 2021 Air Force Contracting World-Wide Training Summit (AFCWWTS).

Figure 6. Player in "Flow"

Additionally, games help keep the learner engaged because our brains seek out the pleasure that games offer. "Research has shown our brains are 'wired for pleasure,' and that games are an effective way to learn because they simulate adventure and keep our brains engaged and happy," (Noonoo, 2019, para. 2). This is an important observation because keeping someone engaged with learning is not an easy task. As noted by a LinkedIn Learning report from 2020, when learning and development (L&D) professionals were asked what they perceived as their three biggest challenges they faced in the coming year, "increasing employee engagement in learning" was number three on the list of all responses and was mentioned by 36% of all L&D professionals, (LinkedIn, 2020, 22).

According to Richard Mayer, when he discussed the Science of Learning, while we are actively engaged in the learning process there are three critical steps that are taking place in our cognition, (a) selecting, (b) organizing, (c) and integrating (Mayer, 2008). Selecting refers to paying attention to the incoming material, organizing refers to attempting to make sense out of what you received, and integrating refers to finding a place

for the new material alongside your existing long-term memory and experiences. We have all at times tuned out for the "selecting" part of Mayer's theory due to being a disengaged learner during mandatory online trainings or even an important lecture. With the increased engagement that gamification offers to the learning process, the likelihood of this occurring decreases.

b. Trial and Error

Another effect games and gamification have on the learning process is to provide a safe space for trial and error. "Trial-and-Error Gameplay is what happens when an incorrect (in-game) action kills the character, ends the mission in failure, or otherwise forces the player to replay that part from the beginning again," (Trial-and-Error Gameplay, n.d., para. 1). Airline pilots learn how to fly a plane by flying in a simulator prior to the real thing. Firefighters practice their firefighting skills by putting out simulated fires. This allows for the user to make costly mistakes in an environment in which there are no real-world consequences. In this type of learning, the user is free to experiment and see what works best.

> Game-like materials are also far more interactive than many traditional forms of training, like tests and quizzes, allowing users to learn through active practice and to review the content to increase their knowledge, skills and confidence through repeated practice. Games can thus boost understanding and retention, giving the learner a much better chance of getting it right in real life. (Glass, 2017, para. 6)

c. Concept of Play

Additionally, games are beneficial to the learning process because they inherently introduce the concept of play. Stuart Brown is a well-known psychiatrist who dedicated decades to studying and researching play in animals and humans. His book titled "Play: How It Shapes the Brain, Opens the Imagination, and Invigorates the Soul," tells a story of a hungry polar bear who loved to play. Normally, during that time of year (November), the polar bears would travel over the frozen sea ice and hunt seals from the surface, however this particular year the sea was taking longer to freeze than usual. The polar bear was noticeably skinny and likely very hungry. One day, the polar bear had an encounter with a Canadian Eskimo sled dog. Instead of the bear turning the dog into its next meal, they

began to play, wrestling around with each other for about 15 minutes. Then the next day, the polar bear returned to the same location looking for yet another play date. The two animals continued to play every day for about a week, before the sea eventually froze over, and the bear travelled north to begin feeding. Brown asked himself how these two animals were able to play together rather than succumb to natural survival instincts. He concluded that play was a "tremendously powerful force throughout nature…(it's) intensely pleasurable. It energizes us and enlivens us. It eases our burden. It renews our natural sense of optimism and opens us up to new possibilities" (Brown & Vaughan, 2009, p. 28).

Brown (2009) defined play as having seven key properties: "apparently purposeless or done for its own sake, voluntary, inherent attraction, freedom from time, diminished consciousness of self, improvisational potential, and continuation desire" (p. 20). Games tap into several, if not all these key properties. Games are voluntary in that using games for learning should be chosen by the learner. It will not be the best method of learning for some, however those that choose to use games are not obligated to do so.

Games also have an inherent attraction because they are fun. They provide for freedom from time by allowing the player to get so engaged and immersed that they lose track of time. Playing games also allows a player to experience a diminished consciousness of self, which Brown explains as when a person stops thinking about how they look or feel (Brown & Vaughan, 2009). Games can provide improvisational potential as well. "We aren't locked into a rigid way of doing things…The act of play itself may be outside of 'normal' activities. The result is that we stumble upon new behaviors, thoughts, strategies, movements, or ways of being" (Brown & Vaughan, 2009, p. 21). In other words, games can allow us to get outside of our normal thinking and come up with new ideas or ways of doing things rather than sticking with the status quo. Lastly, games integrate a continuation desire to play. The player wants to keep going because they are having fun. They forget they are even learning important life skills like how to think critically and make good decisions.

d. Scaffolding

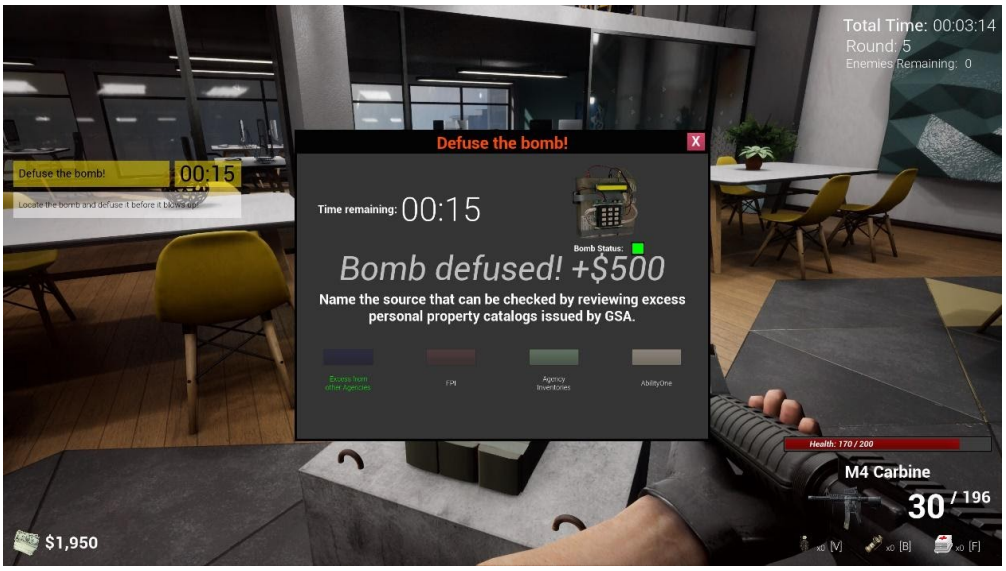
Another key benefit from using games in training is the ability for the learner to progress through the material at their own pace. This is what is known as "Instructional Scaffolding," and was derived by Lev Vygotsky's sociocultural theory of a Zone of Proximal Development. Vygotsky believed that most people learned best through social interaction, rather than in isolation. He defined instructional scaffolding as "the role of teachers and others in supporting the learner's development and providing support structures to get to that next stage or level," (Raymond, 2000, p. 169).

Every learner absorbs new material at a different rate. It does not make sense to push some along when they are struggling or hold others back when they are ready to move on. In a recent article in the *Air Force Magazine*, the Aircraft Maintenance Technical School tested a new virtual reality version of their Fundamentals of Aircraft Maintenance Course, which is the initial skills training that all new Airmen receive when going into that career field. The traditional instructor led training takes on average about 23 days to complete, however Airman Cody Alfred was able to complete the virtual reality version of the training in a mere six days, a 74% decrease in total time. "The instructors told me I could take breaks…but I didn't want to," said Airmen Alfred (McCullough, 2021, para. 3). Allowing the learner to progress at their own pace is critical for several reasons. First, the learner can fully absorb the material and move on to the next lesson once they have demonstrated mastery of the previous one. This ensures that every learner is mastering the lessons, rather than being forced to go at the pace of an entire class whether they are ready to move on or not.

e. Feedback

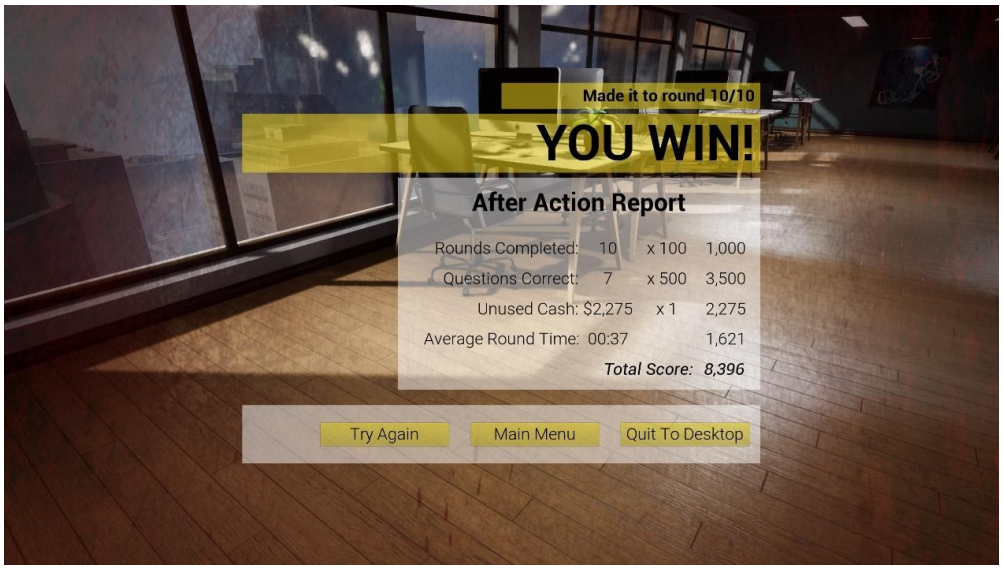
Furthermore, playing games can allow for players to receive immediate feedback on their performance. Where did they succeed? What could they have done better? Faster? This feedback is invaluable in the learning process and is a cornerstone for training and education. Without feedback, a player or learner would not be able to discern what is right from wrong and might not actually remember what the correct answer is to something in the future. In some instances, using traditional methods for learning, a learner might take a

test and never actually see what they answered correct or incorrect, but instead just receive an overall grade for the test or course. “Games…provide immediate feedback and the opportunity to change behavior based on the feedback. This instant feedback and course correction supports better knowledge retention and application on the job,” (Oesch, 2018, para. 4).



Player receives feedback while playing the student developed video game Sandbox Contracting. Player has correctly answered a question, which successfully defused the bomb and earned him/her $500 in upgrade cash.

Figure 7. Sandbox Contracting Feedback Example #1



Player receives feedback while playing Sandbox Contracting. Player has finished round ten and has received his/her total score for the run through.

Figure 8. Sandbox Contracting Feedback Example #2

f. Self-Efficacy

Self-efficacy is also extremely important to the learning process. Perceived self-efficacy is defined by renowned psychologist Albert Bandura as "…people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives," (Bandura, 1994, para. 1). In other words, after you have learned something, how confident would you be in applying what you learned. He goes on to state,

> A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided. Such an efficacious outlook fosters intrinsic interest and deep engrossment in activities. They set themselves challenging goals and maintain strong commitment to them. They heighten and sustain their efforts in the face of failure. They quickly recover their sense of efficacy after failures or setbacks. They attribute failure to insufficient effort or deficient knowledge and skills which are acquirable. They approach threatening situations with assurance that they can exercise control over them. (Bandura, 1994, para. 2)

Introducing games to the learning process has shown a dramatic increase in the learner's self-efficacy ratings. In a study conducted by Eastern Michigan University titled "Increasing Student Intrinsic Motivation and Self-Efficacy Through Gamification Pedagogy," James Banfield and Brad Wilkerson found that the average student's self-efficacy increased dramatically when taught using gamified methods versus a traditional instructor led teaching method. They reported that 90.3% of their gamification students reported a 50 or higher (on a scale from 0-100) in self-efficacy ratings, while only 28.5% of the traditional methods reported self-efficacy ratings at 50 or above, (Banfield & Wilkerson, 2014). Additionally, a study conducted by the University of Colorado Business School looked at 65 individual studies of almost 6,500 trainees and concluded that the self-efficacy for learners who were taught using games was 20% higher than for those who were not (cite).

g. Intrinsic Motivation

Additionally, when considering the benefits that games and gamification offer to the learning process, one of the more important things to consider is intrinsic motivation. Section A of this chapter titled "The Ways We Learn," discussed adult learning expert Malcolm Knowles' Six Principles of Andragogy, in which internal motivation was the largest driver. Specifically, the six principles talked about how adults have a need to know, or a need to know "why" they need to learn this material. Games help with this because they typically set the player up with some sort of problem that needs to be solved (i.e., Mario needs to save the princess or Ash Ketchum wants to be the best Pokémon trainer in the world). Another principle of Knowles' andragogy is that adults learn from their own or their peers' experiences. Games are also useful for meeting this need because most provide these experiences through the story of a Non-Player Character (NPC) within the game. A player learns what to do (or what not to do) through either their own experience with the game or by hearing the tale of an NPC's experience. Another principle of Knowles' andragogy that games, or gamification, is a good match for is self-concept, or the need for adults to feel like they are in control of their own learning. A quest type game that offers the player multiple problems to go out and solve in any order they choose aligns perfectly with this principle. A player can choose a specific quest that teaches them the specific skills

they are wanting to learn at that given moment. All these characteristics of games align with Knowles' principles of andragogy, and therefore fuel the learner's intrinsic motivation to learn.

The Banfield and Wilkerson study mentioned above also considers intrinsic motivation. They define intrinsic motivation as "…participating for pleasure, or satisfaction derived from performing an act," (Banfield & Wilkerson, 2014, p. 292). In other words, the student is participating because they are motivated within themselves to do so, usually because they are getting some type of enjoyment or pleasure from the act of doing. This is quite the opposite from extrinsic motivation, which is more of the carrot and the stick approach. With extrinsic motivation, the student is motivated external to themselves to participate. You get a reward for doing, like a passing grade or a raise, and a punishment for not doing, like a failing grade or a pay cut. "As IM (intrinsic motivation) increases, self-efficacy to complete tasks is learned and active processes begin which lead to deeper understanding and the creation of aptitude," (Banfield & Wilkerson, 2014, p. 292). The key for the learning process is trying to get students intrinsically motivated, and games can do this in a big way.

Tables 1 and 2 come from the Banfield and Wilkerson study on increasing intrinsic motivation through gamification. Their study produced some eye-opening statistics when comparing motivation between a group using gamification methods to learn and a group using traditional (Didactic) methods. As you can see in Table 1, 25 (48%, n = 52) of the gamification students reported the training as "fun," compared to only 2 (5%, n = 42) of the traditional method students. Additionally, 43 (83%) of the gamification students responded, "Can we do more of this?", compared to only 2 (5%) of the traditional method students. Overall, when looking at both tables, you can see that the gamification group heavily favors the intrinsic motivation responses and the traditional method students heavily favor the extrinsic motivation responses, (Banfield & Wilkerson, 2014).

Table 1. Intrinsic Motivation. Adapted from Banfield and Wilkerson (2014).

Didactic N=42	Gamification N=54	"Word tree" examples; Coded Comments	Intrinsic Themes Identified by Lei (2010)
2	25	"Fun"	Experience pleasure in what they are doing
21	32	Questions why a setting was made	Attends to instruction
2	43	"Tough, but cool"	Perseverance
0	45	"Another issue down"	Applies skills and knowledge to problem
0	25	Tried "X"	Show creativity in action
12	44	Why? What if?	Striver for true understanding
0	35	"High score!!"	Regular evaluation or monitoring of own progress
3	11	"This wasn't covered in lecture"	Organize knowledge and relate it to existing knowledge
23	74	"How have people found 5 errors"	Regular evaluation or monitoring of own progress
3	56	"Now the lecture makes sense"	Organize knowledge and relate it to existing knowledge
3	66	"I found more then 5 errors"	Undertake more challenging aspects of a task
2	43	"Can we do more of this?"	Does not depend on tangible reward

Table 2. Extrinsic Motivation. Adapted from Banfield and Wilkerson (2014).

Didactic N=42	Gamification N=54	"Word tree" examples; Coded Comments	Extrinsic Themes Identified by Lei (2010)
27	4	" I could not evaluate and find errors in a running system"	Low self-esteem
16	7	"I'd try it for Extra credit"	Receiving extremely rewards or reinforcements (e.g. extra credit or bonus points)
22	5	"Competition WOULD have been important piece"	Competition for tangible rewards (e.g. honors and awards)
31	4	"I'd do the work as a class"	Social reasons for learning
12	5	Stupid/dumb, when will I use this	Learning compliance
31	14	"Scoreboard WOULD have helped me"	Competition for tangible rewards (e.g. honors and awards)
23	3	"Would we have to find all 5 errors for credit?"	Least effort needed

Games also create intrinsic motivation for players by enabling "them to leverage many of their natural desires: learning, socializing, achievement, mastery, and status. Behaviors that initially seem hard, tedious, and boring can be made fun. Users get motivated to perform actions and engage in specific behaviors in return for rewards," (Goethe, 2019, p. 14). We witnessed this firsthand while allowing the NPS students in our current cohort to play through our test video game Sandbox Contracting. The students were motivated through socializing, achievement, mastery, status, and above all, competition with one another. Learning simply occurred as a secondary effect of the students'

enjoyment with the game. The students continued to iterate through the game one upping each other's top score. Figure 9 shows Captain Pete Barringer playing Sandbox Contracting. Captain Barringer finished the day by collecting the highest score and bragging rights over his peers.

Captain Pete Barringer (left) and Captain Mitch Mickley (right) playing a gamified Category Management lesson at Naval Postgraduate School.

Figure 9. Intrinsic Motivation Example

h. Teamwork

Another benefit games and gamification bring to the learning process is that they help foster teamwork and trust in ways that traditional group projects and the like do not.

> Recently, in-house team video gaming (TVG) has emerged in organizations as an interesting alternative to traditional team-building activities. TVG can take place in short sessions (less than 60 minutes) and can occur "in house" at the physical location of the team… They can enhance education, improve training, and provide experience in complex situations. Individuals can also use them to practice collaborative decision making and to facilitate social networks. (Keith et al., 2018, para. 3)

Teamwork and collaboration are important to the learning process because, just like with a class discussion, teamwork and collaboration can help learners grasp concepts faster or develop a deeper understanding of the material. This once again ties into the Knowles

principle of experience. Each player brings his/her experience to the game/learning process and each player benefits from it. A study conducted by Brigham Young University indicated that teams that spent just 45 minutes playing video games together performed about 20% better in their assigned tasks than teams who did not (Keith et al., 2018).

i. Speed to Competence

Additionally, speed to competence is another benefit gaming brings to the learning process. Speed to competence is essentially defined as how quickly a student or trainee can learn the target material. Speed to competence is a big deal for businesses as it influences the cost line. Cutting training time down means more productivity faster, and in most cases that comes with a cost savings. In the example mentioned earlier with the Aircraft Maintenance Technical School virtual reality training, the Air Force realized a cost savings because it no longer needed to provide temporary duty (TDY) funds, which include food and hotel, for the entire 23 days of the program. Instead, because Airman Alfred surged through the program at a pace he was comfortable with (scaffolding), the AF was only on the hook for 6 days of TDY costs.

In an industry example, Domino's pizza teamed up with AllenComm to create an onboarding gamification course to train new employees. The course was called the Pizza Maker course.

> With three microlearning modules, Pizza Maker included simulations and gamification to engage, assess and reward employees to decrease onboarding time. By including competitive elements, both games encouraged new employees to beat their past scores, which drove speed to competency. The games build recipe knowledge for new employees and boost the recipe focus for long-term personnel, which leads to better accuracy and faster pizza making. (Dominos delivers employees top tier onboarding training, 2021, p. **)

After implementing the Pizza Maker course, Domino's reported that newly onboarded employees were fully trained at a much quicker rate than before, cost savings were realized because employees learned accurate portions for toppings, and the customer complaint count was reduced, however they did not report any statistics behind these statements.

j. Knowledge Retention and Application

One of the most important factors to consider when evaluating the learning process is knowledge retention and application. Are the students or employees having to consistently re-learn the material? Gaming has been shown to increase employee knowledge retention and application as well. When analyzing data from nearly 6,500 trainees, the University of Colorado Denver Business School reported that those who were trained using games demonstrated a knowledge retention rate 9% higher than those who were not, (Glass, 2017). This is critically important because you want your employees to be able to remember what you taught them so they can apply the knowledge later to make correct decisions, but also because if employees make incorrect decisions, it can cause unexpected additional costs. Not to mention you might need to fire or retrain the employee which comes at a cost as well.

Specifically, in government acquisitions, these incorrect types of decisions can have very lofty price tags attached to them and/or cause an extensive delay in introducing a critical technology to the field. The nature of work being accomplished by the personnel in the acquisition community, often obligating millions of U.S. tax dollars with a single decision, lends itself to leaders needing to be confident that their employees are properly trained and can retain and apply the knowledge they receive at any given time. This worry is the root of the inspiration of our research. We want to find out if the benefits of games and gamification that have been realized in other disciplines translate to the learning of government acquisitions, specifically to the learning of AF contracting. And with that translation, can it arm acquisition professionals with the knowledge retention and applicability needed to avoid costly mistakes?

2. Drawbacks of Gamification

a. Loss of Performance

Gamification has many benefits to consider, however introducing games to the classroom can also have drawbacks. In a 2018 empirical study that focused on the negative effects of gamification, loss of performance was the largest drawback. “This issue arises from tasks and situations where gamification harms or hinders students’ learning process,”

(Toda et al., 2018, p. 7). The study attributed the loss of performance to several factors. Among those were (a) demotivating effects from gamification elements like leaderboards, points, and badges, (b) some students did not understand the rules, (c) some did not like being penalized during the gamified activity, and (d) some students were more focused on the game mechanics rather than on the actual material to be learned, (Toda et al., 2018). The finding that says leaderboards, points, and badges caused a loss of performance is counter to what we found when researching benefits of gaming. The study mentioned that this finding was only applicable to those that did not achieve the highest scores on the leaderboard. Toda explained that when these individuals saw their name on the leaderboard with others ahead of them, they were not motivated to do better, but instead were demotivated to continue participating. This is interesting as it suggests that only certain people, and perhaps certain Bartle's player types, are motivated by the inherent competition a leaderboard, points, and badges system provides.

b. Mandatory Play

Another drawback to consider is mandatory play. "By making play mandatory, gamification might create rule-based experiences that feel just like school," (Furdu et al., 2017, p. 58). In addition to feeling like school, we learned in the previous section that voluntary participation is a key tenet of the concept of play. Forcing someone to play will likely start them out on the wrong foot and hinder their learning experience.

c. Poor Game Design

If not designed properly, a game can turn players off to learning the material before they even get started. "The design of the challenges and the setting of the content have to be carefully considered in order to make it as neutral as possible while not seeming trivial and boring," (Furdu et al., 2017, p. 58). Game developer Kathy Sierra offers her perspective in an online blog on gamification in the classroom. "A well-designed game only deploys certain mechanics to support an intrinsically rewarding experience," (Geraldine, 2017, para. 15). In short, all the benefits an instructor might hope to realize from gamifying their lesson could be thrown out the window if not designed in a way that offers intrinsic motivation to the player to keep coming back and playing.

d. Over-Arousal Theory

The inverted-U hypothesis refers to a proposed correlation between motivation (or arousal) and performance such that performance is poorest when motivation or arousal is at very low or very high states. This function is typically referred to as the Yerkes–Dodson law. Emotional intensity (motivation) increases from a zero point to an optimal point, increasing the quality of performance; increase in intensity after this optimal point leads to performance deterioration and disorganization, forming an inverted U-shaped curve. The optimal point is reached sooner (i.e., at lower intensities) the less well learned or more complex the performance. (Inverted-U Hypothesis, n.d.).

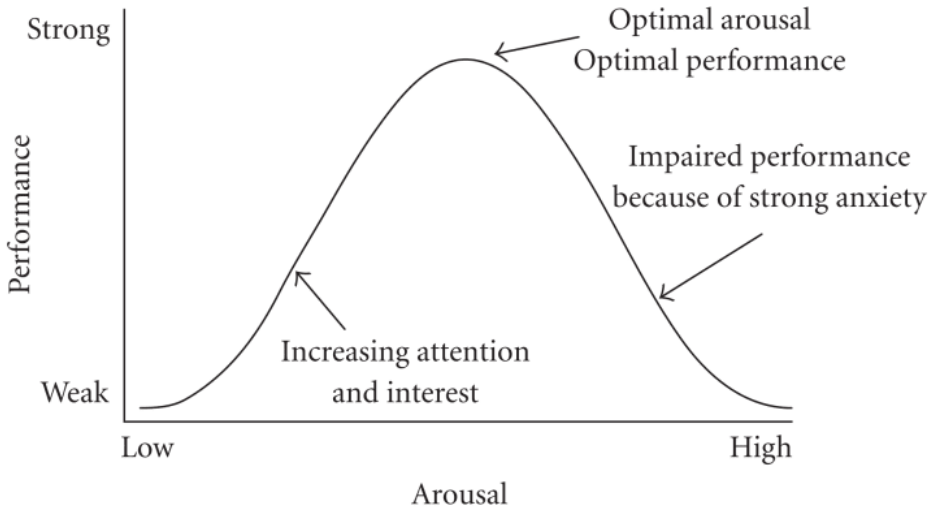


Figure 10. Inverted-U Hypothesis (Barrett, 2015)

This is a careful balance that must be monitored. If a player becomes over-worked or over-stimulated, they become over stressed, and performance begins to decrease. Finding the sweet spot at the top of the inverted-U, where optimal arousal and optimal performance exist, can be challenging.

C. IMPLICATIONS AND SUMMARY

This chapter explored the topics of learning, the way adults learn compared to children, and the benefits and drawbacks of gaming in training. We concluded that gamified training and education is a form of active learning versus passive learning, as learners are providing inputs to their own learning. Among the many benefits of games are the concepts of feedback and trial and error (safety), both of which are key features of games, as found in the background research. The drawbacks of poor game design and over-arousal informed us of critical factors that need to be considered in the development of gamified training.

IV. METHODS AND FINDINGS

A. METHODOLOGY

This study explores the effects of integration of gamified learning into professional training and education. Our research consisted of a between-subjects and between-group differences study. We randomly assigned participants to either a treatment group (gamified learning) or a control group (traditional lecture) and assessed improvements on a short quiz given both pre- and post-instruction. We conducted this between-subjects evaluation across multiple waves of classes, allowing for us to conduct between-groups analysis as well. The control group received a PowerPoint training that is currently the ongoing training method used by the Air Force to train new enlisted personnel, what is known as passive instruction in the between-subjects gamification literature. There are two types of learning arrangements in most gamification studies: 1) passive (lectures, videos, reading textbooks, etc.) and 2) active (assignments, exercises, laboratory experiments, etc.) (Sailer and Homner, 2020). The treatment group received a game to play that focused on the same learning objectives as the traditional method but presented the information through an interactive game.

All students received a pre-evaluation survey to assess job-specific knowledge on the current learning objectives and to score overall satisfaction with current training methods. All students were then randomly assigned to a group: roughly half the students made up the control group and the other half were placed in the treatment group (note: not all classes had an even number of students). Each group was put into a separate room and told the current learning objectives. Each group was then given the same amount of time with the material. The control group had an instructor that taught the material and focused on the learning objectives in the current format. The gaming group was self-paced and learned the same material by playing the game. After both groups finished, a post-evaluation survey was given to assess each participant's reaction and learning in line with the Kirkpatrick Model.

The data collected were both quantitative and qualitative. The quantitative data were our primary outcome measures for assessing raw performance improvement. We compared the treatment and control groups to understand how the traditional method learning and the gamified method learning affected immediate knowledge retention on the assessment. We were unable to conduct a longitudinal evaluation of knowledge retention over time due to the time constraints of our research effort. After data collection, all data was scrubbed to ensure that every answer was completed and that there was no missing data.

We took a thematic approach to qualitative survey questions. This approach involved coding data before identifying themes and trends in the data (Nowell et al., 2017). The different themes were looked at to gain an understanding of survey participants' familiarity with different type games and any suggestions for improvement as well as other feedback.

1. Participants

The participants in the primary study (n = 41) were enlisted military members from the 344th Training Squadron (344 TRS) located in Lackland AFB, Texas. All participants were completing their contracting initial skills training. The 344 TRS trains enlisted military members on the basics of contracting and prepares them for their first contracting assignment. The 344 TRS had incoming students every few weeks, which allowed us to iterate our experiment over four waves of classes. The control groups for each of the four waves at the 344 TRS were all taught by in-person instruction.

We were also able to test our hypotheses with a second group of participants located at NPS (n = 14). These participants consisted of Air Force students enrolled in the Master of Business Administration (MBA) program with a focus on Acquisition and Contract Management curriculum. The NPS participants were tested on Category Management (CM) policy guidance from the Office of Management and Budget. Throughout this paper, this group will be referred to as the CM wave. The CM wave treatment group received their instruction in person, and the control group received their instruction via Zoom, an

online meeting software. It is important to note that the thesis team instructed the gaming group for this wave.

2. Materials

The 344 TRS instructors emailed our team a list of lessons that were amenable for experimentation on method of delivery. Some of the lessons from the curriculum were not available due to the impact they would have on the student's overall grades. Our thesis team was given the opportunity to test knowledge areas that were required by the school but did not impact the student's overall grade for the course. The lesson we selected was Federal Acquisition Regulation (FAR) Part 8 – Required Sources of Supplies and Services. The learning objective from this lesson was to, "Identify basic facts and terms about priority for use of Mandatory Sources, Federal Prison Industries (FPI) and the AbilityOne Program." Once the lesson was chosen, a game needed to be designed that would encompass the learning objectives and implement them in the same amount of time as the traditional PowerPoint method. This was important as we wanted to ensure both groups were able to have the same amount of time with the material to mitigate confounds arising from differing time on task.

We used many different software programs to assess and analyze the data, as well as for game creation. Unreal Engine 4 was used to build the game which is discussed further in the game design section. To play the game, the 344 TRS students utilized Microsoft Surface tablets with a mouse and keyboard connected. Instructors at the 344 TRS utilized traditional PowerPoint lessons given in a standard class lecture. A single instructor taught each lesson, though each instructor did not remain constant across waves. This course instruction was over the period of one hour and consisted of the same learning objective the game incorporated. Qualtrics was utilized for survey creation, pre- and post-evaluation survey, and data collection. We administered the survey to each student via a weblink before and after each group received their training. All data was exported and analyzed using Stata and Excel.

3. Game Design

Before introducing the game design and mechanics in writing, we would like to provide a YouTube link to a video we produced which highlights the game design, game mechanics, and what the treatment group participant experienced while playing Sandbox Contracting. To view this video please visit the following web address:

https://www.youtube.com/watch?v=Zknt6KGPaV0

The current education program and the new gaming learning method needed to be analyzed to determine the degree to which the learning objectives were achieved. In addition, the two different learning methods needed to be analyzed to explore areas for improvement and to gain feedback from participants on to improve the learning in future trainings. The goal of this design was to promote and assess learning transfer that was focused on context and skill development. The program design consisted of identifying learning objectives that need to be met and customizing the game to meet those needs. Our thesis team worked closely with the education and training providers to ensure that the learning objectives from the lesson were clearly communicated and understood.

The game was designed and developed by our thesis team. We utilized a free commercial game development software called Unreal Engine, version 4.26. When designing the game, we wanted it to be fun, engaging, and interactive while teaching and testing the same skills students would learn from the traditional lesson in the curriculum.

The game started off teaching the player, in layman's terms, the basics of the chosen lesson, FAR Part 8 mandatory sources. When teaching the player, we did not want it to feel like the player was just reading from a textbook or a government regulation, but rather they were receiving on-the-job training (OJT) from a peer. The game explains the lesson in a way that a coworker with years of experience would explain it to a novice in the career field. We wanted to determine if receiving the instruction face to face from a "virtual teacher" would be better received by the learner than simply reading it from a document. However, to meet the requirements of at least providing the student with the lesson plan they would have received from the traditional lesson, we incorporated a pause menu widget within the game to access this information.

Shortly after beginning a game, the player is presented with the lesson from the virtual teacher, followed by a tutorial for using the keyboard and mouse to control the in-game character. The tutorial is in-depth and explains everything from simply moving the player around in the world, to interacting with objects in the world, and ultimately defeating enemies. We understood that not everyone has experience in playing games, and of the ones who do, not all of them have played keyboard and mouse (PC) games. A natural barrier to receiving a benefit from this type of training would be not knowing how to use the controls. The tutorial is meant to mitigate this barrier as much as possible.

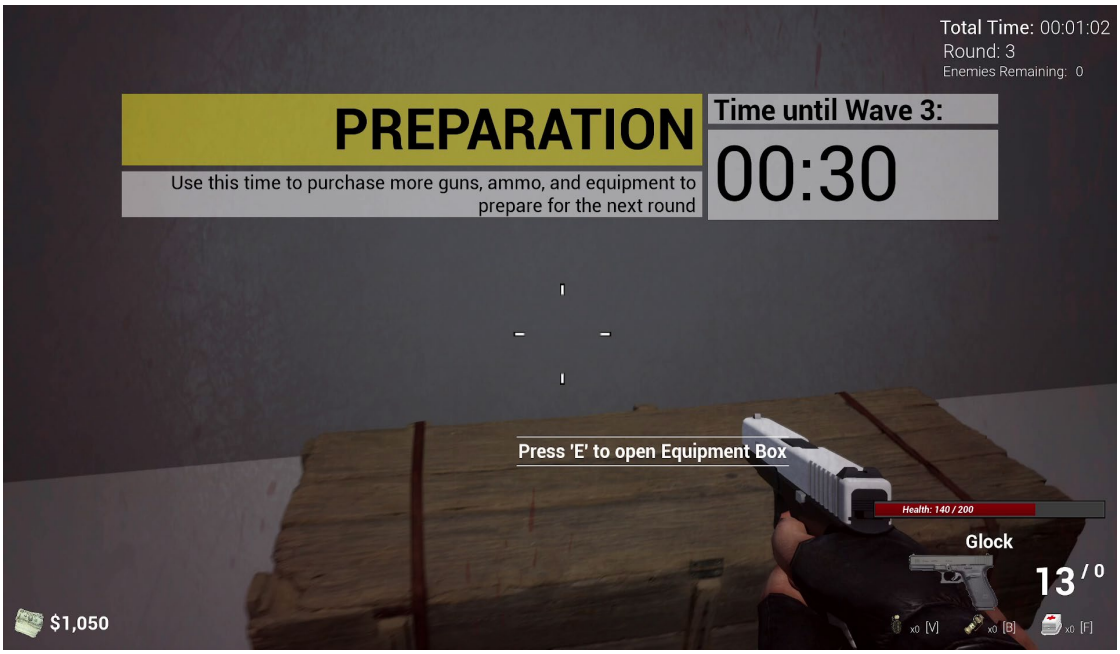
This screenshot shows a player advancing through the tutorial stage prior to being thrust into the action.

Figure 11. Sandbox Contracting Tutorial Screenshot

The main aspect of the game was built as a round-based First-Person Shooter (FPS) style game. In this type of game, the player's main objective is to survive through wave after wave of enemy combatants for as long as they could. Each successive wave becomes increasingly more difficult. There would be stronger enemies than from the round prior and more of them to deal with. Additionally, at the conclusion of defeating all the enemies

in a round, the player is presented with a bomb that needs to be diffused. The bomb is armed with a timer, and the only way to diffuse the bomb is by answering questions related to the lesson. The questions are randomized as well as the order of the responses, so that the players cannot simply memorize the answers by the order in which they appear (i.e., #1 is C, #2 is B, etc.)

With the questions and answers appearing out of sequence, the player is forced to read the question and try to recall their knowledge on the topic. If the player chooses an incorrect response to the question, the bomb will explode, causing the player to receive damage before the next, more difficult round, begins. If the player answers the question correctly, the bomb will diffuse, the player will receive a monetary bonus, and the timer to begin the next round will start counting down. In this short time before the next round started (30 seconds), the player will use the cash they earned to this point to purchase additional weapons, ammunition, grenades, or health packs to prepare them for the next round. The player's goal for the game is to survive as long as possible. By mastering the lesson material, they will have a means for achieving that goal more easily.



This screenshot shows a player in the preparation phase between rounds. After each round, the player is afforded 30 seconds to purchase additional weapons, ammo, grenades, and health packs to prepare for the next wave of enemies.

Figure 12. Sandbox Contracting Preparation Screen

Additionally, in an attempt not to derail the learning process for non-gamers, we included a practice mode option. We anticipated that some non-gamer players may not be able to progress through the game enough to be exposed to all the questions. When the player enables practice mode, the game will not allow them to receive damage, and thus the player's character is not able to die. While this does remove the difficulty and challenge from the game, with practice mode enabled, they would be able to complete the rounds without issue. This allowed less experienced players to learn the game mechanics and the lesson without fear and frustration of an unachievable goal, and issue that has been highlighted for proper game design by experts (McGonigal, 2012).

Lastly, when the player has finished their round of play, by either getting through all the questions, or by their character dying, they are presented with an After-Action Report (AAR) of their performance. The AAR is presented to the player on screen and shows the player how many rounds they were able to survive and complete, how many questions they answered correctly, how much cash they were able to accumulate, and their

average round time. The game then calculates the player's total score based on each of these metrics, offering a benchmark for the player and his or her peers to compete against the next time they play.

4. Evaluation Survey Design

The evaluation survey design consisted of incorporating the test questions that the schoolhouse utilized as well as questions to assess other key metrics. To create the evaluation survey, the schoolhouse instruction team was consulted to ensure proper questions would be asked and to ensure appropriate data would be collected from the pre- and post-instruction evaluation.

The evaluation survey contained multiple choice questions related to pre and post evaluation of student knowledge, Likert scale-type questions, and open-ended questions related to experience and satisfaction. The Likert scale questions were put on a five-point scale from strongly disagree to strongly agree. These Likert-based questions were inserted to assess favorability/quality of the training, confidence in participants' answers, and experience with video games. The open-ended questions asked about military experience, most-played video games, and feedback on each type of training.

A question was inserted to assess the Net Promoter Score (NetPS) for each participant. This score was based on how likely the respondent was to recommend these learning methods to a friend or colleague. We decided to use NetPS to directly compare favorability between the groups as it is a commonly used technique. NetPS is a metric used in customer experience programs and measures the loyalty of customers to a company (The ultimate guide to net promoter score (NPS), 2021). Utilizing NetPS gives an instant indication of customer satisfaction that helps us determine the overall favorability (Jain, 2020). For NetPS, respondents who score zero to six are labeled as detractors, respondents who score seven to eight are designated as passive, and respondents who score nine to ten are classified as promoters (Reichheld & Markey, 2011). A promoter generally means a respondent is loyal and enthusiastic. Passive means that they are satisfied with the product, but not happy enough to be promoters. Detractors are unhappy customers who are unlikely

to use the product again and may even discourage others about the product as well (The ultimate guide to net promoter score (NPS), 2021).

We also asked about the primary reason for the respondent's rating and how we can improve their experience. These questions were essential to assess the limitations of the two learning methods and to enhance future studies within the gamification field. These questions can enhance learning outcomes as gamification continues to become more incorporated in training and learning methods.

B. DATA ANALYSIS

This study consisted of five different groups of US Air Force students. Each group went through the randomized experiment in one controlled wave, each on different days. Four of the groups consisted of students at the 344th Training Squadron (TRS) enlisted schoolhouse in San Antonio, Texas. To differentiate data between the groups, the first 344 TRS cohort that went through the training is referenced as 344-A, the second cohort that went through the training will be referenced as 344-B, the third group will be referenced as 344-C, and the fourth group will be listed as 344-D. All four waves had different instructors for the presentation to the control groups. The last group that went through the course were Naval Postgraduate School students in the process of completing their MBA. As previously stated, this NPS cohort will be referenced as CM wave to distinguish them in the data analysis. This study compares each group to see the differences in overall quiz scores (pre/post), enjoyability of the game, likelihood of recommending game, and insight to overall input between the students to help ensure the game can be improved upon in future iterations to better meet learning-based needs. It is important to note that the 344 TRS traditionally uses in-person instruction supplemented with PowerPoint presentations, and NPS instruction was delivered via Zoom. Another important note is that the game was patched before the 344-C and 344-D waves occurred. This was due to several software glitches that were occurring in the video game. For instance, the game physics had a glitch that caused players to be blown off the playing arena when a grenade exploded. Another instance was whenever a player would choose to play in "practice mode," the player could

not exit this mode unless they restarted the software. There were no updates to the lesson content.

1. 344-A – Wave 1

The 344-A group was the first that went through the experiment. The group size of this experimental trial was 11 and took place on August 6, 2021. The 344-A group had six individuals placed in the treatment condition and five individuals placed in the control condition. First, we calculated the difference between the two groups in relation to overall quiz score. Figure 13 shows the median quiz score before receiving the learning method (pre-course) compared to the quiz score after receiving the learning method assigned (post-course).

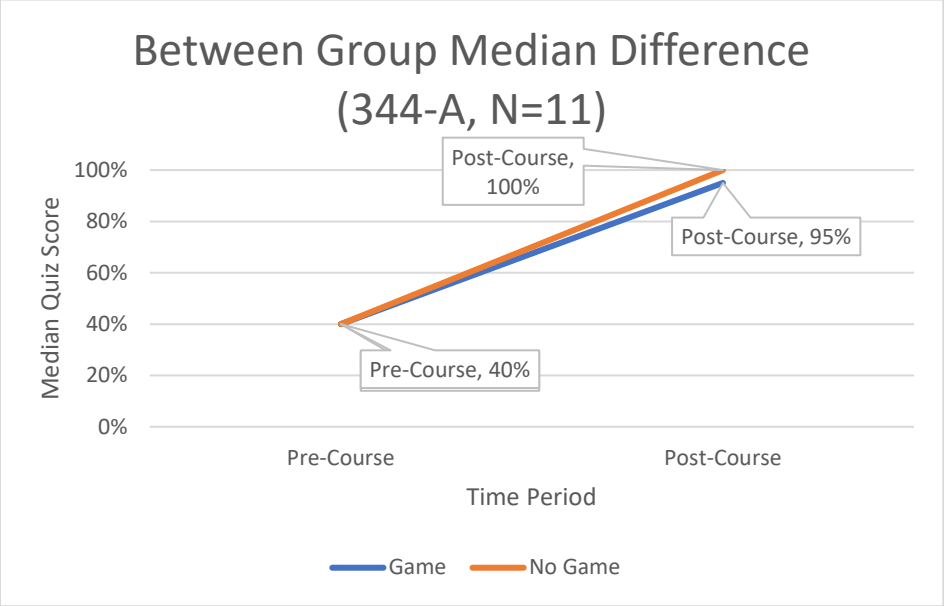


Figure 13. Between Group Median Difference, 344-A

Medians were analyzed for each group because the scores consisted of non-normally distributed observations. During a pre-test, both groups had a median score of 40% before the learning method was assigned. The treatment group that received the game had a 95% median score post-course while the control group had a median score of 100%. This led to an overall improvement of 60 percentage points for the control group and a 55

percentage points for the treatment group. We also analyzed the mean scores between the groups to see if there were any differences in the results, shown in Figure 14.

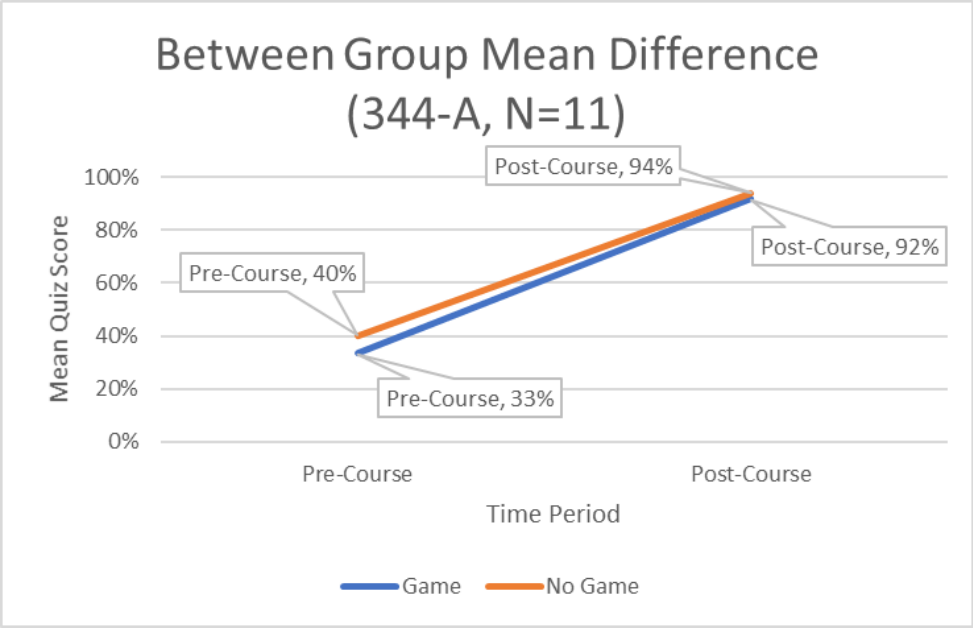


Figure 14. Between Group Mean Difference, 344-A

The treatment group had a pre-course score of 33% and a post-course score of 92% for an overall improvement of 59 percentage points. The control group had a pre-course score of 40% and a post-course score of 94%, for an overall improvement of 54 percentage points. These results show similar results for both groups for the median and mean as both groups saw large increases in post-instruction outcomes. Figure 15 shows data for individual differences among the participants.

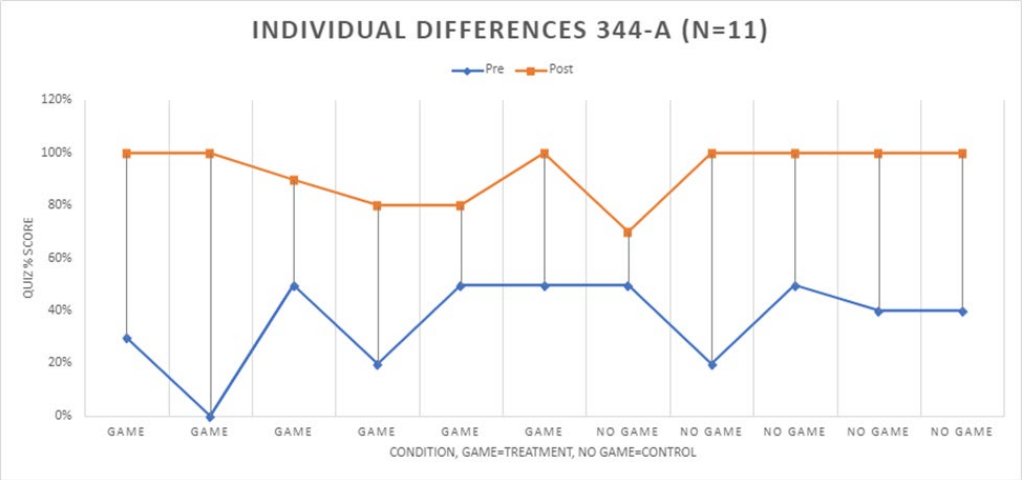


Figure 15. Individual Differences, 344-A

The data shows that most respondents in both groups had a large improvement of quiz score outcomes. The largest increase was found in the treatment group with a 100-percentage point improvement, and the lowest increase was in the control group with a 20-percentage point increase.

On the post-instruction survey, we asked respondents how likely they are to recommend the learning method they received in this training to a friend or colleague. The control group had three participants rate the training with a passive score and two participants rate the training with a promoter score. The treatment group had three detractors, one passive, and two promoters. The treatment group had more detractors which means that for this response, they would likely not recommend this training. Figure 16 shows the breakdown of each bucket that the participants fell into by group. The treatment group had three participants that were detractors and three that were promoters.

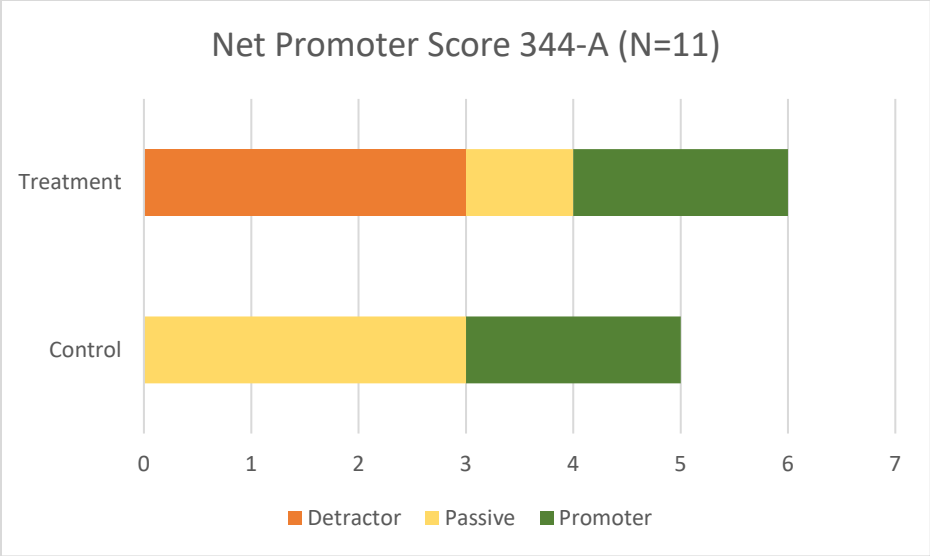


Figure 16. Net Promoter Score, 344-A

We also asked all respondents how they would rate their overall level of engagement with the training they received by indicating their rating on a sliding scale. Engagement in this context represents the participant's desire to perform, level of attention/effort, and motivation. This scale runs from low to high engagement (1=lowest, 10=highest). For engagement scores, our team reported median levels instead of averages. This is because the data for engagement did not have a normal distribution. The median level of engagement for the treatment group was eight and the median level of engagement for the control group was eight. This data shows that for the 344-A group, both learning methods had the same median level of engagement.

The respondents were asked why they gave the rating they did for the NetPS. The common theme for the first wave of respondents revolved around the format of the game. While many of them enjoyed the idea of the game, they mentioned that a first-person shooter type game was not the best learning format for the information being conveyed. Multiple people suggested a puzzle game would be the best solution for this. One important quote from the 344-A group was:

> While I believe gamifying the learning environment is a great idea, the game that was produced for this experiment did not feel relevant to the lesson or information we were taught. I was able to learn the answers as well as the

> relevant nomenclature/terminology of the related material, but it didn't feel as if the FPS game was necessary for it, perhaps a puzzle, RPG, or sandbox style game would have worked much better in my honest opinion.

In the control group, comments centered on how good the instructor was and that they enjoyed learning from this instructor. This indicates that heterogeneity in instructor skill can influence the NetPS heavily and that a higher NetPS may not be the result purely of the control modality. One comment from the control group was, "Good instructor who is able to disseminate information well."

We also asked the respondents to share ideas about ways the Air Force can improve their experience completing trainings like these. The number one response was to fix the glitches in the game. We were able to take this feedback and fix the glitches before the 344-C wave, but the first two waves received the version of the game with small technical problems. One quote stated:

> If the idea of gamifying the learning environment is to take off, a larger investment needs to be put in the development and hardware aspects of the games. The game ran choppily, glitches occurred to many of my fellow students, and overall, the quality of the game itself played fairly poorly compared to what one would expect from a new experiment designed for learning.

This response revealed a critical opportunity for improvement that is being constrained by a lack of funding. To make progress in this field, investment in the research of gamification and its affects must be prioritized.

One respondent from the control group suggested:

> While I didn't compete in the Gamification, I think that it is a good idea, however execution is the most important aspect. It is difficult to properly create a video game that manages objectives in the gaming world while also trying to communicate information. It's my belief the best way to do it would be to create a linear story as opposed to simply asking multiple-choice questions hoping that the information is absorbed through trial-and-error. On the other side, typical class-room environments are dependent on the participation of the class and an instructor that makes the learning environment engaging, which also depends on the individual and the way that they learn. It would be my suggestion to break up mundane class objectives and incorporate mini-games or competitions that not only teach but re-engage students.

This is feedback that is instrumental to improve further iterations of the research that can be developed over time. The best type of game to implement for learning needs further exploration and development. In addition, utilizing traditional methods of learning with gamified methods of learning, could be instrumental to unlocking the potential for future learners.

2. 344-B – Wave 2

The 344-B group was the second group that went through the experiment. The group size of this experimental trial was 9 and took place on August 18, 2021. The 344-B group had five individuals placed in the treatment condition and four individuals placed in the control condition. The first analysis performed looked at the difference between the two groups in relation to overall quiz score. Figure 17 shows the median quiz score before receiving the learning method compared to the quiz score after receiving the learning method assigned.

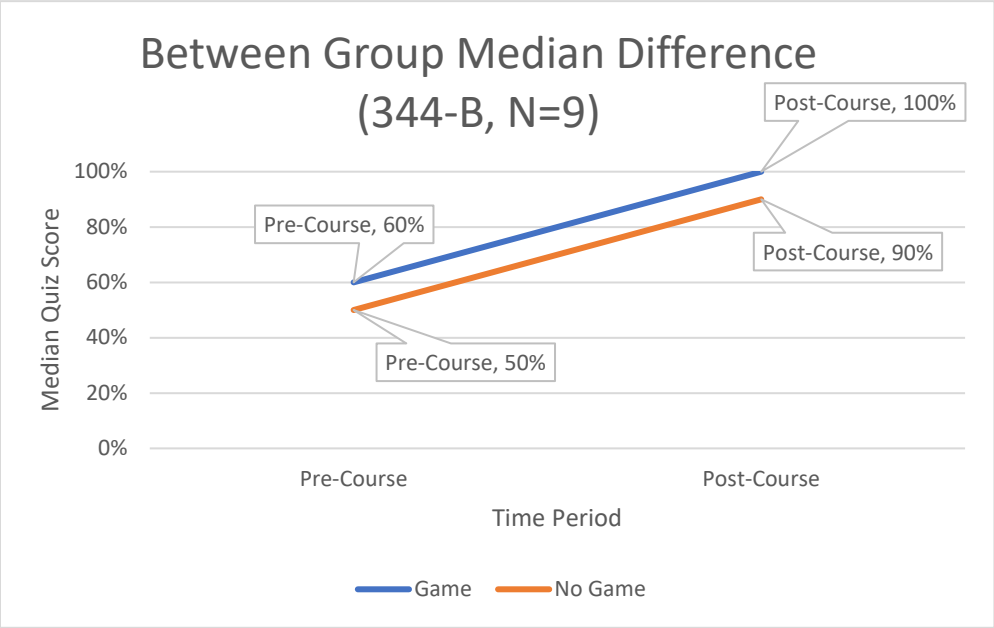


Figure 17. Between Group Median Difference, 344-B

The control group had a 50% pre-instruction score and the treatment group had a 60% pre-instruction score before the learning method was assigned. The treatment group had a 100% median score post-course while the control group had a median score of 90%. This led to an overall improvement of 40 percentage points for both groups. We also analyzed the mean scores between the groups to see if there were any differences in the results, seen in Figure 18.

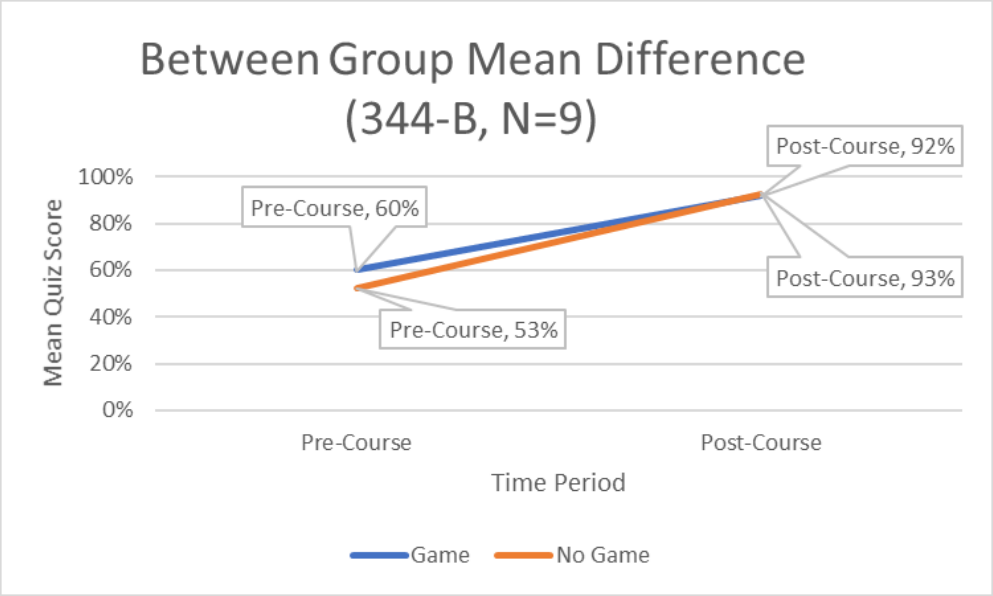


Figure 18. Between Group Mean Difference, 344-B

The treatment group had a pre-course score of 60% and a post-course score of 92% for an overall improvement of 32 percentage points. The control group had a pre-course score of 53% and a post-course score of 93%. This led to an increase in 40 percentage points for the control group. These results show consistent results for both groups for the median and mean as both groups saw large increases in post-instruction outcomes. Figure 19 shows data for individual differences among the participants.

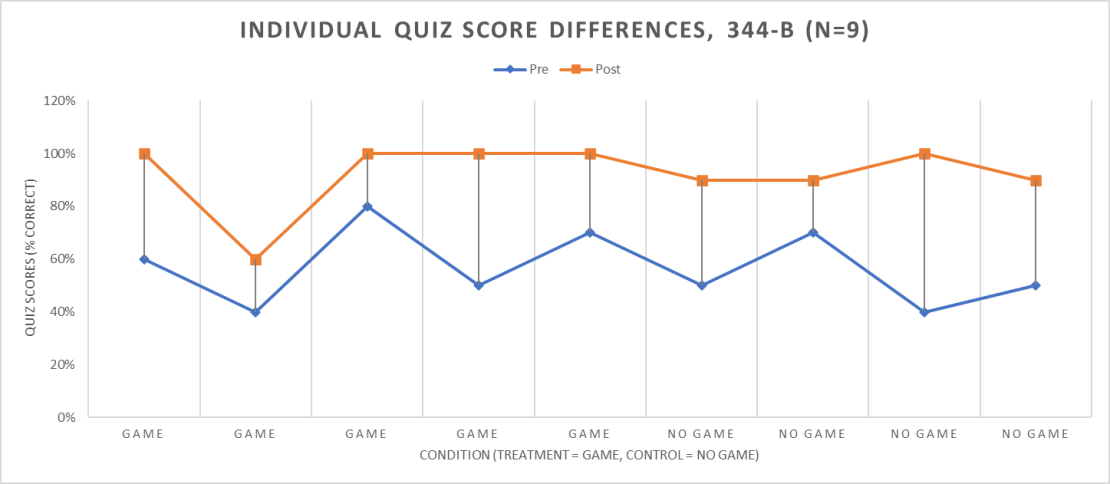


Figure 19. Individual Difference, 344-B

There were consistent outcomes on the post-instruction quiz for both groups, but the treatment group had more variability. The largest increase was in the control group with a 60-percentage point increase and each group had one respondent with the smallest improvement in outcomes with a 20-percentage point gain.

On the evaluation survey, respondents were asked the same NetPS question regarding how likely they are to recommend the learning method they received in this training to a friend or colleague. The control group had one detractor and three promoters. The treatment group had one detractor, one passive, and three promoters. These ratings show that for this wave, NetPS was consistent in both groups but the treatment group had one additional participant. Figure 20 shows the buckets the participants fell into for both groups.

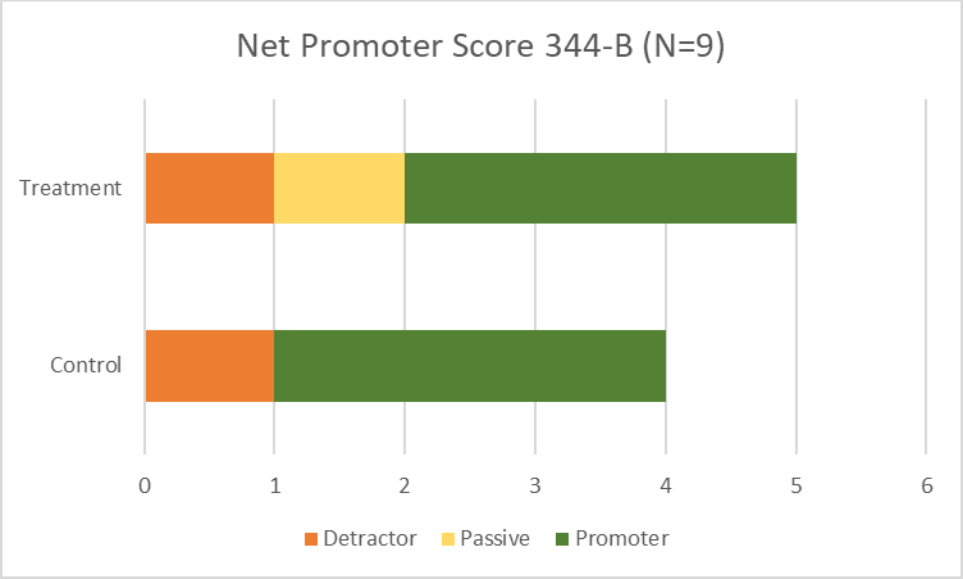


Figure 20. Net Promoter Score, 344-B

All respondents were also asked how they would rate their overall level of engagement with the training they received. The median level of engagement for the treatment group was eight while the median level of engagement for the control group was 9.5. This data shows that for the 344-B group, the control learning method was rated with the higher level of engagement.

The respondents were asked why they gave the rating they did for the NetPS. The common theme for the second wave revolved around the game being a bit repetitive, but enjoyable. One important quote from the treatment group was:

> I believe that gamification takes the mundane feeling out of learning. Death by PowerPoint is never a fun time for anyone, and it can make learning (and teaching) an arduous experience and task. Being able to break up that monotony with interactive games which utilize repetition and recall, I believe, would drastically improve test performance and overall opinion on the classroom environment. If you make individuals have a desire to come to class and be engaged (i.e., playing games, having fun, etc.) then they will be more eager to learn and have an overall more positive attitude towards the subject. I believe gamifying military education is a wonderful step in the right direction.

One comment from the control group included a thoughtful comparison of the groups, stating, “I like to be able to openly discuss and ask questions with others, which video games can distract from or possibly not even allow for.”

Respondents were also asked what are some ideas you have about ways the Air Force can improve your experience completing trainings like these? One comment in the treatment group that stood out was:

> I believe an understanding that some of the material is dry is a great start. It's also important to note the distinction between dry/boring and importance. I would like to say that all of the training I have received in tech school so far is vital to my success as a contractor upon arrival to my first base. At the very least it will prepare me to be able to learn everything I need to know from guidance and mentorship through the start of my career. I don't think this process should be dry however, and the more interactivity/fun you can provide during the education, the easier it is to learn and pay attention. I would suggest these following things. Gamify the lessons as done in this test study, create some sort of mobile app that allows for quick and easy studying of material. Many students use Quizlet to study and are taking time to create these for each chapter. Imagine an air force sponsored study app that had all the resources readily available. I also think some YouTube videos/tutorial about how to do commonplace things in the job would be great. This would be a wonderful resource for those looking to expand on their classroom material OR those who are looking to seek more information about the contracting career field.

This detailed comment investigates both app-based ideas and incorporating YouTube into the instruction. This participant seemed very open to gaming and offered ideas on how to improve future iterations of this research with new insights. For the control group, there were some insightful responses suggesting incorporating gaming into the lessons. One comment stated, “They can mix games like Kahoot to improve our memorization skills on the material we learned.” This comment is important as it shows that the respondent thinks an integrated approach of including traditional elements with gamified elements can increase their learning capability and enjoyment.

3. 344-C – Wave 3

The 344-C group was the third group that went through the experiment. The group size of this experimental trial was 11 and took place on September 9, 2021. The 344-C

group had six individuals placed in the treatment condition and five individuals placed in the control condition. The first analysis performed looked at the difference between the two groups in relation to overall quiz score. Figure 21 shows the median quiz score before receiving the learning method compared to the quiz score after receiving the learning method assigned.

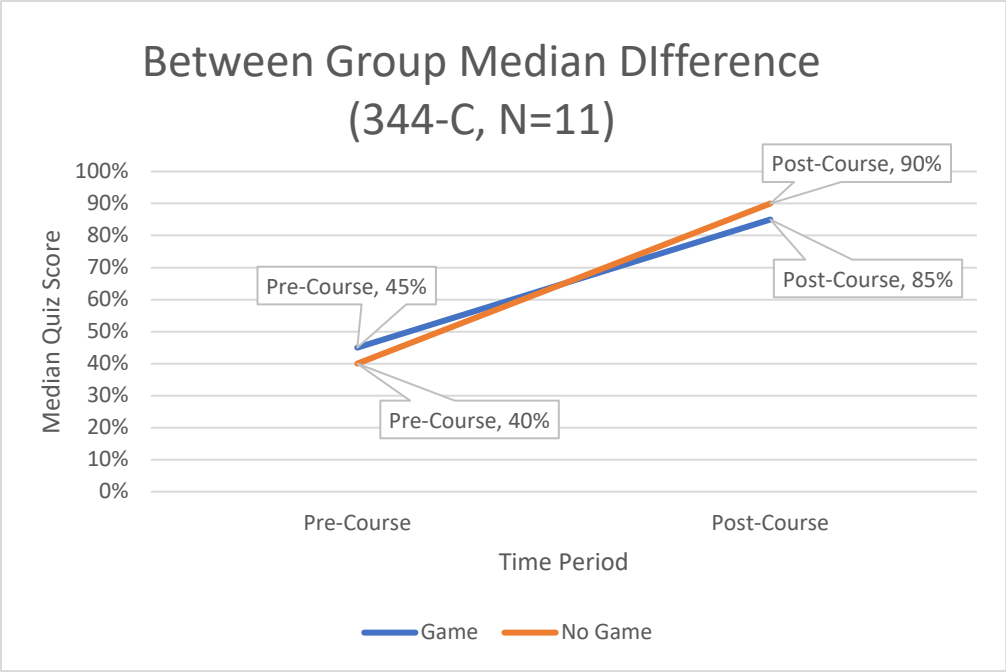


Figure 21. Between Group Median Difference, 344-C

The control group had a 40% pre-instruction score and the treatment group had a 45% pre-instruction score before the learning method was assigned. The treatment group had an 85% median score post-course while the control group had a median score of 90%. This resulted in an overall improvement of 50 percentage points for the control group and a 40-percentage point increase for the treatment group. Mean scores were also analyzed between the groups to determine if there were any differences in the results, as shown in Figure 22.

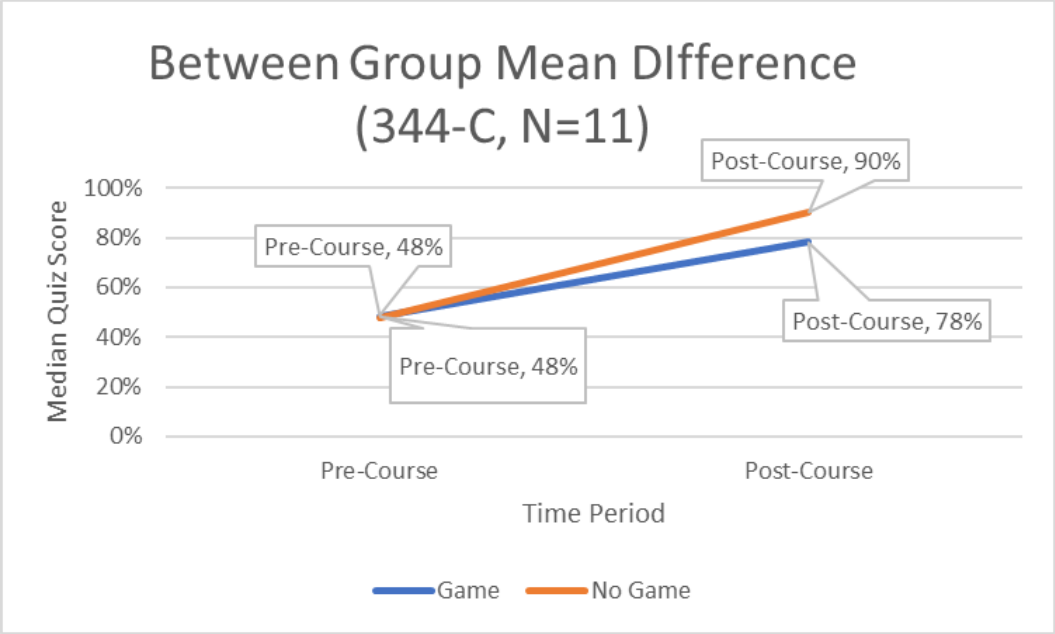


Figure 22. Between Group Mean Difference, 344-C

Both groups had a pre-instruction average score of 48%. The treatment group had a pre-course score of 48% and a post-course score of 78% for an overall improvement of 30 percentage points. The control group had a pre-course score of 48% and a post-course score of 90%. This led to an increase in 42 percentage points for the control group. The median and mean results are consistent for both groups as they saw large increases in post-instruction outcomes, with the control group seeing the largest increase in both. Figure 23 shows data for individual differences among the participants.

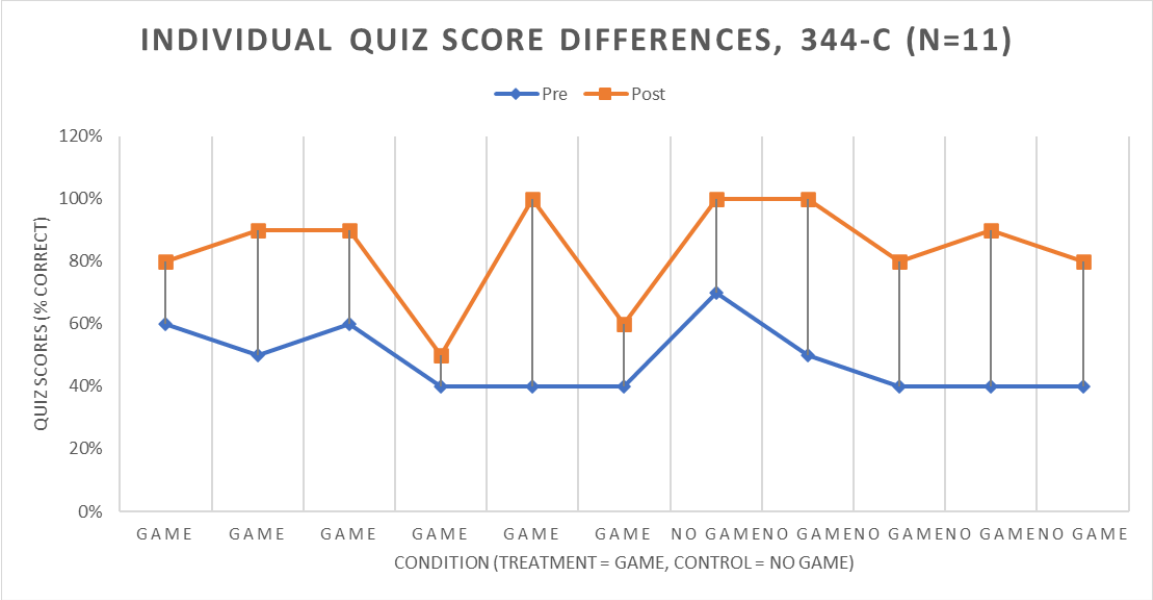


Figure 23. Individual Differences, 344-C

There were consistent outcomes on the post-instruction quiz for the control group and slightly more variability for the treatment group. The largest increase was in the treatment group with a 60-percentage point increase and the smallest improvement was in the treatment group with only a 10-percentage point gain.

As with the other groups, during the evaluation survey, respondents were asked how likely they are to recommend the learning method they received in this training to a friend or colleague to measure their NetPS. The control group has one detractor, three passive, and one promoter. The treatment group had four detractors, one passive, and one promoter. This data shows that for this wave more detractors fell in the treatment group. Figure 24 shows the buckets the participants fell into for both groups.

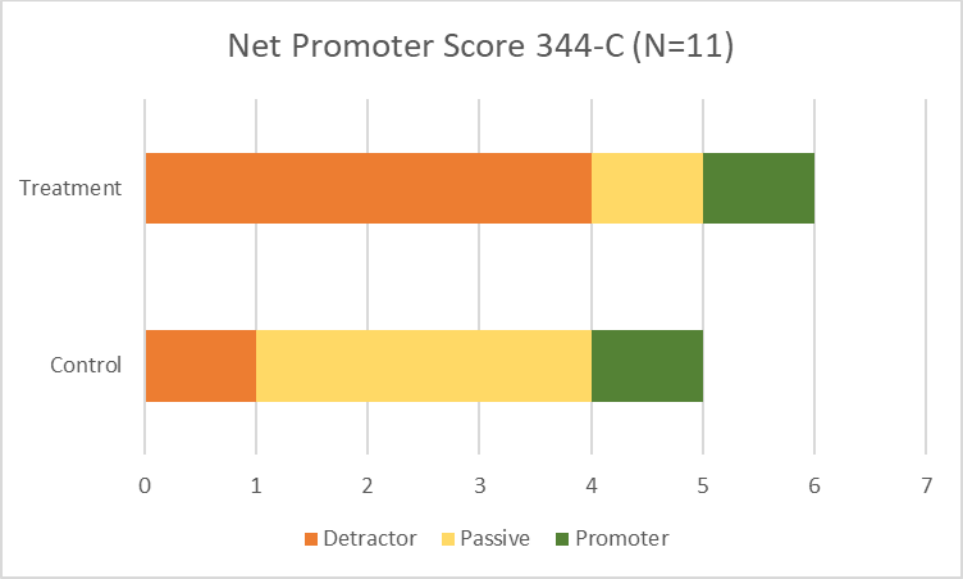


Figure 24. Net Promoter Score, 344-C

We also asked all respondents how they would rate their overall level of engagement with the training they received. The median level of engagement for the treatment group was seven while the median level of engagement for the control group was nine. This data shows that for the 344-C group, the control learning method was rated with the higher level of engagement.

The respondents were asked why they gave the rating they did for the NetPS. The common theme for the third wave was a lack of favorability and game design. An important quote from this group, "The game was clunky and presented information through a long introduction rather than through the game itself." This comment suggests that teaching the material to the player using an NPC sitting behind a desk may not be the best method. We set the game up this way to simulate learning from a peer during on-the-job training, which is natural in air force contracting offices. However, this player would have preferred to learn the material in a different manner.

In the control group, the major themes were on level of information and instructor delivery. One control group comment stated,

> The level of information retention & trainee engagement is all dependent on the type of instructor. If the instructor is monotonous or speeds through

the material, you won't learn anything. I think the gaming aspect of the other training takes that variable out of the equation.

We also asked the respondents what are some ideas you have about ways the Air Force can improve your experience completing trainings like these? One response from the treatment group in 344-C included, "More games like this but after normal PPT class."

For the control group, there were some thoughtful responses suggesting incorporating gaming into the lessons. A few of the comments included, "Trainings can have more interaction through games like Kahoots, instead of a First-Person Shooter."

4. 344-D – Wave 4

The 344-D group was the fourth group that went through the experiment. The group size of this experimental trial was 10 and took place on September 14, 2021. The 344-D group had five individuals placed in the treatment condition and five individuals placed in the control condition. The first analysis performed was looking at the difference between the two groups in relation to overall quiz score. Figure 25 shows the median quiz score before receiving the learning method compared to the quiz score after receiving the learning method assigned.

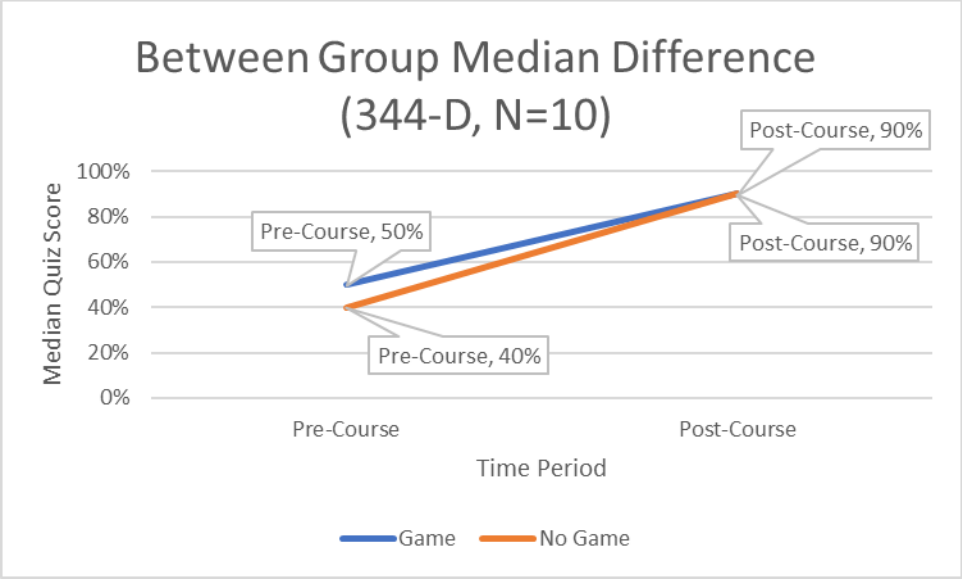


Figure 25. Between Group Median Difference, 344-D

The control group had a 40% pre-instruction score and the treatment group had a 50% pre-instruction score. The treatment group had a 90% median score post-course while the control group had a median score of 90%. This led to an overall improvement of 40 percentage points for the treatment group and a 50-percentage point increase for the control group. Mean scores between the groups were also analyzed to determine if there were any differences in the results, as shown in Figure 26.

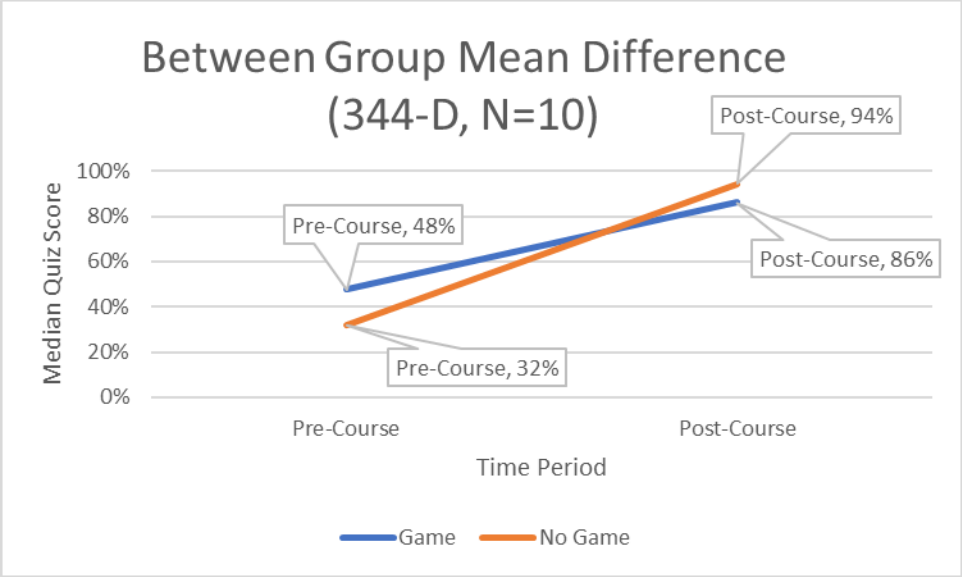


Figure 26. Between Group Mean Difference, 344-D

The treatment group had a pre-course score of 48% and a post-course score of 86% for an overall improvement of 38 percentage points. The control group had a pre-course score of 32% and a post-course score of 94%. The result is a mean increase of 62 percentage points for the control group. The median and mean results are consistent for both groups as they saw large increases in post-instruction outcomes, with the control group seeing the largest median and mean increases in post-quiz performance. Figure 27 shows data for individual differences among the participants.

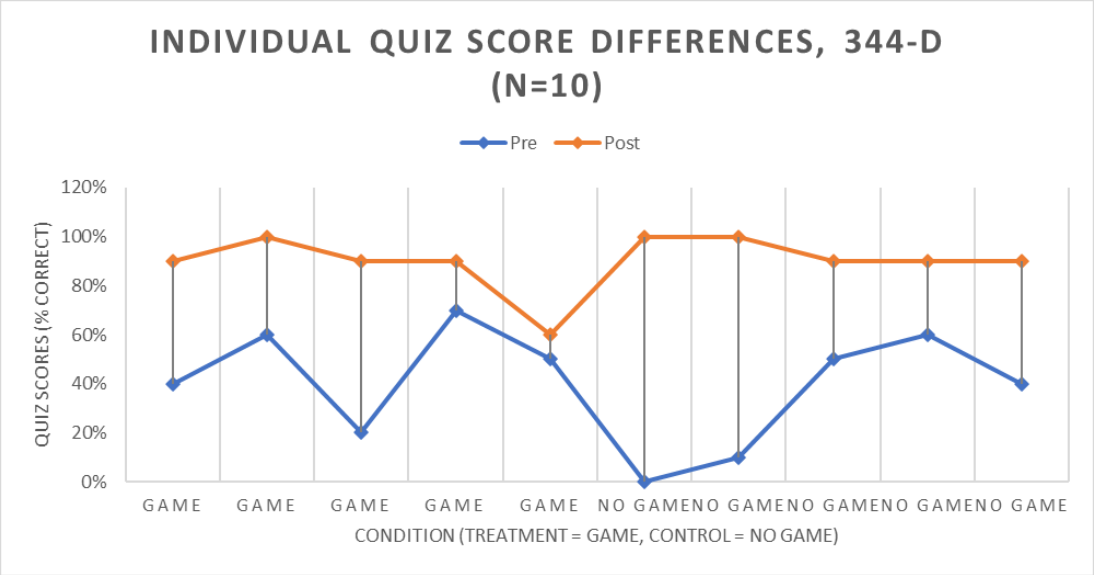


Figure 27. Individual Difference, 344-D

There were consistent outcomes on the post-instruction quiz for both groups. The largest increase was in the control group with a 100-percentage point increase and the treatment group had one respondent with the smallest improvement in outcomes with a 10-percentage point gain. Overall, the control group had more consistent levels of positive improvement individual.

On the evaluation survey, respondents were asked how likely they are to recommend the learning method they received in this training to a friend or colleague. The control group had three passive and two promoters. The treatment group had two detractors and three passive participants. The treatment group has more detractors which means for this response, they would likely not recommend the training. Figure 28 shows the buckets the participants fell into for both groups.

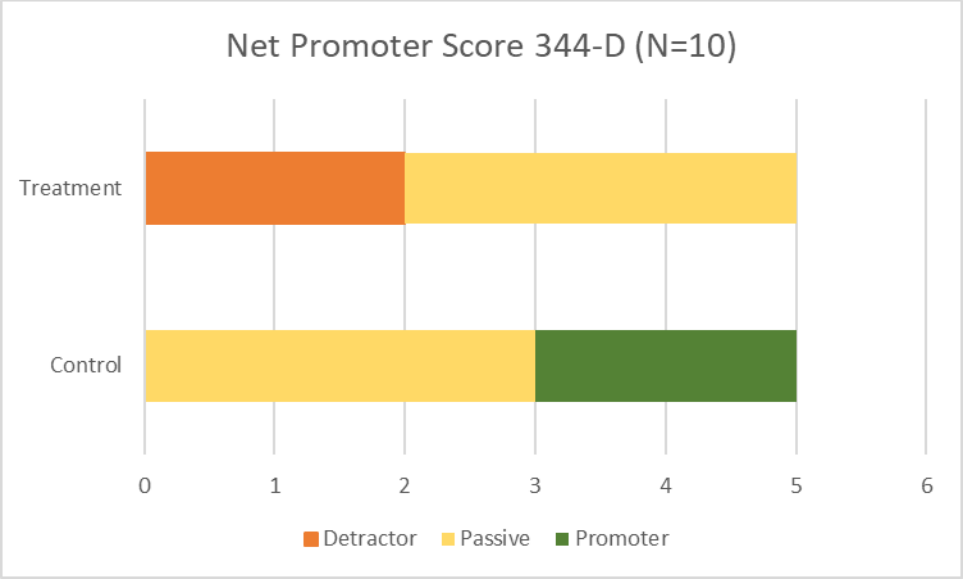


Figure 28. Net Promoter Score, 344-D

Respondents were also asked how they would rate their overall level of engagement with the training they received. The median level of engagement for the treatment group was eight while the median level of engagement for the control group was ten. This data shows that for the 344-D group, the control learning method was rated with the higher level of engagement.

The respondents were asked why they gave the rating they did for the NetPS. Common themes among this group were game design, difficulty of the game, and overall preferences. A participant in the 344-D treatment group stated, "It was repetitive questions/answers, so it helped you learn but the shooting game/defusing bomb for people who never played video games was challenging. It felt like there's too much going on, but I was able to retain some of the information."

For the control group, the major theme was preferences. One comment from this group stated, "Learning through a person is much more effective than through any other method."

We also asked the respondents what are some ideas you have about ways the Air Force can improve your experience completing trainings like these? One comment from the treatment group stated, "better computers to handle the game."

This is comment is one that we were not able to influence or control with the 344 TRS waves but is something that we would like to explore further. The 344 TRS treatment groups all had government computers that struggled to handle the performance of the gaming simulation. This comment shows the difficulty our group faced in the game development and deployment.

Typical DoD computer systems are not designed to operate graphically intensive programs, like video games, therefore the gameplay was inconsistent, even in the bug-free version. These comments also highlight the need for further investment in researching gamification to determine optimal learning game types for contracting professionals.

To answer this same question, three participants from the 344-D control group stated: "Hands on application would improve retention of information"; "Having a hands-on portion/something individuals can look at instead of just words in PowerPoint format"; "Less acronyms on unending PowerPoints."

These comments touch on multiple facets of traditional learning. Over utilization of acronyms can make it difficult to focus while learning, as one participant stated. They also stated they would enjoy something hands on instead of just a PowerPoint. This idea has been stated multiple times and tends to encourage the idea of a multi-learning format that is inclusive of both traditional and gamified learning. This could be an effective way to encourage learners to study ideas that are delivered by traditional methods and needs continued research to continue to investigate potential outcomes.

5. CM Wave – Wave 5

The CM wave consisted of students at NPS learning about Category Management policy guidance from the Office of Management and Budget. The control wave in this group was taught utilizing PowerPoint but was delivered in an online setting with a live instructor on Zoom.gov. It is important to note that no participant in this control group was taught face-to-face, while every 344 wave was taught face-to-face. The treatment group was held in person with two members of the thesis team overseeing the participants. The participants in this wave (control and treatment) were classmates of the thesis group and

utilized their computers. No government computer was utilized for the CM wave treatment group, while all the 344 utilized government computers.

The CM wave group was the only group that went through the experiment from NPS. This group also received different quiz questions from the other four waves. These questions were also derivative versus one-for-one as in the 344 TRS waves. In the 344 TRS waves questions in the pre and post evaluation survey mirrored those in the game. In the CM wave, questions in the pre and post evaluation survey were the same but were not directly stated in the game. The students could derive the correct answer to the post evaluation survey questions from information provided in the game. This introduced a higher degree of knowledge retention involving some amount of critical thinking, while the 344 waves consisted of rote memorization information. The group size of this experimental trial was 14 (n=14) and took place on August 17, 2021. The CM wave group had 7 individuals placed in the treatment condition and 7 individuals placed in the control condition. The first analysis performed looked at the difference between the two groups in relation to overall quiz score. Figure 29 shows the median quiz score before receiving the learning method compared to the quiz score after receiving the assigned learning method.

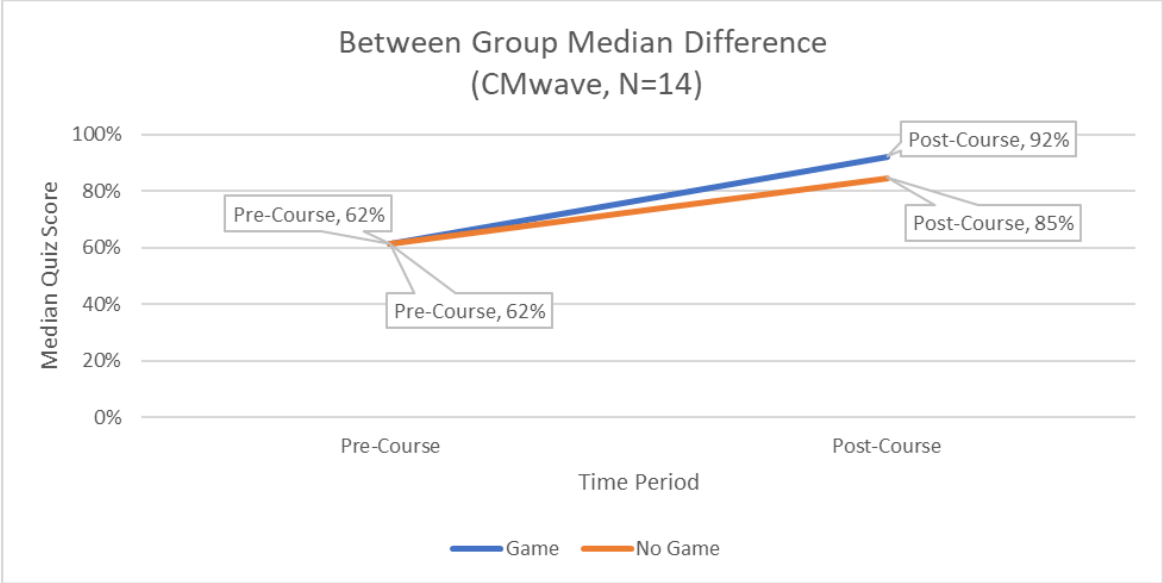


Figure 29. Between Group Median Difference, CM wave

Both the control and treatment group had a pre-instruction score of 62%. The treatment group had a 92% median score post-course while the control group had a median score of 85%. This led to an overall improvement of 30 percentage points for the treatment group and 23 percentage points for the control group. The mean scores between the groups were also analyzed to identify any differences in the results, as shown in Figure 30.

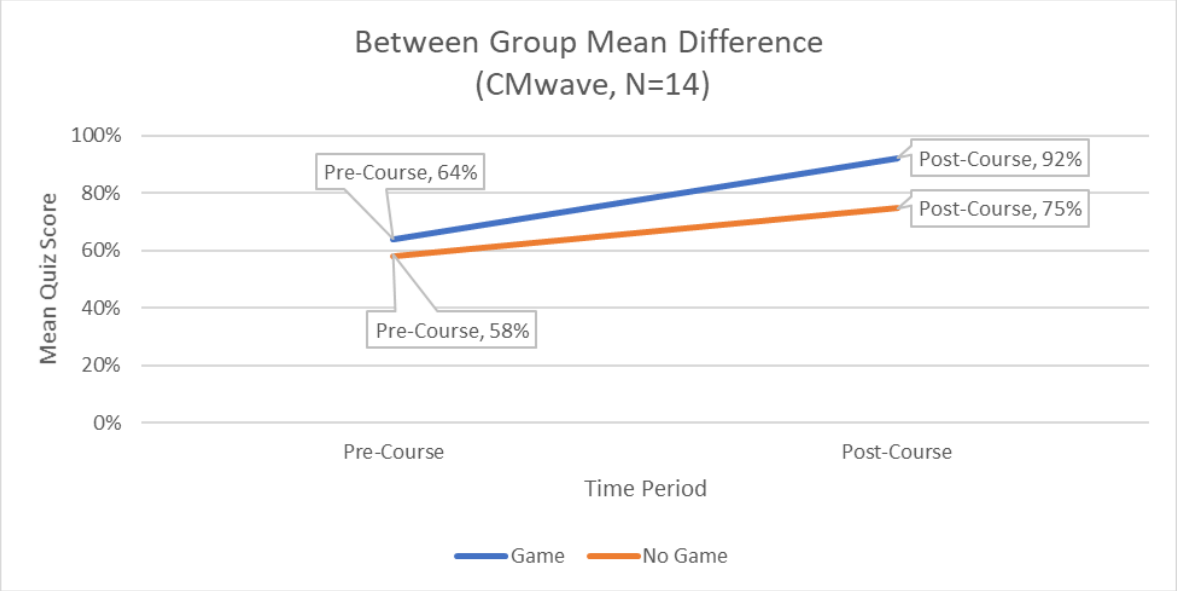


Figure 30. Between Group Mean Difference, CM wave

The treatment group had a pre-course score of 64% and a post-course score of 92% for an overall improvement of 28 Percentage points. The control group had a pre-course score of 58% and a post-course score of 75%. This led to an increase in 17 percentage points for the control group. The median and mean results are consistent for both groups as they saw large increases in post-instruction outcomes. The treatment group had the larger overall improvement for both the mean and median results of the wave. Figure 31 shows data for individual differences among the participants.

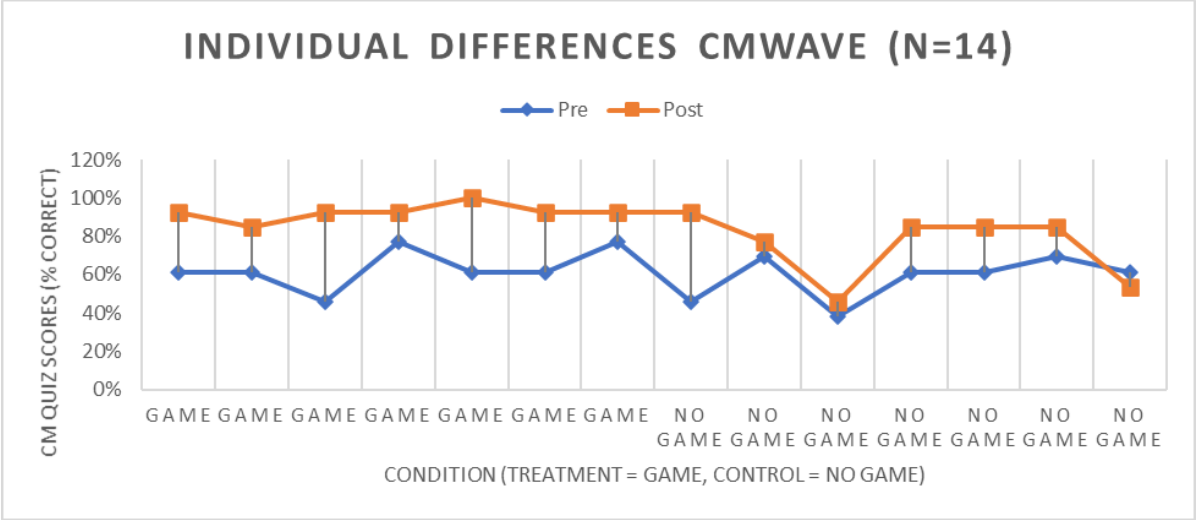


Figure 31. Individual Differences, CM Wave

There were more consistent outcomes on the post-instruction quiz for the treatment group. The largest increase was in the control group with a 46-percentage point increase. The control group also had the largest decrease, as one respondent had negative results, with an 8-percentage point decrease.

On the evaluation survey, respondents were asked how likely they are to recommend the learning method they received in this training to a friend or colleague to measure their NetPS. The control group had four detractors, one passive, and two promoters. The treatment group had two passive and five promoters. The treatment group had the highest percentage of promoters of any wave with 71% of participants self-identifying as promoters. Figure 32 shows the buckets the participants fell into for both groups.

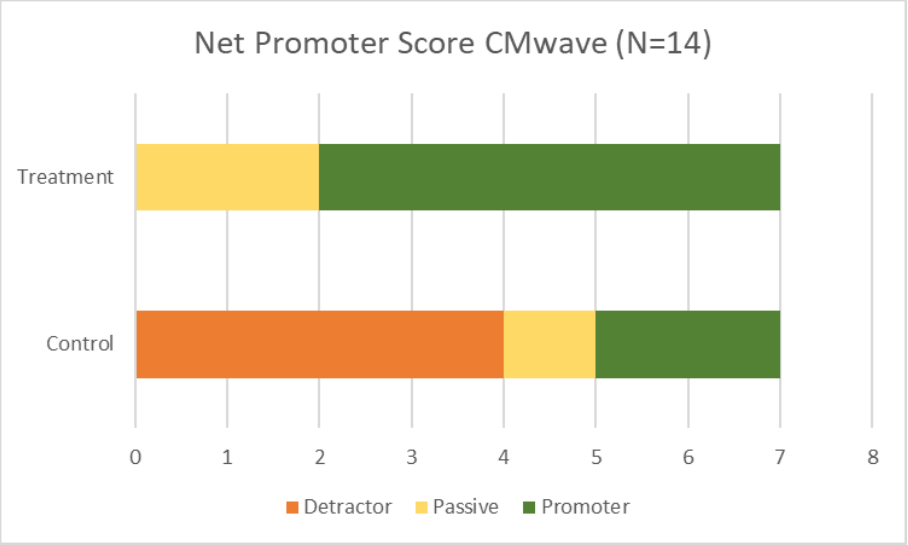


Figure 32. Net Promoter Score, CM Wave

Respondents were asked how they would rate their overall level of engagement with the training they received. The median level of engagement for the treatment group was ten while the median level of engagement for the control group was seven. This data shows that for the CM wave group, the treatment learning method was rated with the higher level of engagement. It is important to note, again, that the control group was receiving synchronous virtual instruction versus face-to-face, in class instruction.

The respondents were asked why they gave the rating they did for the NetPS. There were a lot of positive feedback notes related to the treatment learning method. The major themes incorporated in this group was game design, active learning, and preference. One response stated, "Information is infused into a situation that maximizes engagement naturally. Engagement is not manufactured around the information. Therefore, it is more likely that I will engage the information in a gamified environment."

The respondents in the control group had various responses to this same question as well. The major themes were associated with instructor delivery, preference, and level of learning. One response stated, "I love the traditional method, also the instructor brought in other context into the material which if not brought into the gaming environment they will have far less knowledge."

Respondents were asked about ways the Air Force can improve your experience completing trainings like these. Two important responses from the participants were: "Implement training like this in for DAU courses that we have to take online. We just click through those a lot of times anyways, and there is so much information in them. It would be so much more fun to do it in a game like we did today and would honestly probably take the same amount of time"; "Taking the training around peers made it more competitive and I was more engaged because of it."

Defense Acquisition University (DAU) is the primary educational organization used by DoD acquisition professionals, including contracting professionals. The first comment highlights an opportunity to enhance DAU training delivery methods' effectiveness or efficiency through gamification. We should note that our program at NPS is supporting DAU in studies of gamified learning as well. The other response centered around competition, and this participant enjoyed the competitive environment around this learning method.

The control group also stated some ideas about ways the Air Force can improve your experience completing trainings like these. One respondent stated, "AF should understand difference between training and education. Develop different options for education. Increase dialog and engagement when educating."

6. Overall Analysis – 344 TRS Waves

a. Change Analysis

For the overall data analysis, we looked at a side-by-side comparison of the box charts. This type of graphs helps easily illustrate variability found within the data. Figure 33 shows the box charts that were run for the analysis of the change in test scores among the control and treatment groups.

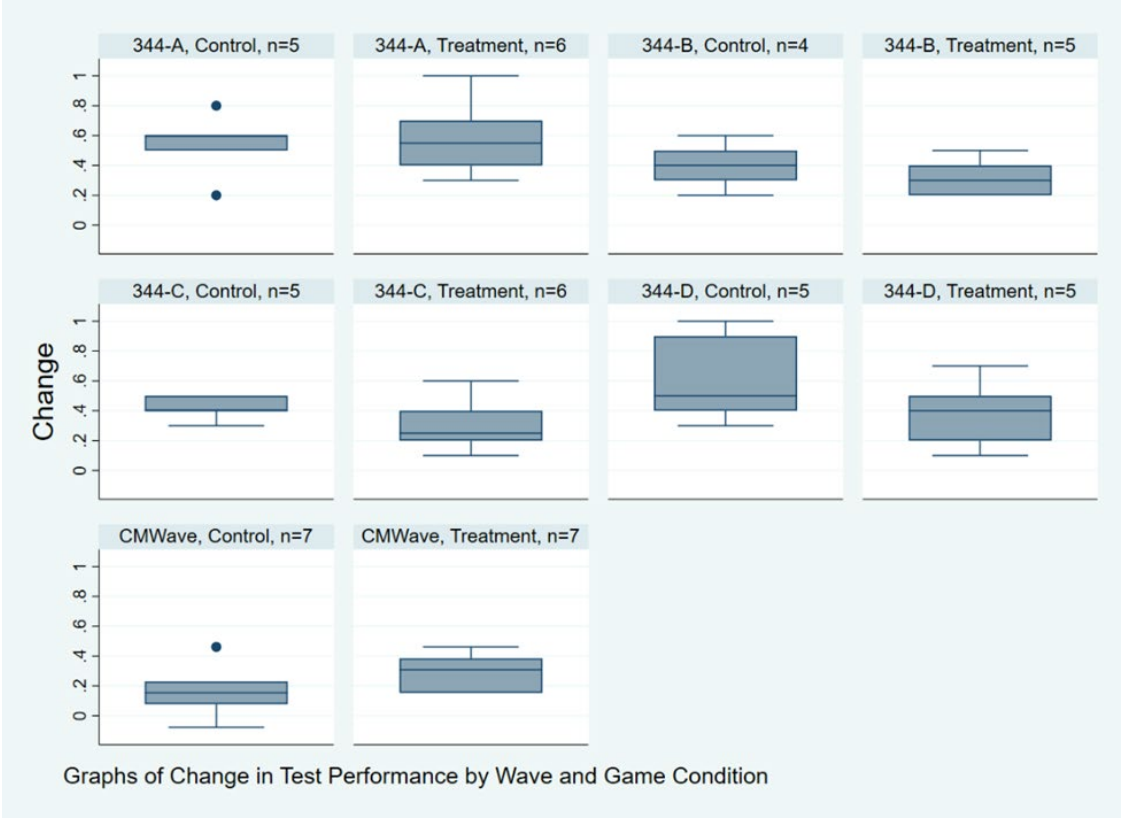


Figure 33. Box Chart Change in Scores, 344 TRS Waves Control versus Treatment

We utilized the box chart graphs to quickly look at variability in the data. Every wave has a control and treatment chart in the Figure. 344-A control is tightly coupled with 2 outliers to either side, whereas the treatment group is more widely distributed. With 344-B the treatment group is more concentrated, but at lower levels of change. In 344-C the control is less variable and higher on change that the treatment group. In 344-D both groups vary a lot, but the control is much higher. In the CM wave group, the treatment group is less varied and higher overall than the control group.

The overall data has been analyzed with the treatment and control compared against each other among different types of analyses. The first t-test performed compared the change in scores of the treatment and control groups. Table 3 shows the comparison of these two groups.

Table 3. T-Test Change in Score for 344 TRS Waves Control versus Treatment

Group	Obs	Mean	Std Error	Std Dev
Overall - Control	19	0.5	0.0495	0.216
Overall - Treatment	22	0.4	0.0478	0.2246
P-Value	0.078			
P(|T|>|t|)	0.1560			

The results of the analysis show that p-values fall beneath the 0.10 level in the one-sided test. However, the two-sided test and confidence intervals reveal that the null hypothesis cannot be ruled out.

A comparison of between waves data was analyzed to determine which results should be included in further overall testing. To do this, we ran a t-test on the change in scores from pre to post for each condition in each wave. Scores were grouped by the control method and the treatment method to identify any group that should not be included in the data for the overall test between the groups. Stata was used to execute t-tests and that data is provided below. We ran an analysis with a 90% confidence level, therefore any p-value less than 0.1 denotes a significant value. Tables 4 and 5 show data for significant findings.

Table 4. T-Test 344-A Treatment versus 344-C Treatment

Group	Obs	Mean	Std Error	Std Dev
344-A - Treatment	6	0.58	0.1013	0.2483
344-C - Treatment	6	0.3	0.073	0.1788
P-Value	0.0234			

Table 5. T-Test 344-A Treatment versus 344-B Treatment

Group	Obs	Mean	Std Error	Std Dev
344-A - Treatment	6	0.58	0.1013	0.2483
344-B - Treatment	5	0.32	0.0583	0.1303
P-Value	0.0312			

There is a significant difference between the treatment groups of 344-A and 344-C as well as the treatment group of 344-A and 344-B. Because of this, we are not including the data for 344-A into the overall comparison of the treatment and control groups of the 344 waves. The CM wave group was not analyzed against the other waves due to different experiment conditions as well as a different set of evaluation survey questions to respond to. The 344-B, 344-C, and 344-D will all be included in the overall data. The first analysis performed was a t-test run between the overall control group and the overall treatment group, as shown in Table 6.

Table 6. T-Test Change in Score for 344 TRS Waves Control versus Treatment (Excluding 344-A)

Group	Obs	Mean	Std Error	Std Dev
Overall - Control	14	0.48	0.0591	0.0591
Overall - Treatment	16	0.33	0.0444	0.0444
P-Value	0.0216			
P(|T|>|t|)	0.0431			

When we analyzed the overall change in scores from the pre to the post for each wave, we see there is a significance difference between the control group and the treatment group. For this experiment, the control group saw a significantly greater improvement in scores when compared to the treatment group with a p-value of 0.0216.

We also analyzed a comparison of the pre-test scores between the 344 waves. We looked at an overall comparison with all the waves, excluding 344-A. We did not find a significant difference between the two groups, as shown in Table 7.

Table 7. T-Test Pre score values for 344 TRS Waves Control versus Treatment (Excluding 344-A)

Group	Obs	Mean	Std Error	Std Dev
Overall - Control	14	0.43	0.052	0.1945
Overall - Treatment	16	0.51	0.0378	0.1515
P-Value	0.1			

\Table 7 shows that there is no significant difference between the treatment and control pre-score quiz values for the 344 waves. The p-value was 0.1. This indicates that there is no significant difference between the two groups analyzed. This is important to note since there was a significant difference in the change in scores that was not found in pre-instruction scores.

The next analysis performed was to examine a comparison of the post-test scores between the control and treatment groups of the 344 waves, shown in Table 8.

Table 8. T-Test Post score values for 344 TRS Waves Control vs Treatment (Excluding 344-A)

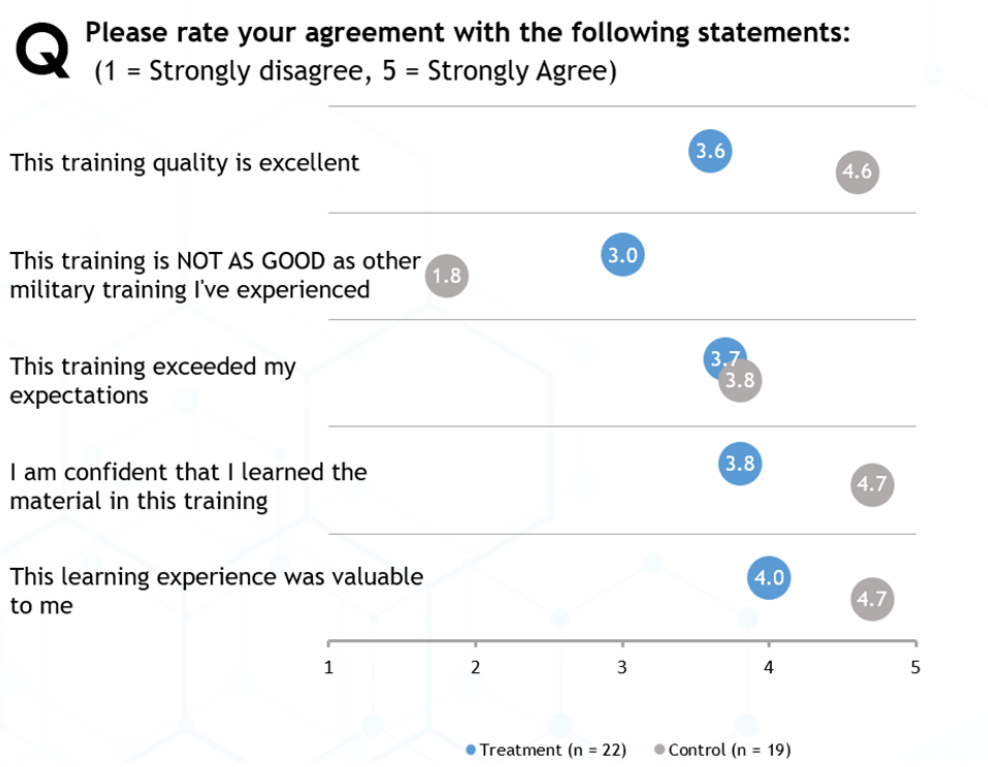
Group	Obs	Mean	Std Error	Std Dev
Overall - Control	14	0.9214	0.0186	0.0699
Overall - Treatment	16	0.85	0.0437	0.1751
P-Value	0.0823*			

This analysis shows a significant difference between the control and treatment group with a p-value of 0.0823. This shows that the control group had a significantly higher overall score compared with the treatment group. This is important to note as the significant change in overall scores was due to the significant change in post-instruction scores.

b. Subject Expectations and Experience

In the post-instruction evaluation survey, respondents were prompted to select if they agree or disagree with five statements. These statements ranged from strongly disagree (1) to strongly agree (5). Table 9 shows a graphical representation of the five questions asked.

Table 9. 344 TRS Agreement Scale

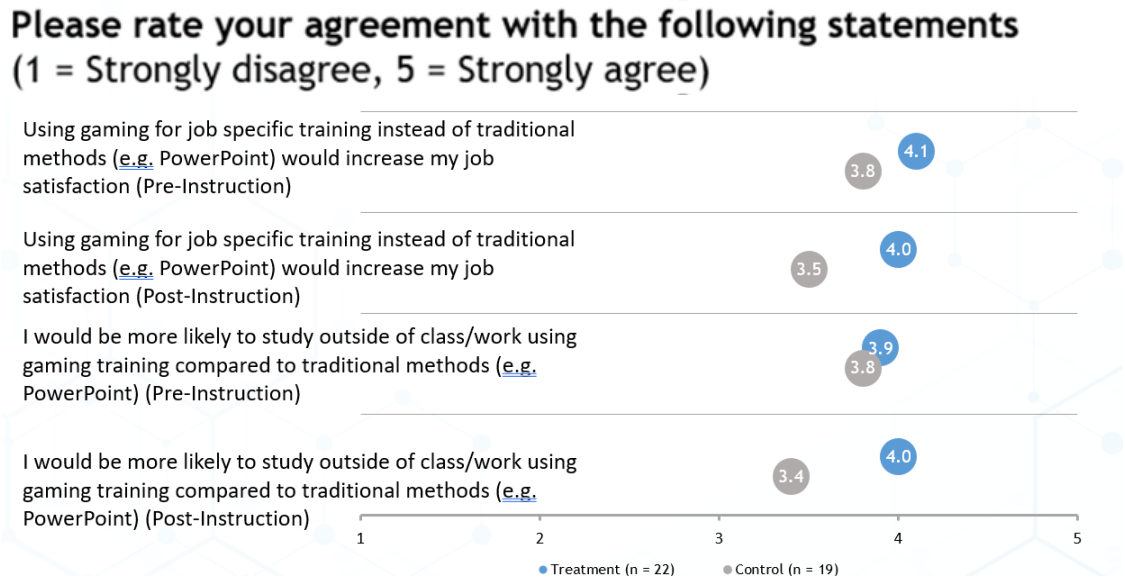


The 344-control group indicated higher agreement than the treatment group to all statements except one. The responses to the statement “this training is not as good as other military training I’ve experienced” means that the control group delivery method was rated

as better than or as good as most military training they have received in the past. For the gaming group, this selection falls more in the middle, indicating mixed results from the waves. One question where there was minimal difference between the two groups is "this training exceeded my expectations." Both groups indicated a closely related agreement with this statement, 3.7 for treatment and 3.8 for control.

Two additional agreement scale statements were provided prior to instruction and after receiving instruction, as shown in Table 10.

Table 10. 344 TRS Waves agreement scale (Pre and Post Instruction)



The treatment group did not move very much between pre- and post-instruction while the control group seemed to be less agreeable about gaming after they received their instruction. It is evident the pre-instruction scores started higher for the treatment group in both questions. After receiving the different training types, the post-instruction control group found it less likely than the pre-instruction control group to state that gaming would increase their job satisfaction. For the treatment group, while the overall score dropped from a 4.1 (pre-instruction) to a 4.0 (post-instruction), this indicates that it would still increase their job satisfaction. This also reveals that the treatment group is more likely to state that gaming would increase the job satisfaction, if they played the game. The second

question asked if they would be more likely to study outside of class/work using gaming compared to traditional methods. The pre-instruction scores both indicated an agreement with this statement as the treatment group had a 3.9 score and the control group a 3.8. The post-instruction scores for the control group did drop in agreement, but score a 3.4, meaning that they still had an agreement with the statement. The post-instruction scores for the treatment group increased to a 4.0, which indicates a stronger agreement with the statement. These scores also indicate that those who received the treatment learning method have a higher agreement with the question than those who did not receive the treatment.

We asked respondents to rate how likely they are to recommend the learning method they received in this training and follow the question with an open-ended question. The question, "what is the primary reason for the rating", was analyzed to identify possible trends in responses. Respondents' answers to NetPS open-ended questions were also categorized into the below themes. Table 11 shows the categories that were created to identify any trends in the responses and which learning group they were found in.

Table 11. NetPS Categorized Themes

Theme	Definition
Active Learning	Mentions of different concepts of active learning (see Chapter III literature review) – Treatment group
Ease	Participant rated the experience based on ease of learning/information delivery – Treatment group
Game Design	Includes game genre, various gameplay mechanics, difficulty of gameplay, gameplay issues (bugs/glitches) – Treatment group
Instructor Delivery	Mentions of instructor delivering material effectively – Control group
Neutral	Comments did not provide significant insight to the reason for rating – Both groups
Opportunity for Feedback	Learning environment presents opportunity for immediate feedback. Respondent appreciates the opportunity for feedback and interaction with instructor – Control group
Perceived High Level of Learning	Respondent perceived their level of learning to be high – Control Group
Preference	Mentions of a preferred method/modality of learning i.e., visual learning, auditory learning, active learning, gamified learning etc. – Both groups

For the treatment group, Figure 34 reveals the categories and number of times a response fell into this category.

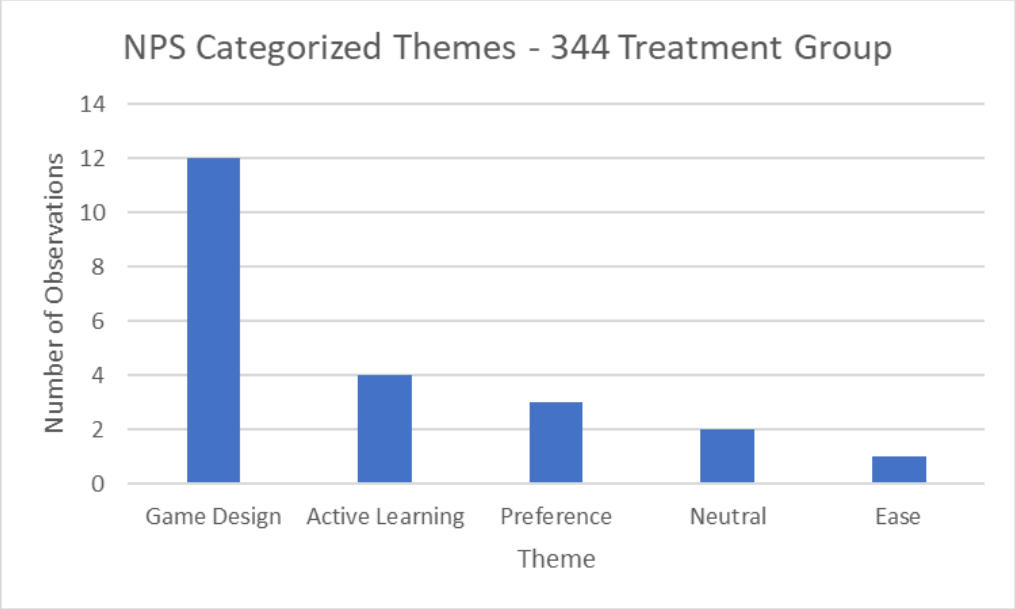


Figure 34. 344 TRS Treatment Group – Net Promoter Score – Reason for Rating

This data indicates that game design was a significant factor in participants' ratings. Game design may have affected results among this wave of participants and is an element that must be considered in any future iterations of the research. Multiple users commented on the difficulty of a first-person shooter type game, especially to new gamers. The comments that fell into the active learning theme centered around enjoyment during the learning process and engagement. Preference type comments simply were about their own personal preference to gaming as a learning style, regardless of whether the comment was positive or negative.

The control group was asked the same question and their responses were analyzed. Responses were categorized based on themes, shown in Figure 35.

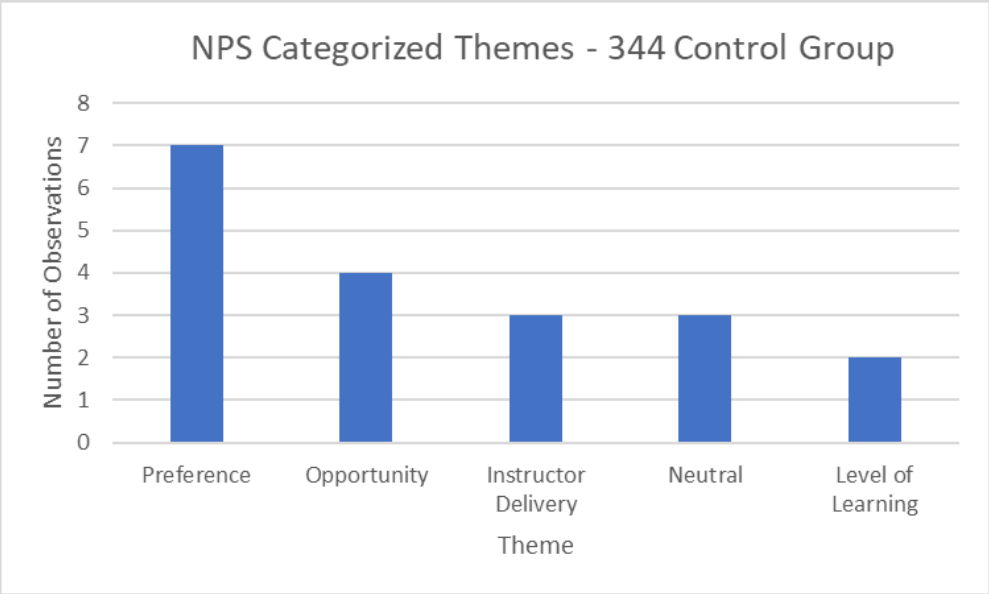


Figure 35. 344 TRS Control Group – Net Promoter Score – Reason for Rating

The most common theme was preference, with seven participants mentioning this. Preference related to the type of learning they conceptually preferred and the participants gave their individual preference, although only going through one version for this experiment. Within the preference theme, one participant gave a detractor rating, five gave a passive rating, and one gave a promoter rating. The opportunity category was made to put a place where respondents mentioned they believe that the control learning method has certain opportunities that they find helpful. For example, one respondent mentioned how they can interact and ask questions with an instructor, which gives them an opportunity to excel. Another category was the instructor delivery, including respondents' comments on the way the instructor presented the material. This is going to be very dependent on the professor for these types of comments and could have a wide range for different professors.

Respondents were asked to state if they had experience with video games. Any respondent who had experience was asked to list how many years of experience they had with video games. Table 12 lists the participant's years of experience with video games for both groups broken out by waves.

Table 12. 344 TRS Years of Experience with Video Games by Wave

	344-A		344-B		344-C		344-D	
(years)	**Control**	**Treatment**	**Control**	**Treatment**	**Control**	**Treatment**	**Control**	**Treatment**
Mean	14	6.33	13.25	19.8	9.4	6.67	11.6	9
Median	14	1.5	12.5	18	10	4	10	14
Min	10	0	5	14	0	0	0	0
Max	20	20	23	25	15	18	20	16

The data shows that the control group had more experience in video games and less variability between the mean and median for two of the waves. The treatment groups average was more affected by those with zero experience with video games than that of the control group. This shows that there were more non-gamers in the treatment group than in the control group. Those that do have experience with video games were asked to list their top three favorite games. Responses were then categorized into game genres. The genres have been defined as shown in Appendix-C. Figure 36 indicates both groups' responses to this question.

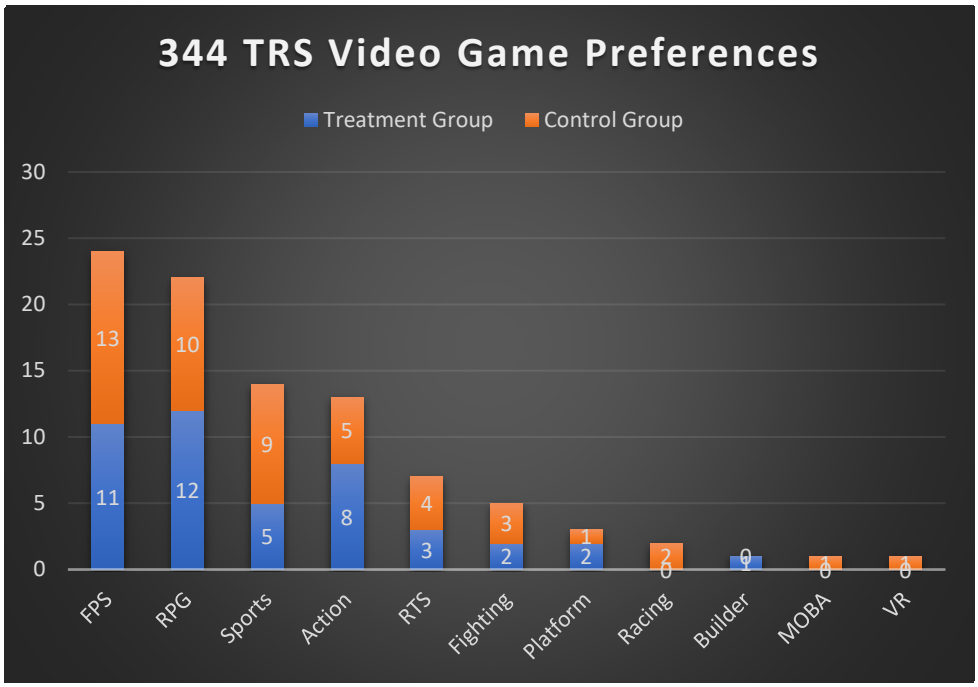


Figure 36. 344 TRS Favorite Video Games - Categorized

The data shows that the two most popular games chosen in the 344 TRS are FPS (24) and Role-Playing Games (RPG) (22). Other popular gaming choices were action and sports games. The next tier of selected games were sports with 14 observations and action games with 13 observations. Less popular gaming types included Real-Time Strategy (RTS), platform, fighting, and builder.

We asked respondents of the treatment group if they enjoyed this gamified method of training, as shown in Figure 37.

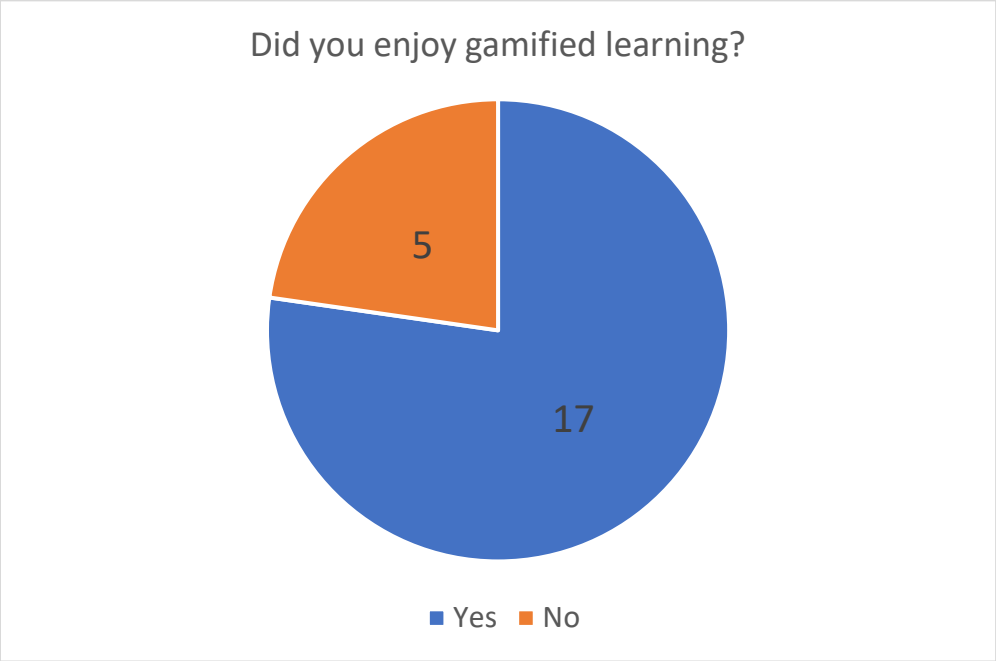


Figure 37. 344 TRS Treatment Group Enjoyment Rating

The treatment group had seventeen participants that stated they enjoyed the learning method, when asked in a yes or no format. Five participants responded that they did not enjoy the learning method. If the respondent selected no, we asked them in a follow-up question if they would still like to see gamified learning in another format. The five participants who selected no, were all detractors in the NetPS rating. All five participants responded that they would like to see gamified learning, just utilizing something different from a first-person shooter. Additionally, five participants all stated they would like to see a puzzle game, and two of them stated they would like to see a role-playing game as well. These results were very encouraging and could indicate a strong enjoyability towards gaming. In later discussions with the Defense Language School in Monterey, California, we found that they also attempted an FPS formatted game only to find that most participants preferred role playing fantasy games.

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V. LIMITATIONS, AREAS FOR FURTHER RESEARCH, AND RECOMMENDATIONS

A. LIMITATIONS

While we were able to field a minimum viable product in approximately two months, we were still limited by various factors. Some factors include time, number of participants, proximity to participants, capability of and changing of instructors, fear of reprisal in a training environment, funding for game development, and poor hardware performance.

Time limited the research in more than one way. First, we were restricted to the schedule of the 344 TRS. The schoolhouse plans their schedules ahead of time and we had to adjust to it. Development of the game was expedited to meet the scheduled start date of an upcoming set of classes. During the shortened development period, all efforts were focused on creating a playable game, with less focus on game design and fit for the audience. Also, there is no current data on the player types of the Air Force acquisition community. Our timeline did not allow us to survey the Air Force to try to collect this data. Knowing player types of the target audience is critical in game design and having this knowledge would have helped us field a more suitable game, potentially altering learning and evaluation survey results (Bartle, 1996). This limitation is evident in player feedback when seeing negative comments related to game genre (FPS) and preferences for other types of games. Although FPS games were a favorite among participants, they stated in comments that the FPS genre was not the ideal fit for the material.

The next limitations dealt with the number of participants. We would have preferred a larger number of participants, but also larger waves with more participants for both the treatment and control groups. Larger treatment and control groups would have increased the reliability of the change in pre and post assessment scores as a valid sample for the entire population. We were unable to affect this change because of the natural limit of class sizes at the 344 TRS schoolhouse. Also, although our methodology of conducting a randomized controlled experiment is the gold standard for experiments, in the case of gaming, there exists a stigma of forced or "mandatory fun". Some detractors may not enjoy

or prefer games in general and would have preferred traditional training methods. The concept of play, mentioned as a benefit gaming brings to learning in Chapter III, was most likely not realized by our research. Ideally, it would have been beneficial to experiment with one or two waves in a self-selecting approach, meaning participants would choose to either play the game or take the standard method. We did not have enough waves to attempt this, nor the sample sizes available to ensure balanced group sets.

Our proximity to participants differed between the 344 waves and the CM wave of learners. We were in Monterey, California for the duration of the experiment. The 344 TRS cadre and experiment participants were located in San Antonio, Texas. Communications between us and the cadre assisting with executing the experiment were done primarily through emails and a small number of phone calls or text messages. With that, the researchers were unable to provide comprehensive introductions and background to the participants before they played the game, nor were we able to troubleshoot issues during gameplay, of which it was reported there were many. Although the focus of this research was with the 344 TRS waves, the CM wave also provided data. We were co-located with the CM wave of learners and conducted the gameplay experiment in-person. Having this difference in location may have influenced the experiences of the 344 TRS participants and NPS participants and the data suggests as such as the CM wave had much higher positive experience ratings.

One variable we were not able to control was who provided the instruction for each 344 TRS iteration. It was realized after the experiment concluded that waves were taught by different cadre instructors. Also, instructors were not explicitly directed to remain completely unbiased towards the new training delivery method. Cadre instructors may have put forth increased effort in delivering their instruction to prove their worth in the program. This is a factor that we would have preferred to be controlled, as instructor capabilities can affect learning. The 344 TRS mission requirements and manpower prevented the preferred scenario of a single instructor for all waves.

Fear of reprisal is innate to a training environment for newer military members. It must be noted that Airmen in the 344 TRS are still Air Force trainees and may have very recently completed basic training. Military training environments, especially basic and

initial skills training, are inherently tense and failure is frowned upon. Because of that, some participants may have been in a mindset that their assessment performance and evaluation survey feedback, while completely anonymous, could negatively affect them and their careers. This is merely our experiential supposition, but this notion was suggested in the data when comparing evaluation survey comments between the 344 waves and CM wave. The CM wave comments were more critical of both the instructor's delivery and material. Both this reprisal concern and the possible instructor bias concern could be mitigated by using historic traditional instruction performance to a treated group. However, this data was not available. Future researchers could look for instances where such data are available and design a pure treatment study from which to draw comparative conclusions.

Chapter III discussed the benefits that games and gamification can bring to the learning process. One of the benefits mentioned, the concept of play, was most likely not realized by our research. The 344 TRS students in this study were not given a choice to decline participation, therefore it is unlikely that the concept of play was realized in most of the empirical data. Future research on gamification of Air Force contracting training will cover this benefit).

Lastly, our research was limited by a lack of funding. Game design and development is an in-demand, high-salary, profession, and we were unable to hire a game developer to create a training game. Also, having funding to travel to San Antonio, Texas to conduct the 344 TRS experiment waves in-person would have resulted in a more controlled experiment and potentially more reliable data. Lastly, the 344 TRS computer hardware was not designed for gaming and did not provide an ideal user experience. Learners were playing the game on Microsoft tablets that lacked in graphical performance and were not provided an external monitor, further reducing the player experience. Allocating funds to provide improved hardware suitable for gaming would have greatly enhanced the player experience.

B. AREAS FOR FURTHER RESEARCH

After completing our research, we have uncovered several areas in which further research is needed to understand the full impact of gamification on government acquisition

training and education. One of those areas is long-term retention of material learned through gamified modalities. This study analyzed the immediate effects of gamification. The participants at the 344 TRS were tested on learning results directly after receiving their training. In the future, we believe a study should be conducted on the retention of knowledge gained post training plus six months and again post training plus 12 months. This data would be another important point in the overall picture of the effectiveness of gamifying government acquisition training and education.

This study tested the effects of learning government acquisitions through gamified modalities using a multiple-choice question and answer type format. Another interesting area for further research would be to replicate this type of study using more scenario-based cases. Using this type of format, a player would be forced to think more critically. A scenario could have multiple correct decisions, however some more correct than others. Would gamifying contracting scenarios lead to better learning than using the traditional case study format? A puzzle or escape room type game could be used to setup this type of study to provide an extra layer of immersion in either traditional or virtual reality format.

Looking at gamification through a psychological lens, we also pondered if using video games and gamification modalities for learning government acquisitions can lessen the significance of the craft in an individual's mind. Government acquisitions is an occupation that, if not performed in a completely ethical manner, can have very serious consequences. Understanding what the effect that learning using games can have on a person's ethical behavior in the future is important. Gamification of government acquisition training and education would likely need to become prevalent for at least 5 to 10 years before this type of study could be performed. However, the results would be very interesting in understanding the entire picture effect of using games and gamification for learning government acquisitions.

We discussed Richard Bartle's Taxonomy of Player Types in Chapter II. We learned that there are four main types of game players, Achievers, Explorers, Killers, and Socializers. In Section A of this chapter, Limitations, we discussed how we did not design our Sandbox Contracting game with these player types in mind, as we had not researched Bartle's Taxonomy until after the game had been developed. We suggest an area for further

research would be to design an evaluation survey to learn which player type dominates the government acquisition demographic. We gathered data on which player types existed among our NPS cohort members during a class exercise by having them complete the survey at the following link: https://matthewbarr.co.uk/bartle/. The survey respondent answers several scenario-based questions, after which the survey calculates the percentage the respondent aligns with each player type, totaling up to 200%. Figures 38 shows the total count of each player's primary type. From this data, we can state that the Achiever, Explorer, and Killer player types seem to be separating themselves from the Socializer player type.

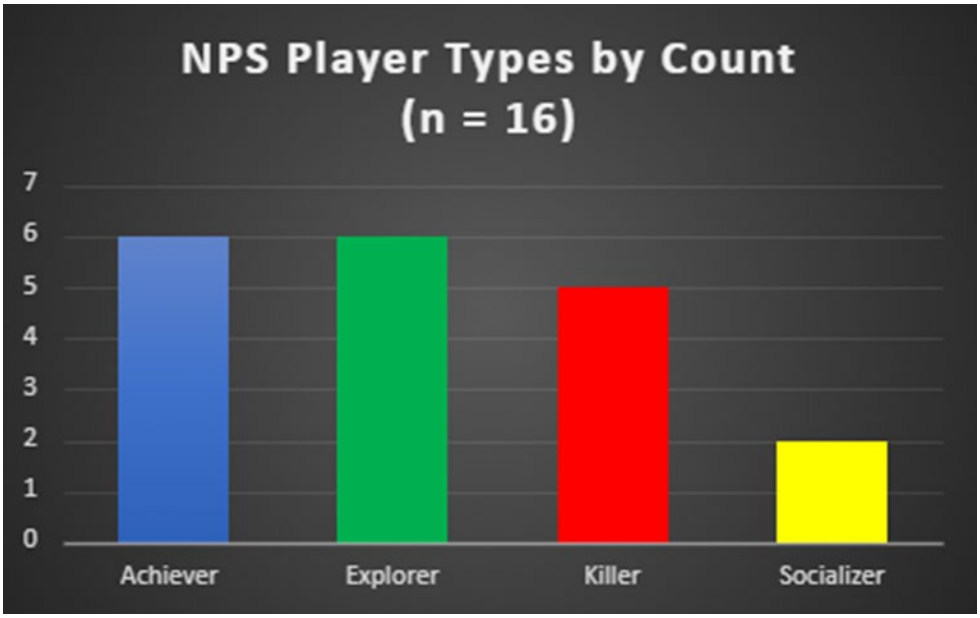

Figure 38. Bartle's Taxonomy – NPS Player Types by Count

Figure 39 demonstrates the average (i.e., prototypical) player type among all 16 respondents. In other words, if we average the scores of all 16 observations as one, prototypical individual, the result would be 26% achiever, 22% explorer, 22% killer, and 18% socializer. Due to the survey providing a result totaling 200%, these values were normalized to total 100% by dividing each percentage by two.

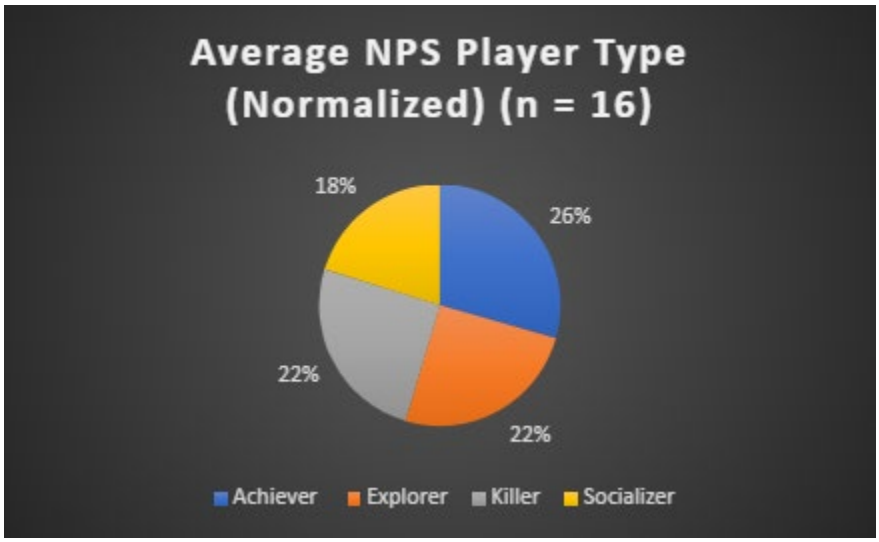

Figure 39. Bartle's Taxonomy – Average NPS Player Type (Normalized)

The number of observations (16), however, is still very small. By surveying a much larger pool of the government acquisition workforce, we believe that there will be one or possibly two player types that emerge as the most predominant. Once this information is gained, a game should be designed that caters to that specific player type or types, and some form of this study should be replicated implementing said game.

In Chapter III we discussed potential drawbacks from gamification and using games for learning. One of the negatives brought out by gamification was a loss of performance, which can occur from making participation mandatory. We designed this experiment in a manner that does not allow for participants to decline participation, which could have resulted in less-than-optimal data from the treatment group. We suggest that an area for further research would be to simply duplicate this experiment while allowing for people to self-select if they would like to be in the treatment (game) group or if they would like to be in the control (traditional) group. This would eliminate the loss of performance from mandatory play and would also allow for the concept of play, which we learned in Chapter III requires voluntary participation, to occur.

Lastly, an area for further research is simply experimenting with different genres of games, with different types of games, or with the same game using slightly different mechanics. We chose a first-person shooter game for our experiment simply because it was

the most popular video game genre at the time of our study. However, maybe learning acquisition techniques would be better suited for a role-playing game, or a virtual reality escape room. Or possibly a card game or a board game. Maybe the game we used would have worked better without using a timer on the bomb, or without allowing for free ammunition reloads. An interesting area for further research is simply experimenting with different genres of video games, with different types of games or with the same game using slightly different mechanics to find out which offers the best results when learning government acquisitions.

C. RECOMMENDATIONS

Our thesis group learned a lot from this experiment. The 344 TRS control group had an overall higher change in test score than the treatment group. This overall higher score was found to be significantly different than the treatment group score. We feel that there are many potential reasons for this difference in data. One recommendation is to ensure that we are in-person to deliver the game in future iterations. Our team felt that we could have explained it differently and have been able to help as needed, especially with such an in-depth game like a first-person shooter. Another key recommendation is to have appropriate hardware for the game. When we looked at the NetPS categorized themes for the 344 TRS, we found game design to have the most observations with 12. We feel that since many participant's comments were associated with bad game performance, this could have been alleviated with appropriate hardware in place.

We also asked the 344 TRS participants to select if they agree or disagree with five statements, from strongly disagree (1) to strongly agree (5). One observation we noted was that there was a minimal difference between the scores for the statement, "training exceeded my expectation." We found this to be a curious result because the control group scored higher on the quiz and received higher scores on the other agreement questions. Due to these observations, we thought it was interesting that the control group did not have a much higher score (3.8) for the training exceeded my expectations or that the treatment group did not have a lower score (3.7). This could have something to do with systematic differences in expectations for gamified versus traditional education and training methods

that could be further explored. With these observations noted, we recommend asking questions to further investigate this in future research experiments.

In addition, we asked 344 TRS participants two other agreement scale questions. We asked the statement, "using gaming for job specific training instead of traditional methods would increase my job satisfaction." The treatment group responded with a 4.1 score pre-instruction and 4.0 post-instruction evaluation survey. This shows that although some of the scores for the treatment were lower for this experiment, if some of the kinks get worked out, there is a lot of enthusiasm for gamified learning. Another agreement statement was posed that asked participants, "I would be more likely to study outside of class/work using gaming compared to traditional methods." The treatment group rated the question 3.9 pre-instruction and 4.0 post-instruction. This again shows positive results for gamified learning, especially when it comes to utilizing materials outside of work.

We asked the 344 TRS participants to state their experience with gaming on the pre-instruction quiz. Table 13 shows the overall average of years of experience with gaming.

Table 13. 344 TRS Years of Experience with Video Games

	Control Overall	**Control Gamers Only**	**Treatment Overall**	**Treatment Gamers Only**
Experience (Avg in years)	12	13.4	10.09	13.06

The control group had an average of 12 years of experience with gaming. When we removed those with zero gaming experience (2 of 19 observations, 10.5%), the average years of experience jumped to 13.4. The treatment group had an average of 10.09 years of experience. When we removed those with zero gaming experience (5 of 22 observations, 22.7%), the average years of experience jumped up to 13.06. This is important data because having a higher percentage of "non-gamers" in the treatment group could have caused a negative effect on the participants understanding and enjoyment of the game, especially with such an advanced game (FPS) being played by those with zero gaming experience.

We strongly recommend that future research start with an easier game to be played and to continue to track the participants average years of experience with video games.

Some of what we found to be very valuable data was captured in open-ended questions in the post-instruction evaluation survey. This allowed participants to give honest feedback that we think really helped us learn from the experiment. Because of this feedback, it helped us to conclude that a first-person shooter was probably not the best format to use for an early adoption of gamified learning. Multiple comments centered around the fact that the participants loved/enjoyed gamified learning, but that the game did not feel as relevant to the lesson as it could have. The participants also stated that it might have been better to utilize a puzzle, role-playing game, or a more open world game to learn the material. Since our team designed and made the game from scratch, one of the issues that we ran into was time to create the game. We recommend to future researchers to utilize a game that already exists if they are limited based on time. The team would then be able to focus their efforts in other areas of study design and analysis. This could also be helped by an exploration of overriding gamer types within the population of interest (i.e., Air Force acquisition communities).

Another observation that we noted is the difference in favorability for the treatment wave and the 344 TRS. Overall, the CM wave was found to have a higher change in the treatment group, relative to the control group, than the 344 TRS waves. While many factors could have played a role into this overall difference, we did come to some conclusions associated with this outcome. One potential bias is that the 344 TRS is a training squadron, early in the contracting career of our enlisted Airmen. The responses related to the control group could have bias in the data as some Airmen could fear potential retaliation if they give a more negative comment. One suggestion for future research to combat this would be to conduct a study that utilizes a control group of pre-existing data and compares it to a treatment group employing gamified learning.

D. CONCLUSION

We asked three research questions at the beginning of this effort. Through our experiment and research, we were able to provide responses to each. First, we learned that

the effects of gamification can vary in learning results. In most of the data, the treatment group results were less favorable than the control group results, however we discussed the possible causes of this earlier.

We were able to respond to our second research question regarding feelings towards gamified training methods through the collection of survey responses. Again, the results vary, however gamification showed promise. Of note, respondents stated they would be more likely to study outside of the classroom using gamified methods.

The third question we asked was "what features of gaming are most applicable to Air Force contracting training?" As mentioned in the limitations section, we were not able to apply all features researched into the game design because of time constraints. However, we found that game genre is important. Many respondents provided comments about an FPS game not being their preferred genre. A deeper exploration of Bartle's taxonomy and determining the contracting career field's predominant player type can help match game design to the players. Early indications show that Air Force acquisition personnel may be more likely to fall into Achiever and Explorer types.

We believe this research has provided the baseline data required for Air Force contracting leadership to make decisions about the implementation and future of gamification. Our recommendations provide a basic roadmap to help researchers and Air Force leadership determine how to best explore the use of gamification in training and education for the future. It also points to novel ways to capitalize on the benefits that commercial business practices are already capturing using gamified methods. We highly encourage a continued exploration into these non-traditional training and education methods. Game on!

APPENDIX A. PRE-INSTRUCTION EVALUATION SURVEY

1. **Which training will you be receiving?** (The instructors should have split you into groups already)

❑	Traditional method (PowerPoint)
❑	Gamified learning (Video game)

The next ten questions will give a baseline on your knowledge for the selected topic

2. **What does FPI stand for?** (Please select only one)

❑	Federal Prison Industries
❑	Federal Products Industries
❑	Federal Prison Incorporation
❑	Federal Products Incorporation

3. **Which mandatory source for supplies has the highest priority?** (Please select only one)

❑	Federal Prison Industries
❑	AbilityOne
❑	Commercial Marketplace
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)

4. **Which is the only mandatory source for services?** (Please select only one)

❑	AbilityOne
❑	FPI
❑	Commercial Marketplace
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)

5. **Which source uses stock programs of GSA, DLA, and VA?** (Please select only one)

❑	Wholesale Suppliers
❑	AbilityOne
❑	FPI
❑	Agency Inventories

6. **Which source provides training and employment for prisoners confined in federal and correctional institutions?** (Please select only one)

❑	FPI
❑	AbilityOne
❑	Excess from other Agencies
❑	Commercial Marketplace

7. **Which source can be checked by reviewing excess personal property catalogs issued by GSA?** (Please select only one)

❑	Excess from other Agencies
❑	FPI
❑	AbilityOne
❑	Agency Inventories

8. **Which source can be checked by material managers?** (Please select only one)

❑	Agency Inventories
❑	AbilityOne
❑	FPI
❑	Commercial Marketplace

9. **Which source maintains a "Procurement List" of all supplies and services required to be purchased from nonprofit agencies employing people who are blind or have other severe disabilities?** (Please select only one)

❑	AbilityOne
❑	FPI
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)
❑	Commercial Marketplace

10. **After the FAR mandated sources, which sources become available to use?** (Please select only one)

❑	Strategic Sourcing Launchpad and Commercial Marketplace
❑	FPI and AbilityOne
❑	AbilityOne and Commercial Marketplace
❑	Wholesale Suppliers and Strategic Sourcing Launchpad

11. **What is the name given to the list used to show what supplies are required to be purchased from the Federal Prison Industries?** (Please select only one)

❑	The Schedule
❑	The Procurement List
❑	The List
❑	Required Supplies List

12. **There were 10 questions on this test, how many do you feel you answered correctly?** (Please insert number)

Demographics Section

13. **Please select your highest education level** (Please select only one)

❑	High School
❑	Some College
❑	Undergraduate Degree
❑	Advanced Degree
❑	Other (please specify)

14. **How many years of military experience do you have? _____ (Years)**

15. **How many years of acquisition experience do you have? _____ (Years)**

16. **Do you have experience with video games?** (Please select only one)

❑	Yes
❑	No

16a. **If Yes, how many years have you played video games for? _____**

17. **Which of the following best describes your experience with video games?** (Please select one number for each item)

	Not at all experienced	Somewhat experienced	Moderately experienced	Very experienced	Extremely experienced
Experience with video games	1	2	3	4	5

18. **What are your top 3 favorite video games you have played?** (Please type in answers below, put in N/A if no experience)

19. **How would you describe your playing habits?** (Please select only one)

❑	I play games on my phone occasionally to pass some time
❑	I play console/pc games as a hobby in my free time
❑	I eat, sleep, and breathe video games
❑	I never play video games, not even on my phone

Notes for next section:

The DoD has been investigating different ways of utilizing gamification for military training. Gamification means building interactive game-like elements into training modules. We would like to know your thoughts on this idea.

20. **Please rate your agreement with the following statements:** (Please select one number for each item)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Using gaming for job specific training instead of traditional methods (e.g., PowerPoint) would increase my job satisfaction	1	2	3	4	5

I would be more likely to study outside of class/work using gaming training compared to traditional methods (e.g., PowerPoint)	1	2	3	4	5

APPENDIX B. POST-INSTRUCTION EVALUATION SURVEY

1. **Which training did you receive?**

❑	Traditional method (PowerPoint)
❑	Gamified learning (Video game)

The next ten questions will check your understanding of the training.

2. **What does FPI stand for?** (Please select only one)

❑	Federal Prison Industries
❑	Federal Products Industries
❑	Federal Prison Incorporation
❑	Federal Products Incorporation

3. **Which mandatory source for supplies has the highest priority?** (Please select only one)

❑	Federal Prison Industries
❑	AbilityOne
❑	Commercial Marketplace
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)

4. **Which is the only mandatory source for services?** (Please select only one)

❑	AbilityOne
❑	FPI
❑	Commercial Marketplace
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)

5. **Which source uses stock programs of GSA, DLA, and VA?** (Please select only one)

❑	Wholesale Suppliers
❑	AbilityOne
❑	FPI
❑	Agency Inventories

6. **Which source provides training and employment for prisoners confined in federal and correctional institutions?** (Please select only one)

❑	FPI
❑	AbilityOne
❑	Excess from other Agencies
❑	Commercial Marketplace

7. **Which source can be checked by reviewing excess personal property catalogs issued by GSA?** (Please select only one)

❑	Excess from other Agencies
❑	FPI
❑	AbilityOne
❑	Agency Inventories

8. **Which source can be checked by material managers?** (Please select only one)

❑	Agency Inventories
❑	AbilityOne
❑	FPI
❑	Commercial Marketplace

9. **Which source maintains a "Procurement List" of all supplies and services required to be purchased from nonprofit agencies employing people who are blind or have other severe disabilities?** (Please select only one)

❑	AbilityOne
❑	FPI
❑	Wholesale Suppliers (GSA, DLA, VA, etc.)
❑	Commercial Marketplace

10. **After the FAR mandated sources, which sources become available to use?** (Please select only one)

❑	Strategic Sourcing Launchpad and Commercial Marketplace
❑	FPI and AbilityOne
❑	AbilityOne and Commercial Marketplace
❑	Wholesale Suppliers and Strategic Sourcing Launchpad

11. **What is the name given to the list used to show what supplies are required to be purchased from the Federal Prison Industries?** (Please select only one)

❑	The Schedule
❑	The Procurement List
❑	The List
❑	Required Supplies List

12. **There were 10 questions on this test, how many do you feel you answered correctly?** (Please insert number)

<u>Demographics Section:</u>

13. **(Treatment Group Only) Please select how many times you played the game.** (Please select only one)

❑	1
❑	2
❑	3
❑	4
❑	5+

14. **(Treatment Group Only) Please input the score for each game trial. Game trials are not rounds. They are the discrete games you attempted inclusive of rounds. So trial one is the first time you tried to make it through all the rounds and the final score for that**

trial. Trial 2 is the second attempt, etc. Use numbers such as 3,500. Put "N/A" if you did not get to that trial (If you did 3 trials input Trial 4 - N/A, Trial 5 N/A)

Trial 1 Score - (Fill in textbox)
Trial 2 Score - (Fill in textbox)
Trial 3 Score - (Fill in textbox)
Trial 4 Score - (Fill in textbox)
Trial 5 Score - (Fill in textbox)

15. **(Treatment Group Only) Did you enjoy this method of training?** (Please select only one)

❑	Yes
❑	No

15a. **If yes, would you like to see gamified training in another format? (Puzzle games, Role Playing Games, VR/AR, etc.)** (Please input type of games you would like to see or put N/A if it does not apply)

15b. **If no, would you like to see gamified training in another format? (Puzzle games, Role Playing Games, VR/AR, etc.)** (Please input type of games you would like to see or put N/A if it does not apply)

16. **Please rate your agreement with the following statements:** (Please select one number for each item)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The quality of this training is excellent	1	2	3	4	5
This training is NOT AS GOOD as other military training I've experienced	1	2	3	4	5
This training exceeded my expectations	1	2	3	4	5
I am confident that I learned the material in this training	1	2	3	4	5
I learned valuable new information from this training	1	2	3	4	5

17. **On a scale of 0 to 10, how would you rate your overall level of engagement with the training you received?** (Please slide scale to input choice)

Notes for next section:

The DoD has been investigating different ways of utilizing gamification for military training. Gamification means building interactive game-like elements into training modules. We would like to know your thoughts on this idea.

18. **Please rate your agreement with the following statements:** (Please select one number for each item)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Using gaming for job specific training instead of traditional methods (e.g. PowerPoint) would increase my job satisfaction	1	2	3	4	5
I would be more likely to study outside of class/work using gaming training compared to traditional methods (e.g. PowerPoint)	1	2	3	4	5

Net Promoter Score

19. **On a scale of 0 to 10, how likely are you to recommend this learning method to a friend or colleague (who is employed in a job like yours)? (**Please side scale to indicate score)

19a. **What is the primary reason for your rating?** (Fill in textbox)

19b. **What are some ideas you have about ways the Air Force can improve your experience completing trainings like these?** (Fill in the textbox)

APPENDIX C. VIDEO GAME GENRE DEFINITIONS

Genre	Definition
Action-Adventure	"Action games focus on challenging the player's reflexes, hand-eye coordination, and reaction times... Generally, involve a player exploring the world within the game while experiencing the story through the eyes of a protagonist." (Abhishek, 2021)
AR/VR	"A virtual reality game or VR game is a video game played on virtual reality (VR) hardware. Most VR games are based on player immersion, typically through head-mounted display unit or headset and one or more controllers." ("Virtual Reality Game," 2021)
Battle Royale	"A battle royale game is an online multiplayer video game genre that blends last-man-standing gameplay with the survival, exploration and scavenging elements of a survival game." ("Battle Royale Game," 2021)
Fighting	"Focus on the players' character fighting in real-time against one or several foes via hand-to-hand or weapon-based combat." (Abhishek, 2021)
Fitness	"Require the player to perform a physical activity to complete an objective, generally with the intent of making the player exercise." (Abhishek, 2021)
MOBA	"Multiplayer online battle arena is a subgenre of strategy video games in which two teams of players compete against each other on a predefined battlefield." ("Multiplayer Online Battle Arena," 2021)
Platformer	"Focused on traversal between platforms suspended in the game environment while avoiding obstacles and enemies." (Abhishek, 2021)
Puzzle	"Test the player's problem-solving skills including logic, pattern recognition, sequence solving, and word completion." (Abhishek, 2021)
RPG (MMORPG)	"A Role-playing video game (RPG) primarily involves the player taking control of a character and progressing gradually by upgrading, levelling up, and/or increasing the character's power as they progress through the game. "Massively Multiplayer Online games require players to play online simultaneously with numerous other players." (Abhishek, 2021)
Shooter (FPS)	"Require the player to aim and shoot at objects/enemies throughout all or most of the game" (Abhishek, 2021). First-person shooters are played from a first-person camera perspective.
Simulation	"Games that are realistically modelled to simulate real-life (driving a race car or flying a plane for instance) or hypothetical (space exploration games) experiences/events taking into account most or all possible parameters." (Abhishek, 2021)
Sports	Focused on "virtually playing a real or fictional sport and managing the activities around it." (Abhishek, 2021)
Strategy	"Focused on measured planning and tactics to either defeat opponents or achieve a goal. Such games may present strategic, tactical, and even logistical or financial challenges." (Abhishek, 2021)

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