The Transition from Simulation to Game-Based Learning

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ABSTRACT

The United States military has a long and complex relationship between computer games and simulation and training. With the establishment of United States Department of Defense's (DOD) Advanced Distributed Learning (ADL) initiative, the DOD began investigating the effectiveness of different types of training from classroom instruction to the realm of massively multiplayer online games and other types of instructional games. DOD Training Transformation (T2) goals may utilize ADL as the enabling technology to investigate the merits of game based learning. DOD today looks towards the commercial game market for ideas and concepts to teach its new recruits and senior staff the skills a modern warrior needs. Both concepts and methods for training military service members have changed from completely face-to-face or classroom instruction to a blending of different methods to include computer-based instruction. Instructional designer and developers must find better techniques to keep the computer-based learner actively engaged. One of the components of a game is the incorporation of entertainment into the scenario. Traditionally, instructional designers and developers have overlooked exploiting entertainment, thereby making instructional type games boring and game players ambivalent toward games used for learning. Equally, Gamers have overlooked using learning objectives and evaluation to determine if learning has occurred. The DOD would like to change that by truly challenging, engaging, and entertaining the learner. The way in which games can become exciting for the learner, and effective as a learning tool is through the use of an engaging learning strategy coupled with structured learning objectives. One of the primary learning strategies is that the game needs to be challenging enough for the learner to be engaged by it, but not too challenging so they quit in frustration. The presentation of learning objectives to the learner and the eventual testing against these learning objectives through game-play is another way to ensure the game is instructionally sound.

ABOUT THE AUTHORS

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Amy Scott is the Joint ADL Co-Lab's instructional specialist, provides instructional design and project management guidance for the Co-Lab. She has over ten years experience in project management, usability and design in the e-learning and web industries and is well versed in the characteristics of online communities. She holds a Master of Arts in Instructional Systems Development from University of Maryland.

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INTRODUCTION

Today the average new recruit in the military service was born in 1986, long after the first wave of video games were established in homes and arcades. Our military leaders realize that these eighteen year-old recruits are a new challenge, requiring new training concepts and methods to reach them. These recruits were brought up in an environment with computer-based technologies and high-end collaborative video games. In our new approaches to military training, these computer-based technologies and video games can now be used as training tools. However in the push to use video games as training tools, some very basic tenets of instructional design have been left behind in order to push the limits of technology. It may be argued that there is not a place for instructional design in educational video games because formalized instruction takes the "fun" out of a game. But without instructional design games may cease to be an effective training tool. By using complementary learning strategies that apply both to instructional design and gaming, these new tools can be engaging, exciting and effective training tools transforming a fresh-faced recruit into a high-tech, well-trained, world-focused warfighter.

Convergence of Media

For over a century mock battles have been a part of military training programs. In this discussion, we will discuss the influence that entertainment media had on gaming in the military from the 1980s to current technology development. (see Figure 1). The entertainment media fueled the military's interests in interactive simulation technology, gaming, and battlespace environments. Could there be a potential to link these ideas and technology for use in the military in the 2000s and beyond?

1980s-Interactive Simulations and Games

In the mid-1980s, video games using the Atari 2600 game console hit the U.S market. At the same time, on the *Star Trek: The Next Generation*, the virtual world concept used in video games, evolved one step further into the Holodeck: a simulated reality to engage, play, or develop mock battles. (Thorpe, 2003) Popularized in the 1980s, Orson Scott Card's book, *Ender's Game,* created a vision of a young military squadron switching between live and simulated versions of a military engagement. (Lenoir, 2003) These games and movies entertained us and also suggested new ways to train.

Meanwhile, back in the real world, in the 1980s, the first set of simulators was networked and called Simulation Network (SIMNET) developed by Defense Advanced Research Projects Agency (DARPA). SIMNET was conceived by Dr. Jack Thorpe, at the time an Air Force Program Manager at DARPA. SIMNET was an interactive simulation. SIMNET became the first networked

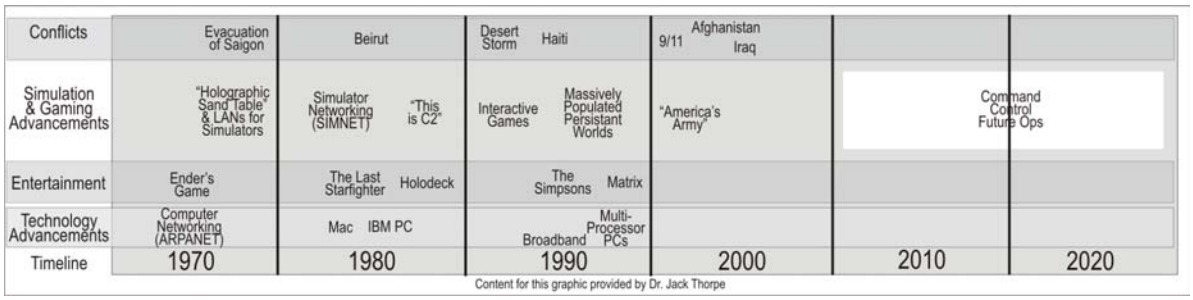

Figure 1. Convergence

armor combat simulation, allowing a four-person crew operating a separate 3-D computerized simulator, to conduct elaborate tank battles. SIMNET is considered the grandfather of popular multiplayer computer games. (Macedonia, 2002)

During approximately the same time period, the Army adopted the JANUS system, a tactical war game developed at Lawrence Livermore National Laboratory, Livermore, California. With the JANUS system, opposing sides viewed simulated troop movements across computer-generated maps to analyze combat strategies. In 1987, the military conducted command and control technology experiments. These experiments networked computers and other devices that passed a large quantity of multimedia back and forth and enabled communication between computers. (Thorpe, 2003)

1990s-Virtual Environments

In the 1990s, the entertainment industry shifted focus from an individual player environment to virtual worlds and collaborative environments. The entertainment game industry introduced *The Sims Online,* where advanced avatars interacted in a simulated environment. Other virtual worlds such as, *Ultima Online* and *EverQuest* existed on-line twenty-four hours a days, seven days a week. *EverQuest* was massively populated with up to ten thousand simultaneous players.

The change from individual player environment to virtual environments was reflected in the military as well. In the 1990s, Modular Semi-Automated Forces (ModSAF) and Close Combat Tactical Trainer (CCTT SAF) exploited a battlespace environment. Situational awareness of all combatant forces could be observed by combatant commanders.

2000s-Game-Based Learning

In the 2000s, the entertainment media and the military finally merged when the Navy Postgraduate School (NPS) developed *America's Army*, a massively multiplayer role-playing game (MMRPG) for the United States Army Recruiting Command. Today, *digital natives*, a term coined by Marc Prensky, (2001b) are our potential new recruits ready to serve in our nation's military. The potential tool to reach these new recruits is the video game.

Again the entertainment industry and the military came together to create The Institute for Creative Technologies (ICT). ICT created new learning tools, i.e. games, for digital natives, such as the *Full Spectrum Command* and *Full Spectrum Warrior*. These games highlight the decision-making and mission rehearsal in modern warfare exercises. The aforementioned ICT projects show how advanced computer simulations, video games, and immersive technologies can link our military concepts with the film and entertainment game industry. (Lenoir, 2000)

As shown in *America's Army*, the evolution from training simulations, the military standard of the past, to game-based learning, the military standard of the future is already taking place. It's not just the technology and delivery methods for training that are changing, but also the very strategies and goals of military training itself.

TRAINING TRANSFORMATION –A NEW APPROACH TO TRAINING

The future training vision and goals of the US military have been laid out as *Training Transformation (T2)*. The vision of T2 within the Department of Defense (DoD) provides dynamic capability-based training to support national security requirements, across the full spectrum of military services, joint organizations, intergovernmental and multinational operations (see Figure 2). (Department of Defense [DoD] Strategic Plan, 2002)

T2 concepts and training approaches are different from those used to conduct training today. Current training approaches are stove-piped. In the T2 approach, training is shared across the DoD and its organizations. The T2 umbrella concept contains the ADL Initiative with total force integration in mind. Jointness is the key to success and the future of military training. (USJFCOM Vision for T2/JNTC, 2003)

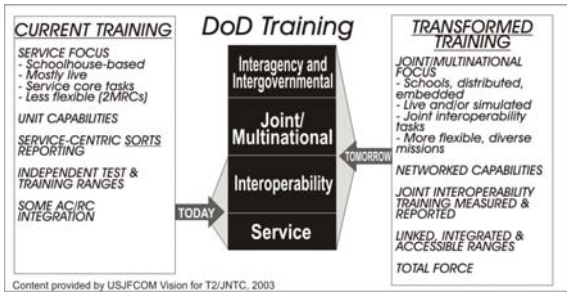

Figure 2. Today's Training and Tomorrow's Transformation

By using advanced technologies and techniques, these changes are possible. As the DoD attempts to transform training, it must preserve existing high standards in service member core skills and use them as a foundation to build joint capabilities. T2 must also meet the requirements of combatant commanders and address DoD's increasing roles and responsibilities. Joint training and educational environments must be established as integral components of lifelong learning and made available to both DoD's military service and civilian components. T2 must provide flexible and effective training that meets the needs of the twenty-first century military. (DoD Strategic Plan, 2002) One way in which to meet the goals of T2 is to use the tenets of Advanced Distributed Learning (ADL).

WHAT IS THE ADL INITIATIVE?

The Executive Branch at the White House Science and Technology Policy office (OSTP) with the support of Office of the Secretary of Defense created the ADL Initiative in 1997. The ADL initiative ensures learners have access to high quality education, training, and decision-aiding materials tailored to their needs, and made available whenever and wherever required. The ADL Strategy modernizes learning and information technologies promoting cooperative development and e-learning standardization.

The ADL Initiative defined high-level requirements for learning content which include: content reusability, accessibility, durability and interoperability. These requirements leverage existing practices and promote the use of technology-based learning and provide a sound economic basis for investment. ADL emphasizes asynchronous technologies that are web-based and which deliver instruction and provide mentoring without requiring learners to gather in specific places at specific times. (SCORM Overview, 2001)

Collaboration between Defense executives and agencies created a plan to transform training. One of the strategic goals of this plan is a live, virtual and constructive architecture that interoperates across training systems. This collaboration has led to the Joint National Training Capability (JNTC). The strategic goals of the JNTC include ADL. The ADL capabilities integrate common standards, such as, the Shareable Content Object Reference Model, (SCORM), digital repositories, simulations, and performance aids to achieve the broad goals of T2. (DoD Strategic Plan, 2002)

ADL and Games

The question is, where do games fit into the ADL concept. Game-based learning architecture is a new and different approach, but the concept still fits into the ADL model. (See Figure 3) The gaming concept provides the student a richer, more robust learning environment with high interactivity. Gaming content must be re-useable and shareable, however, in the ADL model. In the future, gaming content may use and include the SCORM interoperability specifications and standards to support web-based distributed learning. The Joint ADL Co-Laboratory is exploring this new concept by researching the integration of HLA-compliant simulations and games with the SCORM specifications. Game-based learning architecture should support collaborative training as a part of the practice, and assessment. One of the challenges with game-based architecture is communicating student data from the simulation or game back to a Learning Management System (LMS), possibly at different intervals. The assessment determines whether the learner has met the objectives.

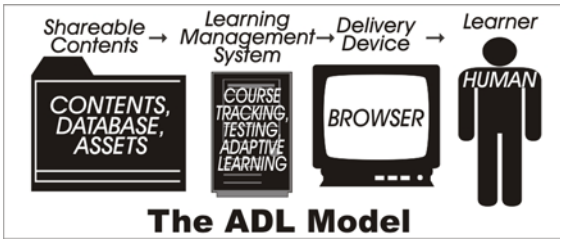

Figure 3. The ADL Model

As we have described, the military is experimenting with moving from simulations to game-based technology. So what exactly is the difference between a simulation and a game?

SIMULATIONS AND GAMES

The words *simulation* and *game* are often used interchangeably when describing a program. There is a distinction, however. "In a true simulation, the users make choices that lead them down different paths toward different outcomes. The learners' individual choices determine where they find themselves later in the simulation." (Billhardt, 2004) Generally, the difference between a game and a simulation is the amount of reality, or *fidelity* it reflects. Simulations are typically copies of reality. A simulation reflects true reality of the system or the environment that it is representing, whereas a game does not have to reflect true reality. Simulation has many important military uses, such as the ability to practice in safety, and/or at lower cost, and to do "what if" experimentation.

Games, on the other hand, are extremely good at engaging and motivating learners. Generally a game is defined as being rule-based, with a quantifiable outcome that can be either positive or negative. The player or learner, influences, and is engaged in the outcome. The game environment, with its pitfalls and rewards, exists outside of real life. (Juul, 2003) All games have rules to make play orderly and controllable, as in "if the player does X, then Y occurs." The player can manipulate objects in the game according to the rules in order to influence the outcome of the game. A game also operates outside of reality. What a player does in the game does not influence what happens to him in real life. To be a game, the player must care about the outcome and be emotionally engaged in the gameplay in some way. This is the most important distinction between a simulation and a game: the degree to which the learner feels engaged. To be a game, the program needs to trigger an intense emotional response, in order to help the concepts be stored in the learner's memory. The emotion triggered could be fun, joy, fear, sadness, anger, tension; it doesn't matter what emotion, as long as it triggers something. Learning is codified better when associated with an emotion. The emotional response provides motivation for the learner to continue in the game. (Prensky, 2001a)

For the military, one way to achieve the motivation required for learning is to turn military simulations into game-based learning. Military simulations, of course, have traditionally had very different objectives from simulation-based games for entertainment. Creators of military simulations worked hard to create high fidelity physic-based, realistic environments and engagements, and seriousness of operations. Entertainment games driven by excitement and fun, make players pay to play them again and again. Dangerous and unrealistic situations, exaggeration of hazards, multiple lives, and heroics are acceptable, and even desirable, in order to increase the excitement. Increasingly, these differing objectives are being combined and reconciled, leading to military games that go beyond the pure simulations of the past. While one can have a game that's not a simulation and a simulation that's not a game, having both is often the best of all possible worlds. (Maguire, Prensky, Van Lent, and Tarr, 2003)

For that reason, games become an important adjunct and even a substitution to pure simulations in many areas. One key reason for this has to do with the mind-set of the user. Typically, simulations do not evoke emotional responses as compared to games. Games, on the other hand, trigger a user's playfulness and willingness to learn. Gameplay requires almost continuous decision-making under increasing conditions of complexity. By designing levels of incentive in the game, learners are not only immediately rewarded with a different rating by mastering a level, but immediately challenged again with the particular difficulties of the next level. Players typically find this both stimulating and motivating, particularly when the game continuously adapts to their skill and performance. Explanation of why games are effective learning tools comes from Dr. Robert Ahlers and Rosemary Garris (in press) of the Navy's NAWCTSD Submarine Lab. They found that games create a self-perpetuating learning cycle, as players initiate and control game play, practice skills, solve problems, persist to the end and strive to win, or "learn," a process which then leads to re-initiation of the cycle.

DIGITAL GAME-BASED LEARNING

With the increasing use of games as learning tools, ideas, both technical and instructional, or Digital Game-Based Learning (DGBL) are used to describe the application of games to learning. There exist successful examples of DGBL, particularly in the fields of military war games and procedure-based manipulations. The primary principle of DGBL is that the content should be aligned with the style of the game. For example, role-playing games are suitable when teaching behaviors, in the more difficult levels of the

cognitive domain spectrum: analysis, synthesis and evaluation. (Prensky, 2001a) In *America's Army*, soldiers are taught the rules of engagement. In the game, if you shoot randomly and hit unintended targets, you are warned it is not appropriate behavior for a soldier. Should the behavior continue, you are ejected from the game.

Unfortunately the wider experience of DGBL is not so organized; as Kirriemuir (2002) argues, "when gaming-oriented entertainment and learning or educational material are combined the result has often been disappointing; the educational value is debatable or irrelevant, and the gaming and engagement qualities compare poorly to those of pure games." He also bemoans the overall poor performance of DGBL but points to the positive features of games in general. Kim (2001) argues that a lack of an infrastructure will inhibit the use of games in wider business. Even Prensky (2001a) recognizes that DGBL is in "a period of putting together the infrastructure."

Games are a new medium for learning and their ideal implementation is still in flux. This current state is both challenging and exciting. Game genres "remain fluid, open-ended. The rules and expectations for computer games are not yet set in stone. Each new game must rethink how it should engage the player, and the best games succeed by discovering new structures of interaction, or new genres." (Friedman, 2002) Prensky recognizes that it is not always necessary to create "huge visual extravaganzas," although his reasoning is based on time and resources: "games we need to create are often much simpler, at least initially…they essentially involve putting some good 'gameplay' around interactions that are helpful to learning…combine game techniques (contributed by game designers) and proven learning techniques (contributed by teachers)." (Prensky, 2001a) For this to happen, there needs to be a common understanding of what is effective game design for learning. Unfortunately there is little theory in game design to lean on. While technically advanced, game design theory and practice is a long way behind the level of theory found in other computer based training disciplines. (Rouse 2001, Rollings and Morris, 2000) We argue that when a traditional Instructional Systems Design approach, used for years in computer- and web-based training is applied to DGBL, games can become very effective tools for learning.

GAMES AND THE ISD PROCESS

In the past, there was a conflict between game designers and instructional designers. Game designers thought that instructional designers take the fun out of their games, and instructional designers thought that game designers take the objectives out of their learning. Compromise exists between these two groups. Traditional Instructional Systems Development (ISD) is essential to educational game development, which does not diminish game design, but only to enhance it.

Traditional ISD uses the ADDIE model for development of training: Analysis, Design, Development, Implementation, and Evaluation. Each phase is planned carefully, and focused on learner needs. The Instructional Designer (ID) creates learning objectives from the deficiencies discovered during analysis. Then the ID develops a course outline and instructional strategies to deliver the content and assess the learner. This process can be very creative, but often, because of trade-offs and compromises the content delivery becomes dull and dry-no fun, and certainly no emotional investment in learning.

On the other hand, game developers have traditionally focused on the other end of the spectrum, focusing solely on fun, entertainment and provoking an emotional response from the game player. Learning objectives are insignificant, and there is no assessment of whether the learner comprehended the new material. The road to agreement for these two groups, instructional designers and game designers, is through the use of effective learning strategies that enhance learning and also enhance gameplay.

Learning Strategies

Developing appropriate learning strategies for games in the design and development phases of the ISD process is the key to bringing the worlds of instructional design and game design together. By using play, practice, multiple paths context, and assessment as learning strategies, games become wonderfully effective learning tools for the digital generation and beyond.

Play

Play is an extremely important method of learning. It is the first way in which humans interact with their environment. As we get older, play becomes less and less a part of our daily routine and our lives. Play need not fall by the wayside as a victim of maturing intellect, however. Play provides stimulation, challenge and reinforcement. Play fosters creativity, and makes the learner want to increasingly perform the tasks. (Prensky, 2001a) Play, in the form of a game, which has set boundaries and rules, helps foster learning by letting learners explore within set boundaries in a safe manner. Learners can then test those boundaries without fear of hurt.

There are also two modifications of the game environment that can help learners master skills in a smaller setting before opening themselves up to the challenge of the full scale game. These are the *sandbox* and the *fish tank*. In the *sandbox*, examples of tasks that occur in a game are scaled down and easier than in normal gameplay, but the learner is provided with a complete set of tools in order to familiarize them with the format of the game or the process of gameplay. Scaling down the system can expedite learning by providing the user with a smaller space in which to play and make mistakes. By the same token a *fish tank*, or a stripped down version of the game, without the complete set of tools, gives the learner an easier toolset to experiment with and make mistakes.

All of these different environments, whether the full scale game, a sandbox version, or a fish tank version, emphasize that it is practice that makes perfect. Only through practice of the game will the learner acquire the skills intended.

Practice

Another instructional strategy is that games should be designed so that learners have the opportunity for long sessions of practice. A game should not be able to be easily mastered; it should take frequent sessions of practice to master. Expertise is formed by continuous playing cycles. Playing cycles reinforce learning. The learner takes time to practice, rest, and then practice again to allow concepts to gel in his/her mind. (Gee, 2004b) Each time the learner progresses through the game, the circle of knowledge is extended; new challenges are presented for the learner to master, and in mastering these challenges, new skills are acquired, and old skills are reinforced.

Even when learners fail, the game should show some sort of progress for the learner. (Gee, 2004b) Make a game too challenging however, and the learner gets frustrated. All the learner remembers if a game is too challenging is frustration, and how difficult the game was to play and master. The challenge level must be just right to ensure that the learner keeps coming back to play the game, without feeling as if it is too easy to master.

Create Multiple Paths to Success

One way in which to increase the challenge level without frustrating the learner is by giving the learner multiple paths to succeed, that can be uncovered through discovery. It is also a traditional game development technique. Multiple learning paths develop creative thinking and problem solving skills by giving the learner options to test different paths and different methods of solutions. Decision making and problem solving are accelerated when the learner's actions affect the creation of the game world. (Gee, 2004b) For example when a player makes a decision that affects which areas of the game world are shown to him, or what tools the learner has available at a particular time. Problem solving is an essential skill for today's military. Marine Corps Commandant General Charles C. Krulak declared in 1996 that it was essential for the modern warfighter to learn to think and make decisions and the way to exercise and practice these skills was through video games. "PC based wargames provide great potential for Marines to develop decision making skills, particularly when live training time and opportunities are limited." (Lenoir, 2003)

Challenge the Context

Adults learn better when they can relate how the concepts they are learning fit into and affect the big picture. What better place to illustrate this concept than in a game, using a virtual world. Concepts become meaningful when learners can attach them to actions in the game and the consequences of those actions. By acting and reacting in the game, learners make new cognitive connections and challenge old constructs of thinking. A learner can take on a new identity to test the boundaries of past learning within the construct of the game. When a game designer allows the player to create his or her own character for the game, the learner opens up a new set of contexts. For example, a man playing

as a woman or a woman playing as a man might encounter differences in the ways other characters react to their character in the game; they might have different abilities, strengths and weaknesses, should they decide to play as the opposite sex.

Assessment

Many instructional designers defeat the purpose of using a game for learning by making the assessment separate from the game. The game should BE the assessment, besides being the learning tool. Learners become immersed in the game environment and if they are forced out of this environment and into another type of assessment, it breaks the pattern of learning. If learners are tested within the context of the game it can give the learner a way to test creative solutions to a standard problem.

CONCLUSION: THE FUTURE OF MILITARY GAMES

So what is the future of games in the military for training? As *America's Army* shows, the future of military gaming is going to be both immersive and distributed. Fidelity of the warspace will become higher as technology allows the virtual world to become more and more realistic. Interaction with fellow wargamers becomes increasingly important in meeting the objectives of the game. Military training encourages individuals to rely and work together as a team or as part of a unit. The future of game-based learning will be both distributed and standardized. Standards present a new set of challenges both to the technical design and instructional design of a learning game. Developers and designers will have to learn to balance creativity, instructional effectiveness, and development standards to create challenging, effective, and engaging military games. This is difficult goal, but not impossible. When instructional and game designers meet to accomplish the goal of making better warfighters, "everyone wins." Not only is learning engaging, but as these digital natives work their way up the ladder through the military ranks, they will transform the military training organization.

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