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Lori F. Thompson
North Carolina State University and
Army Research Institute

Eric A. Surface
SWA Consulting Inc. and
North Carolina State University

Aaron M. Watson
SWA Consulting Inc. and
North Carolina State University

Clara E. Hess
SWA Consulting Inc. and
North Carolina State University

SWA Consulting

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Videogame-Enhanced Teletraining: Using Virtual Immersive Environments to Augment Distributed Collaborative Learning

Lori Foster Thompson
North Carolina State University

Eric A. Surface, Aaron M. Watson, and Clara E. Hess
SWA Consulting Inc. and North Carolina State University

The increasing need to maximize the geographic flexibility afforded to trainees creates a growing demand for distributed training solutions that are not confined to a physical classroom. Meanwhile, technological advances have enabled remote PC-based training options previously unavailable. Each option comes with a unique set of advantages and limitations. A clear understanding of the challenges associated with various technology-mediated training methods can facilitate an optimal integration approach, allowing instructional designers to strategically blend media and methods that compensate for one another's shortcomings. This chapter discusses the possibility of integrating two training techniques, web-based teletraining (WBTT) and videogame-based learning, which have been considered independently during efforts to optimize training for Special Operations Forces personnel tasked with developing proficiency in a foreign language. WBTT uses PC-based cameras/microphones to connect trainees to instructors and peers. Delivery challenges include the need to: encourage trainee interactions, keep learners involved/motivated, and incorporate activities instead of long lectures to maintain interest levels. Videogame-based training typically uses self-directed simulations in immersive environments to extend trainees' experiences in the world. Challenges here include the need for: adaptive guidance, feedback, and interaction with others to reduce isolation and encourage accountability. WBTT and videogames can be integrated, for example, by having WBTT instructors assign videogame activities to learners who may complete the simulation independently or collectively (e.g., as part of a multiplayer game). Afterwards, learners could virtually reconvene for real-time discussion. This integrated training solution has the potential to overcome problems that occur when each training option is implemented alone.

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The increasing need to maximize the geographic flexibility afforded to trainees creates a growing demand for distributed training solutions that are not confined to a physical classroom. Meanwhile, technological advances have enabled a variety of remote PC-based training options previously unavailable. Web-based teletraining is an example of an emerging strategy for providing instruction to remote learners. Another option is the use of virtual immersive environments, such as videogames, to train personnel. While recent discussions have centered on the independent utility of each of these approaches, little attention has been paid to the possibility of integrating these two training techniques. The present chapter considers this prospect.

Overall, this chapter has three objectives. The first two objectives are to provide overviews of web-based teletraining and videogame-based learning, respectively. The third objective is to consider the usefulness of integrating these two training approaches. In doing so, we offer the overarching assertion that instructional designers should consider the utility of strategically combining training methods when determining how best to facilitate learning in a virtual environment.

We begin this chapter by generally considering how different virtual training techniques may interact or complement each other when implemented concurrently. We later consider the possibility of integrating the two training approaches of interest – web-based teletraining and training through virtual immersive environments (e.g., videogames). The characteristics, benefits, and limitations of each independent approach are described, followed by a discussion of how and why blending the two methods may result in improved learning outcomes.

Examining the Interactive Effects of Training Techniques

Applied psychology has a long-standing tradition of going beyond simple “main effects” when trying to understand phenomena of interest. The examination of interactions enables the establishment of boundary conditions. When testing an intervention, for example, identified interactions allow us to specify the situations, circumstances, and/or individuals for whom a treatment will be especially effective or ineffective.

In the training domain, this focus on interactions has traditionally concentrated on individual differences (e.g., self-efficacy, goal orientation, conscientiousness, motivational traits) in learners’ responses to various training media and methods. While we do not dispute the importance of such research, we maintain that another type of interaction has received far less attention than deserved. Specifically, there is a dearth of literature considering how different training methods, when implemented in tandem, may interact to produce learning outcomes that are better (or worse) than the outcomes that would have been achieved by either method alone.

It should be noted that recent years have seen an increased focus on “blended learning,” a term which is normally used to describe a mixture of online, e-learning modules and traditional, face-to-face instruction (e.g., Kaczynski, Wood, & Harding, 2008). In other words, “blended learning” typically refers to the combination of different delivery *media* such as classroom and web-based instruction. Despite this trend, an insufficient consideration of the combination of different training *methods*, irrespective of the medium persists. This deficiency in our collective knowledge base does not only characterize traditional (e.g., classroom) training. It also extends to investigations of the newer, technology-mediated environments upon which this chapter focuses. In the virtual domain, this deficiency is demonstrated when the isolated effects of two or more computer-mediated training techniques are compared without considering the degree to which an amalgamation of the methods could impact learning.

What “main effects” research has taught us thus far is that each virtual training method, when implemented alone, produces a unique combination of benefits and limitations. It appears that some of the shortcomings associated with a given method could be offset by the strengths of another. By considering the strengths and weaknesses that accompany different technology-mediated training methods, an optimal integration approach can be devised, allowing instructional designers to strategically blend media and methods that compensate for one another’s limitations.

To demonstrate this point, the following pages consider how those interested in enhancing distributed collaborative learning might simultaneously capitalize on what both teletraining and immersive virtual environments, such as videogames, have to offer. The benefits and challenges faced by learners undergoing each of these types of training in the absence of the other are discussed next. Both teletraining and videogames have been used (albeit independently) to teach language skills in the military. For illustrative purposes, we therefore cast much of our discussion in the context of Soldiers learning a foreign language, drawing upon two language training effectiveness research studies,[1] with which we have been involved, for examples. One of these two studies centered on a web-based teletraining system (Meade, Surface, & Hess, 2007) and the other examined the use of a videogame (Surface, Dierdorff, & Watson, 2007) to teach language skills. Although military foreign language training provides an illustrative backdrop for this chapter, the principles presented should apply to a variety of populations tasked with developing a range of skills.

[1] Both studies were sponsored by the United States Special Operations Command (USSOCOM).

Web-based Teletraining (WBTT)

Characteristics and Example of Web-Based Teletraining

For the purposes of this chapter, Web-based teletraining (WBTT) is defined as a synchronous, instructor-led form of distance learning which uses various technologies (e.g., cameras and microphones) to connect geographically dispersed students and trainers in real time via audio and visual channels transmitted over the Internet from the convenience of a desktop computer or laptop. WBTT is characterized by a number of notable features. As suggested by the definition above, it supports groups of learners who are physically separated from each other and from the instructor. In addition, it offers learners geographic flexibility – that is, the opportunity to complete the training from a location of their choosing. It does not, however, permit a great deal of scheduling flexibility. Because the instructor and the students typically participate at a common, agreed-upon time, learners cannot complete WBTT whenever they want. Although some forms of training (e.g., autonomous computer-based instruction) give learners a great deal of latitude to control the content, sequence, practice-level, and/or pace of the material presented to them, WBTT does not enable a great deal of learner control. This relatively modest amount of learner control is directly related to the fact that WBTT is led by a real-time instructor who determines much of the course sequencing. WBTT does provide the opportunity to interact with others through audio and visual channels. Each trainee is connected to a computer, through which the instruction is delivered. With the use of technology, most communication is synchronous and spoken, not text-based.

An example of WBTT is the Special Operations Forces Teletraining System (hereafter referred to as SOFTS), which has been used for foreign language training. SOFTS is an online training system which closely mimics classroom instruction. SOFTS courses include an instructor who moderates all interaction, delivers lectures, and leads various activities in the course. Trainees contribute remotely via computer with the instructor and peers. They are visible to one another through webcams (each participant has his own window on the screen) and can be heard via computer microphones. A sizable section of the computer screen is devoted to instructional materials, such as a shared whiteboard. Additional sections of the screen allow chat and other types of interaction among trainees. Research has shown the SOFTS WBTT system to be a viable alternative to classroom instruction, with similar training outcomes achieved by SOFTS and classroom students exposed to the same curriculum and learning objectives (Meade et al., 2007).

Web-based Teletraining: Advantages

The decision to implement WBTT in lieu of a more traditional classroom alternative is often prompted by the potential benefits associated with this form of learning. Because it supports geographically distributed participants, WBTT shares certain advantages in common with other forms of distance learning (e.g., correspondence courses). Because it is technology-mediated, WBTT also enjoys some of the benefits afforded by other forms of online instruction (e.g., web-based instruction). Finally, because it includes a "live," real-time instructor, WBTT shares some of the advantages that characterize other forms of synchronous instruction (e.g., classroom instruction).

Similar to most forms of distance education, one key advantage of WBTT involves the convenience of the WBTT location (i.e., geographic flexibility). Learners can attend WBTT from any location that is equipped with the proper technology and connectivity. Thus, WBTT can be delivered to work or home sites that are convenient for trainees (Evans & Haase, 2001). As Matthews (1999) points out, students can attend class "from any corner of the globe."

This geographic flexibility is beneficial for a number of reasons. For example, the location convenience of WBTT can lead to work/life benefits by allowing personnel who have spent significant amounts of time away from their families to train from home and/or from an office located within driving distance from home. In this regard, WBTT may help lower the personal and psychological costs of training.

As a form of distance learning, WBTT also has the potential to increase the impact of training dollars spent (Evans & Haase, 2001). With WBTT, the need for standalone brick-and-mortar training facilities is reduced if not altogether eliminated. In fact, WBTT technology can be (and in our experience, has been) used with participants at the same geographic location when classroom space is unavailable. Given the high demand for training space in some organizations, this technology can provide an effective alternative. The geographic flexibility of online instruction can also reduce travel-related environmental costs and other expenses such as the money traditionally used to transport and lodge trainees (Evans & Haase, 2001; Lowe & Holton, 2005; Welsh, Wanberg, Brown, & Simmering, 2003). According to the Special Operations Forces Language Office (SOFLO), which sponsors the SOFTS WBTT system described previously, the cost of enrolling geographically dispersed trainees in WBTT courses is substantially lower than the cost of sending them to a central location for instruction. In effect, funds spent on airfare, hotels, meals, and rental cars can be reallocated and directed toward other needs. In addition, travel time can become work time (Kundu, 1992) thereby potentially increasing the amount of time and energy available to learn.

Importantly, the geographic flexibility of WBTT not only saves travel money spent on trainees; it can also maximize the efficiency of resources spent on trainers. Rather than requiring trainers to travel and provide instruction in remote locations, instructors can offer training from the convenience of their home base. Thus, transportation fees, lodging costs, and other expenses generated by traveling trainers are saved. It follows that the geographic flexibility of WBTT also increases personnel's access to qualified instructors (Evans & Haase, 2001; Kundu, 1992) especially in remote locations (Lowe & Holton, 2005) and in areas where few instructors are available to teach highly specialized content. For example, individuals who are qualified to teach difficult and/or uncommon languages may only be available in a few specific regions of the world and may not want to relocate to a remote military base (or spend time at sea) for an extended period of time to teach a single course. By connecting such instructors to personnel who themselves may be geographically tied to a particular region, WBTT can enable the provision of learning resources previously unavailable. In the case of language training, WBTT can allow access to foreign language instructors who are located in their native country of origin or anywhere around the world. For instance, we recently saw an expert instructor, who had moved to South Korea, teaching a class comprised of teletrainees dispersed across the U.S. The WBTT technology allowed this instructor to keep her job and the organization to retain an experienced instructor, which are in short supply for some topic areas. In this manner, WBTT can expand educational opportunities by increasing the pool of qualified instructors available to organizations.

By giving distributed trainees access to a common instructor, WBTT can also increase enrollment, helping courses "achieve critical mass," which may ultimately broaden the training opportunities available to personnel. Organizations are reluctant to spend precious resources on a class for one person. By removing geographic barriers, WBTT enables the assembly of a critical mass of students with common training needs so that a course may be offered. In cases where WBTT can be simultaneously delivered to personnel from more than one organization, employers can cost share rather than having to pay on a one-trainer-per-student basis (or simply assume the cost of not properly training personnel, when offering a course to a single individual is prohibitive).

It should be noted that the geographic flexibility of WBTT not only increases learners' exposure to previously inaccessible instructors and training; it also gives them access to peers distributed across the globe. A secondary benefit of this access is that it can put personnel in touch with members of other organizational, regional, or national cultures, exposing trainees to diverse viewpoints. It can also give trainees exposure to future teammates prior to deployment or team assignments. In certain situations, this prior exposure could speed up the team building process.

The advantages of WBTT are not limited to trainees located at their home base. Rather, the geographic flexibility of WBTT can also benefit personnel while they are "TDY" or located away from home. WBTT can permit individuals stationed in remote regions access to training that would otherwise be unavailable during deployment. This can allow for "just-in-time" training on the job. For example, trainees who need to develop skills in a foreign language could enroll in language proficiency sustainment WBTT *after* relocating to a foreign country. Not only would motivation likely increase on account of the salience of the course material offered, but trainees could ask pressing questions pertaining to real-time struggles with the target language being taught. Such opportunities could enrich the discourse during training, promoting transfer while benefiting a given trainee and his/her classmates alike.

In situations when the trainee is engaged in other job duties (not solely devoted to training), WBTT can also mean fewer instructional hours missed. With classroom instruction, if a trainee is given a duty assignment that requires short-term travel, the trainee would have to miss training hours. WBTT allows learners the opportunity to attend class while they are traveling by logging into class from hotels and other remote sites.

Beyond geographic flexibility, WBTT affords additional advantages of note. Many of them stem directly from the technology used to mediate WBTT. In this regard, WBTT enjoys a number of the benefits also associated with other forms of online instruction. One such benefit has to do with the ability to track and record training. Because it typically utilizes cameras, microphones, and other technologies (e.g., shared electronic whiteboards) to connect instructors and learners, WBTT activities can be electronically captured and archived. This record of training can be used, for example, to track learner progress (Lowe & Holton, 2005) and provide feedback to trainees. For instance, language learners carrying out role plays in a target language can go back and review their own performance after completing the exercise. Instructors can review this as well and use it to provide corrective feedback. Emphasizing the importance of feedback during foreign language training, Meade et al. (2007), note that such feedback should "indicate what in particular was incorrect in the students' language usage, what the correct response should have been, and why this is so" (p. 44). Records of instruction which allow trainers to revisit students' speaking excerpts can augment such a feedback delivery approach.

A record of instruction can also be used to train instructors. One recommendation for improving instruction is to have trainers observe their previously recorded courses to learn from their interactions with trainees (Meade et al., 2007). While such records would be difficult to obtain in some forms of training (e.g., classroom training), they are readily available for WBTT courses. In addition to reviewing recordings, the technology allows for discrete observation of instructors and students in real time, for feedback purposes, without creating a disruption in instruction. By unobtrusively observing WBTT in progress, a master trainer could provide timely feedback to an instructor immediately after a WBTT session was completed, or a trainer could do the same with students.

Finally, archival documentation of WBTT can be used to conduct research to determine the factors that promote learning in a WBTT environment. A good example of using records of instruction to investigate WBTT effectiveness is provided by Meade et al. (2007), who conducted a study which would not have been possible without archival footage of training provided by the WBTT system used to conduct the training under investigation.

Archival records of training are not the only reason why the technology embedded in WBTT serves as an advantage. As Hoopingarner (2007) points out, technology both overcomes obstacles historically presented by the distance learning environment and provides training opportunities that can actually surpass those available in conventional classrooms. Unlike many trainees who are tied to a classroom, web-based teletrainees are virtually guaranteed to be connected to a computer. This connectivity can ease the integration of additional technologies (e.g., electronic bulletin boards, videos, web sites, videogames) into training, potentially increasing the variety of activities and exercises that can be incorporated into a course. For example, instructors whose students have computers at their fingertips can provide opportunities for practice through simulation (Lowe & Holton, 2005). They can also make more efficient real-time use of Internet resources than those whose students are not connected to the Internet during class. Teletrainers can simultaneously send students to educational web sites and seamlessly integrate such experiences into the course of instruction. As noted by Curran and Fleet (2005), "The Internet and worldwide web have expanded opportunities for the provision of a flexible, convenient and interactive form" of training (p. 561). By ensuring trainees' real-time access to the Internet and other technological resources, WBTT can enhance the learning experience.

Comments from students who have participated in WBTT supports the contention that the technologies available to web-based teletrainees can augment the learning experience. When asked to comment on the SOFTS foreign language WBTT system described previously, one trainee studied by Meade et al. (2007) emphasized "tools that were very useful in class on a daily basis, like the whiteboard," adding that "access to Tagalog and Phillipino web sites like Philstar and iGMA was easier to get than a real classroom and helpful in the class." Another noted that "The white board was amazing! … The news and video (co-browser) feeds were very, very useful" (Meade et al., 2007, p. 19).

Because each individual trainee is connected to a personal computer, WBTT has the potential to flexibly adapt to the idiosyncratic needs of each learner. For example, visual displays can be rearranged and resized according to the preferences of each learner. This differs from a classroom environment, where displays are typically fixed or constant across students. Via help screens, tutorials, and other learning aids, the technology embedded in some forms of WBTT may also enable the incorporation of instructional strategies (in addition to what is being offered by the real-time instructor) that serve as a proxy for certain learners' limited cognitive and metacognitive abilities (Cuevas, Fiore, Bowers, & Salas, 2004). The concept of computer-based cognitive prosthetics is well known to those who study cognitive disabilities stemming from traumatic brain injury (e.g., Cole & Dehdashti, 1998). A similar philosophy could drive training technologies which augment learning capabilities by providing adaptive assistance based on each student's particular strengths and weaknesses. Real-time connectivity is required for such an approach to function, and WBTT participants have this connectivity at their fingertips. One adaptation of this idea might involve having an expert mentor, coach, or intelligent agent tutor unobtrusively monitor students online and provide customized assistance after class.

Finally, teletrainees' connectivity also allows for dynamic testing scenarios which are usually unfeasible in a traditional classroom environment. With multimedia capabilities readily available to every learner, testing can move beyond traditional declarative knowledge assessments. "Integrative transfer tests using brief animated simulation vignettes of task-relevant scenarios may better assess whether trainees have mastered a deeper conceptual understanding of the training material (cf. Cannon-Bowers, Burns, Salas, & Pruitt, 1998; Oser, Cannon-Bowers, Salas, & Dwyer, 1999)" (Cuevas et al., 2004, p. 235). In the context of language training, for example, learners participating in a WBTT course can practice taking automated, computerized versions of an oral proficiency exam during training. Instructors and/or peers could then observe their performance and provide feedback. Such testing could be embedded during and after training, thereby facilitating both learning and end-of-course assessment. On a related note, WBTT also addresses a key issue in high-stakes testing – proctoring. Many military and certification training courses require a formal assessment and a standard that trainees must meet to complete the course successfully and/or gain certification. WBTT technology can be used to proctor high-stakes tests. For example, in the language training domain, WBTT technology has been used to conduct oral proficiency exams with trainees, allowing the test taker to be verified by an instructor or unit official online.

A number of the benefits just discussed are shared by trainees who are taught via other forms of technology-mediated instruction (e.g., collective web-based instruction). However, unlike many forms of technology-mediated instruction, WBTT is *synchronous*. It puts learners in touch with instructors and peers in real time rather than requiring trainees to work independently at their own pace while using bulletin boards and e-mail to converse with peers and instructors. On the one hand, synchronous training reduces scheduling flexibility by forcing trainees to attend class at a designated time. On the other hand, human interaction decreases the likelihood that distance learners will feel isolated (Brown & Ford, 2002 as cited in Sitzmann, Kraiger, Stewart, & Wisher, 2006). To some extent, this real-time connection between the trainer and the trainees can therefore be viewed as an advantage when compared to self-directed, asynchronous forms of computer-based training. By humanizing the experience, the synchronicity which characterizes WBTT may promote feelings of trainee accountability and motivation while increasing the timeliness of instructor feedback and guidance.

In sum, WBTT enables a number of significant benefits by combining some of the key advantages traditionally associated with distance education, web-based training, and real-time synchronous (e.g., classroom) learning. Primary among the advantages of WBTT and some other forms of technology-mediated distance education is the geographic flexibility it affords trainees. Furthermore, the technological backdrop of WBTT can provide a record of training. Ready access to computers and the Internet may also expand the educational opportunities provided to trainees by easing the integration of additional technologies into the curriculum. Finally, WBTT keeps trainers and learners connected in real time, which may prove useful for reducing trainee isolation, increasing accountability, and enabling timely feedback.

Web-based Teletraining: Challenges and Concerns

Despite its notable advantages, WBTT is not without its challenges. Drawing from research and practice in WBTT and other forms of distance education, the following pages describe some of the barriers and difficulties associated with WBTT. While some of these challenges are unique to WBTT, some characterize other training techniques as well.

One challenge with WBTT involves the extensive need for pre-planning and the failures that can occur in its absence. Martin, Foshee, Moskal, and Bramble (1996) highlight the importance of devoting time and resources to pre-planning when developing a WBTT course. "Studies conducted by the Army and the Navy have concluded that distance education courses typically require more extensive planning than platform instruction" (Martin et al., 1996, p. 475). A great deal of preparation is needed whether creating the course from scratch or basing it on a preexisting classroom course. Research suggests that traditional classroom programs of instruction can be successfully reconfigured for teletraining (Martin et al., 1996), but this transformation requires a careful consideration of the constraints and opportunities provided by the new training medium. Assessing and adjusting the content and pace of the course is one important part of the planning process. Because of the logistics involved, training students from a distance is usually more time-consuming than offering the same instruction in a traditional classroom. An inappropriate pace or workload can occur when course designers fail to realistically assess the amount of content that can be delivered (Willis, 2000a) and adjust the content or timeframe accordingly.

Another concern involves the potential workload created by changes in WBTT technology. Depending on the flexibility of the WBTT platform, a course may require modifications not only when moving from the classroom to a WBTT environment but also when moving from one WBTT platform to another. For example, a course that incorporates activities requiring classmates to simultaneously view web sites would need to be modified if moving to a platform which does not include this functionality. Choosing an initial training platform carefully, with an eye toward flexibility can help minimize the need for forced or unwanted course design modifications which can result when switching from one WBTT platform (or version) to another. Relative to a more rigid training platform with few user options, flexible WBTT systems can more readily accommodate course design and delivery preferences while allowing the training to maintain its intended structure as technology evolves and as upgrades occur.

Some courses and skill sets may simply be more amenable to WBTT than others. Problems can arise when the knowledge and skills being taught are not well suited for the WBTT medium. This is likely the result of a failure to adequately evaluate the fit between the content and the WBTT delivery medium. The Naval Air Warfare Center, Training Systems Division (NAWCTSD) developed a model for selecting courses most suitable for video teletraining. This model recommends teletraining for courses with high throughput and short duration (to maximize cost savings) as well as courses with an appropriate mix of lecture and laboratory (Martin et al., 1996). The NAWCTSD model also recommends avoiding teletraining for courses that are equipment intensive. Martin et al. (1996) provide several additional recommendations. They suggest that courses that are cognitive in nature are more appropriate for teletraining than courses with a psychomotor emphasis.

A further issue concerns course designers' familiarity with the training platform. Failure to train course designers may result in useful pedagogical features being omitted from the course because those developing the training did not know about or did not understand the technological tools at their disposal. On the other hand, selecting course designers primarily for their technological savvy places WBTT at risk for a "technological solutions in search of instructional problems" mentality (Willis, 2000b). This is especially likely when technologically savvy course developers lack knowledge in principles of learning and instruction. "It is critical that instructional strategies be incorporated into computer-based training to support the development of the task-relevant knowledge structures that allow novices to effectively manage the requisite higher-order processes as they acquire task expertise (Glaser, 1989; Smith, Ford, & Kozlowski, 1997)" (Cuevas et al., 2004, p. 233).

Instructors lacking the necessary technological skills can also severely limit the effectiveness of WBTT. Martin et al. (1996) note that instructors are one of the most important aspects of a WBTT course, adding that they "may require considerable training and practice to be effective" (p. 476). Hands-on training is needed to ensure trainers can effectively operate the equipment and use the technological features incorporated into their courses. Without adequate training, instructors may lack confidence in their ability to use the WBTT technology, causing them to give up easily in the face of technological adversity. Importantly, instructors' attitudes toward and control of the technology can influence student learning outcomes (Webster & Hackley, 1997).

The burden of acquiring the needed technology skills is not limited to course designers and instructors. Problems can also occur when learners are not adequately trained on the WBTT technology. "Some personnel are intimidated by any new technology. Care must be taken to provide sufficient practice and technical support to such personnel when the technology is in use" (Martin et al., 1996, p. 481). In our experience, a technology orientation followed by individual one-on-one assistance, as needed, can help mitigate this problem during WBTT.

Troubles can also arise when trainers and learners participating in WBTT do not have convenient access to high-quality technology (hardware, software, connectivity). The reliability and quality of the technology available can influence WBTT success (Webster & Hackley, 1997). As shown in Webster and Hackley's (1997) research, video quality can influence perceived media richness, which in turn predicts learning outcomes. Other factors of importance include Internet access and bandwidth (Sitzmann et al., 2006). It appears that platforms which enable users to easily adapt visual aids suitable for onscreen viewing are desirable as well (Martin et al., 1996). Also important are student control over the volume of each individual course participant and user-friendly systems which enable classmates to view web-based materials simultaneously (Meade et al., 2007).

While training and superior technology can help minimize technology glitches, they cannot altogether prevent them. Technology failures during WBTT can result in frustration, confusion, disruptions, and wasted time. The impact of technology failures during WBTT is exacerbated when course designers do not develop a priori contingency plans to determine how to proceed when equipment failures occur. Roles and responsibilities of those involved should be delineated ahead of time (Martin et al., 1996), with sufficient resources available to address technology problems that arise. To illustrate, the foreign language training examined by Meade et al. (2007) was designed so that the company maintaining the WBTT platform assumed responsibility for troubleshooting and fixing technology failures. This entailed continuous, real-time monitoring of the classes, with technical support personnel "becoming visible" and working with students and trainers to correct problems immediately upon their occurrence. Moving beyond the foreign language training domain, not every WBTT course will necessarily have the benefit of trained IT personnel conducting continuous, real-time course monitoring. In such cases, the failure to establish, up front, "who" (students, instructors, technology personnel) is responsible for troubleshooting "what" when technological glitches and equipment failures happen can intensify frustrations and degrade the training experience.

Next, it should be noted that during WBTT, learners are at risk for low attention and participation. When students are not involved and engaged, WBTT technology can act like a wall, psychologically separating trainees from their trainer and classmates (Webster & Hackley, 1997). This is one of the reasons why it is important to avoid long lectures and intersperse WBTT with a variety of structured, student-centered activities (Martin et al., 1996; Meade et al., 2007; Willis, 2000a). Martin et al. (1996) recommend limiting any given WBTT lecture to 20 minutes. Willis (2000a) adds that diversifying and pacing activities is one way to break lectures into manageable segments. Meade et al. (2007) offer several ideas for exercises that could be incorporated into WBTT, including student whiteboard presentations, news broadcasts, television clips, cartoons, and Internet websites. It is important to provide clear goals for each exercise incorporated into the course. Instructors should explicitly emphasize the main points in any learning activity as they are encountered (Meade et al., 2007).

Activities may not only promote attention by alleviating the boredom associated with a long WBTT lecture; by encouraging interaction, they may also mitigate feelings of psychological detachment. Despite the real-time connection to peers and instructors, detachment remains a concern during WBTT, in part because WBTT courses do not always capitalize on the relationship-building opportunities available. In general, it is recommended that WBTT courses be designed and delivered to "humanize" the experience by encouraging interaction among participants. That is, it is important to plan *interactive* exercises when designing WBTT courses and it is also necessary to deliver WBTT in a way that encourages interaction among participants. As Willis (2000a) points out, there is a need to "humanize the course by focusing on the students, not the delivery system" (p. 199). Drawing from a variety studies, Sitzmann et al. (2006) make a strong case for the importance of human interaction during web-based instruction (WBI) in general: "A number of studies have found that higher levels of interaction between instructors and learners or among learners result in greater learner motivation, more positive attitudes toward learning or the instructional process, and improved learning outcomes (e.g., Entwistle & Entwistle, 1991; Hackman & Walker, 1990; Ritchie & Newbury, 1989; Wagner, 1994). In WBI, verbal behaviors (e.g., text messages) that establish immediacy are associated with greater participant learning (Freitas, Myers, & Avtgis, 1998; Rovai & Barnum, 2003). Human interaction decreases the likelihood that trainees will feel isolated in WBI and can help trainees remain motivated while learning the material (Brown & Ford, 2002)" (Sitzmann et al., 2006, pp. 631-632).

While the strengths of WBTT support its continued use, its limitations suggest a need to supplement this training technique with other methods that can help compensate for its shortcomings. While no single methodology could possibly offset all of the challenges outlined above, we maintain that videogame-based training has the potential to mitigate problems associated with low attention, inadequate participation, and a lack of interaction among students. The next section of this chapter discusses the nature, benefits, and challenges of videogame-based training.

Videogame-Based Training

Characteristics and Example of Videogame-Based Training

Videogames can be characterized as computer-based systems which include six key structural elements (Prensky, 2001): rules, competition/challenge, goals and objectives, interaction, outcomes and feedback, and representation or story. Normally, videogame-based training is not instructor-led. While there are many types of videogames, our discussion is primarily related to simulation-based videogames. Simulation-based videogames are defined as "systems that attempt to create, augment, extend, or supplant a trainee's actual experience in the world through the use of simulations and virtual/immersive environments" (Cannon-Bowers, Sanchez, Sawyer, & Greenwood-Ericksen, 2006, p. 2).

A program known as The Tactical Iraqi™ Language & Culture Training System (hereafter referred to as "Tactical Iraqi") provides an example of a language training system which includes videogame components. Tactical Iraqi is a self-paced computer-based training program designed to teach individuals how to communicate in Iraqi Arabic. Tactical Iraqi has versions specifically tailored to U.S. Marine Corps and U.S. Army personnel. The program was designed to develop "functional language capabilities focused on particular missions" (p. 3) after 40 hours of training (Tactical Iraqi, 2006). Approximately 100 hours of training are required to complete the entire program. Tactical Iraqi incorporates both videogames and traditional computer-based training methods. It does so via three learning modules: the Skill Builder, Arcade Game, and Mission Game. The Skill Builder is a traditional computer-based training program designed to teach vocabulary, grammar, pronunciation, and cultural knowledge through the use of structured exercises and quizzes. Additionally, the Skill Builder provides instruction on the use of key system components, including Tactical Iraqi's speech recognition interface. The Arcade Game is a videogame designed to train pronunciation and listening skills related to spatial directions (e.g., right, left), colors, common landmarks, numbers, and military ranks. Trainees maneuver their computer character through mazes or a village while listening or speaking. Arcade Game "points" are earned by correctly interpreting spoken instructions or producing correct Iraqi Arabic speech. Finally, the Mission Game is a videogame which instructs trainees in interpersonal interaction with native Iraqi Arabic speakers in a videogame-based environment depicting real-world scenarios and missions. Trainees use their computer characters to interact with other non-player controlled characters (NPCs), using verbal and nonverbal (e.g., avatar hand gestures) means of communication. Trainees begin each mission game scene with a set of informational objectives to complete in the simulated environment. Using content taught in the other learning modules, trainees must build rapport with NPCs and obtain information related to mission objectives using only the Iraqi Arabic language. Trainees always have access to a computer-based tutor, which, when accessed, will suggest what the trainee should do or say.

Although beyond the scope of this chapter to fully report, it should be noted that Surface et al. (2007) conducted an empirical evaluation of Tactical Iraqi across several military training contexts and determined that the program contributed to an increase in Iraqi language and cultural knowledge and self-efficacy. There was also evidence of skill acquisition among trainees using this videogame-based program to develop Iraqi Arabic speaking and listening skills.

Videogame-Based Training: Advantages

Because it is technology-mediated and supports geographically distributed participants, videogame-based training shares some of the previously cited advantages (e.g., geographic flexibility, record of instruction) and disadvantages (e.g., the need for trainee access to reliable, high-quality technology) found during WBTT. However, videogame-based training is also thought to offer some distinct benefits and limitations that are not typically associated with WBTT. One unique advantage of videogame training involves user engagement and immersion. Videogames are visually appealing, with rich graphic aesthetics. This level of detail can lead to a high degree of immersion and engagement in the virtual world (Mitchell & Savill-Smith, 2004). Games present challenges, in which the goal is to win or achieve some level of performance. This challenge, paired with instant visual feedback, can be a motivating force keeping users engaged (Mitchell & Savill-Smith, 2004).

Prensky (2001) adds that videogames can engage learners by providing the opportunity for multiplayer competition and cooperative play with other geographically dispersed players. Indeed, the benefits of collaborative learning in such an environment prompted Surface et al. (2007) to recommend the creation of a multiplayer version of the Tactical Iraqi foreign language training game described earlier. Online collaborative games and simulations provide the opportunity to embed training activities in various team, cultural, and strategic settings. Online games, in general, enable social and situated learning that moves beyond the constraints of more typical classroom environments.

On a related note, videogames and simulations can provide training in contexts that are not well suited to a traditional classroom environment. Simulation training can allow learners to engage in scenarios that are otherwise too dangerous or not easily recreated in a real world environment (Mitchell & Savill-Smith, 2004). The immediate feedback and low-risk environment created by simulation training encourage exploration and experimentation, which provide new opportunities for learning (Kirriemuir, 2002).

Research suggests game-based training offers several benefits related to learners' cognitive processes and strategies during and after training. Games have been found to encourage the use of metacognitive strategies and mental models, as well as to improve strategic decision making, self-monitoring, and creativity (Pillay, Brownlee, & Wilss, 1999; Ko, 2002; VanDeventer & White, 2002). Additionally, games have been linked to the development of visual and spatial skills, analytic and iconic skills, and visual attention (Pillay et al., 1999; Kirriemuir, 2002; Ko, 2002; Green & Bavelier, 2003). As with WBTT, videogame-based training can also provide a record of training behavior and performance, which can serve as indicators of trainee proficiency in various skill/task domains. Empirical work by Surface et al. (2007) exemplifies how data captured from game logs can be used as training effectiveness research criteria.

As noted, videogame-based training is not usually led by an instructor. Therefore, games can help reduce total training time, instructor workload, and dependence on the instructor (Mitchell & Savill-Smith, 2004). Reduced dependence on the physical presence of an instructor can reduce training costs, scheduling conflicts, and increase overall training efficiency. For instance, games provide the opportunity to independently (or collaboratively) practice (i.e., drill) recently acquired skills and knowledge (Mitchell & Savill- Smith, 2004). Self-directed videogame training facilitates learner control by allowing trainees to spend a self-determined amount of time on specific nodes of training content based on their previous knowledge. This flexibility can accommodate individual differences in the preferred pace of learning.

Videogame-Based Training: Challenges and Concerns

Several challenges are inherent in videogame-based training. Moreover, individual differences may exacerbate (or minimize) problems encountered during videogame-based training. Trainee age, videogame experience, and videogame self-efficacy have been cited as influential factors impacting the learning outcomes resulting from videogame training (Clark, 2003; Mitchell & Savill-Smith, 2004). With the Tactical Iraqi foreign language training game described previously, Surface et al. (2007) found that higher levels of pre-training motivation, attitudes toward learning languages, attitudes toward Iraqi Arabic, and learning self-efficacy were related to important post-training outcomes. Other factors such as age, years of military service, and cognitive ability, predicted key learning outcomes as well.

The characteristics of games used for instructional purposes may also impact training effectiveness, often in undesirable ways. Problems can occur when objectives in the training game are not closely matched with the learning objectives of the overall training program (Clark, 2003). Heavy emphasis on completing the game, or achieving top scores, can distract learners from the underlying content, impeding knowledge and skill acquisition (Clark, 2003). In general, games should present a consistent and appropriate level of challenge across trainees, which requires consideration of individual trainees' abilities. Failing to achieve an appropriate level of challenge for the user can result in frustration, decreased motivation, and ultimately decreased training effectiveness (Mitchell & Savill-Smith, 2004).

Technical problems represent another potential challenge with videogame training. Poor software design including confusing user interfaces and lack of feedback can hinder progress during training (Mitchell & Savill-Smith, 2004). Comments from individuals who have experienced technical issues while using videogames to train support this contention (Surface et al., 2007).

Morris, Hancock, and Shirkey (2004) suggest a major shortcoming of the use of videogames as training tools, particularly in military settings, is the lack of similarity (i.e., fidelity) between the training context and the real-world context. These authors investigated the impact of adding context-specific stress to a military combat training game on training outcomes. Findings from this research suggest that supplementing context-relevant stress in game-based training may enhance learners' motivation to successfully complete the training mission. Similarly, Surface et al. (2007) have emphasized the importance of contextual fidelity in videogames used to teach foreign language skills. After using the Tactical Iraqi training program described previously, a number of trainees complained that their characters were forced to walk the (virtual) streets of an Iraqi village without a weapon, reinforcing the importance of small visual details in communicating contextual and psychological factors.

Finally, it should be noted that one of the benefits of videogame-based training, learner control, can also serve as a significant drawback. As suggested earlier, an advantage of learner control is that it can allow individuals to tailor the pace and level of training, skipping material they already know or do not need and spending more time on material they need the most. A disadvantage of learner control, however, is that learners do not always make good choices. They may skip critical material because they are not motivated to cover it or because they do not have enough insight to know that they need it. For this reason, Goldstein and Ford (2002) suggest providing a learner with guidance throughout computer-based training. "Guidance can include information about what material to focus on and how to learn the material effectively as well as instruction and help on how to use the web medium in these efforts. When learners are left on their own, they are often not good judges of their needs for practice in weak areas or of when they have mastered material sufficiently (Gail & Hannifin, 1994). Thus, in self-directed web-based programs, guidance that helps learners make better decisions can be offered" (Goldstein & Ford, 2002, p. 258).

In short, trainees who are given a great deal of independent control over videogame-based training may make poor choices for at least two reasons. The first has to do with motivation and a lack of accountability. Trainees who are not self-motivated may have a difficult time completing videogame-based training if no one shows interest in tracking their progress. Related to this, in a workplace culture where direct orders, explicit commands, mandatory duties, close supervision, and accountability are the norm, offering videogame-based training which allows a great deal of autonomy and learner control may inadvertently send a message that the training is a low priority at best and unimportant at worst. As described above, the second reason why too much learner control can backfire is because learners without access to adaptive guidance may unintentionally make poor choices due to a lack of self-awareness.

In terms of our Tactical Iraqi foreign language videogame example, Surface et al. (2007) make the following strong recommendation, related to the issue of learner control and accountability, based on their observations and research. "Broadly speaking, we recommend units use Tactical Iraqi primarily as a supplement to a structured language training program (i.e., as a blended learning solution) where military personnel are held accountable for their participation and learning. Evidence suggests that Tactical Iraqi can be used as a standalone training option. However, we strongly recommend using Tactical Iraqi as the sole mode of training only when a vigorous, structured POI can be implemented, when learners can be provided a high level of guidance and feedback, and when the learners can be held to a high level of accountability and standard of achievement. Our experience with absenteeism among some trainees at one location during assigned Tactical Iraqi training has convinced us that structure and accountability are important to success. Although Tactical Iraqi has two videogame components and videogames are designed to be engaging, the reality is that learning Iraqi Arabic is difficult and time consuming and would be challenging to accomplish independently using any self-paced training tool. Therefore, we do not recommend fire-and-forget use of Tactical Iraqi as a training strategy for the masses (i.e., handing out the CDs to personnel and considering them trained)" (p. 80).

Indeed, it appears that the issue of too much learner control was also at the heart of the conclusions drawn from an in-depth symposium on the Department of Defense's use of training games, which was held by the U.S. Army Research Institute for the Behavioral and Social Sciences in 2003. Discussion topics covered during this two-day symposium included the effective use of training games and barriers to implementation. "A key finding highlighted in several presentations was that the few training games in use work best when closely monitored by instructors or subject matter experts and are integrated with existing courses and their specific objectives" (Belanich, Mullin, & Dressel, 2004, p. i).

Blending the Two Methods: Videogame-Enhanced Teletraining

As the preceding discussion of WBTT and videogame-based training implies, every virtual training method is characterized by a unique combination of advantages and limitations. As suggested earlier, there is value in moving beyond an "either/or" mentality which seeks to compare and determine the one best method for distributed collaborative training. A preferred alternative is to focus on devising optimal combinations of training approaches that capitalize on each other's strengths and compensate for each other's limitations. In this vein, integrating videogames into WBTT may yield training outcomes which surpass the results that could be achieved by either methodology alone.

Consider the following illustration, which describes how WBTT and videogames could be blended to support foreign language training in the military – a setting where both training methods have already been implemented independently. In our hypothetical example, a teletraining instructor could assign specific videogame activities or modules for students to work on during a training event. Alternatively, rather than assigning specific modules, the instructor could allow more general videogame practice periods at designated points during the course, giving students free time to play a training game (perhaps picking up where they left off the last time they played). Assuming a single-player videogame, such as the Tactical Iraqi program described earlier, learners could play their games independently and then use the WBTT system to virtually reconvene after gaming for discussion and support. This dialogue could be instructor led, or it could entail small group discussions with peers. Regardless, students could ask questions about problems they encountered and compare notes regarding their progress. The instructor could monitor advancement through the game and provide feedback regarding students' progress, decisions, and performance. If a multiplayer game is used, some of this discussion, feedback, and support could occur in the videogame itself.

Alternatively, a slightly different approach to integration would entail the use of WBTT to enhance videogame-based training (rather than using videogames to supplement WBTT). That is, the videogame could function as the predominant, core training technique with the WBTT technology used to periodically connect players, visually and in real-time, with each other and with an instructor/facilitator for discussion, accountability, and social support.

Blending videogames and WBTT as described above has the potential to overcome challenges plaguing each independent method. Videogame-based training modules can alleviate teletrainees' boredom by breaking up lectures and providing the structured, student-centered, diversified activities called for during WBTT (Meade et al., 2007). Multiplayer games can encourage teletrainees to interact with each other, thereby mitigating the feelings of psychological detachment previously described as a concern. Meanwhile, this blended training solution could solve problems frequently found during videogame-based training as well. By bringing peers and instructors into the training loop, this integrated approach could add the element of accountability and adaptive guidance commonly lacking during videogame-based training.

Implementing videogames and WBTT concurrently would allow course designers to leverage the strengths of each training method in order to promote other best practices, in addition to those described above. For example, this integrated approach to training could facilitate observational learning among web-based teletrainees. In the context of language training, for instance, videogames could allow trainees the opportunity role play, practice language skills, and watch classmates interact "in game," in the target language. Game performance could be recorded and reviewed, with feedback later provided by peers and instructors, via the WBTT system. This is important because a lack of in-game feedback is one issue that can severely limit learning during videogame-based training. Records of WBTT and game performance could also be used to assess student performance, evaluate the course, train future trainers, develop/improve training programs of instruction, and research the effectiveness of this integrated strategy.

Of course, the costs of integrating these training methods need to be considered, in addition to the benefits. For example, this integrated approach could significantly increase demands on the instructor, who would need to be adequately trained on both the WBTT system and the videogame prior to course initiation. As with many training approaches, the instructor's preparation and self-efficacy will likely play a key role in the success of this integration strategy. The amount of time it takes trainees to acclimate to both the WBTT and videogame-based training technologies also needs to be considered. In addition, integrating videogames with WBTT increases the demands (bandwidth, etc.) placed on the training system's technological infrastructure. The adequacy of students' and instructors' computer resources and support is a non-trivial issue that must be taken into account.

In short, research is needed to empirically determine the costs and benefits of this integrated approach. All things considered, a qualitative review of the independent strengths and limitations of WBTT and videogame-based learning, as presented in this chapter, suggests that these two training approaches may indeed complement each other effectively. As this concept moves forward, boundary conditions will need to be determined to prevent suboptimal implementations of this solution. To this end, there is a need for research designed to pinpoint when, how, and for whom videogame-enhanced teletraining would be most useful.

Conclusion

In conclusion, integrated training solutions have the potential to overcome problems that occur when individual methods are implemented in isolation. While the current chapter exemplifies this principle in the context of WBTT and videogame-based training, the philosophy itself applies broadly, and is certainly not limited to the two training methods discussed here. We maintain that the field of training in general would benefit from a more deliberate focus on identifying methods which interact in constructive ways to maximize learning outcomes. Research is needed to optimize this method matching process. Ideally, such an agenda will lead to a "playbook" of sorts, describing the strengths and weaknesses of individual training methods, which can be examined to help identify complimentary methods worthy of investigation.

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