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Toward a framework for developing virtual reality skills training in human services

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ABSTRACT

Virtual Reality (VR) is used increasingly for training in human services. A framework that can guide the development and implementation of VR training approaches in human services is needed if the promise of VR is to be realized. Toward this end, we provide design and development recommendations originating from work creating two VR training applications for the child welfare workforce. Our focus is on the training and practice of skills. We begin by providing a brief overview of VR training and the need for effective skills training approaches. Next, orienting information about the two applications is provided. Then, we discuss areas we believe need to be addressed to develop effective VR skills training approaches; namely, incorporating evidence-based learning theories, gaining and maintaining learner engagement using motivational strategies, and creating collaborative technology development teams. The article concludes with a discussion regarding ethical issues that should be considered when developing technology that will be used for training in human services.

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Introduction

Traditional training methods in social work include lectures, roleplays, clinical videos, and supervised practice. Based upon a review of organizational–training literature, Baldwin and Ford (1988) argue that only 10–20% of social work training activities translate into on-the-job skills. Over the past decade, technology-based training methods, such as Virtual Reality (VR), have been increasingly viewed as a means to increase training effectiveness in social work (Lanzieri, Samelson, & Bowen, 2020). VR platforms, each including unique features and design aspects, can present many challenges for educators and workforce administrators. Workforce trainers and

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administrators need to understand these different design aspects to maximize the potential of VR as an effective learning experience within their jurisdictions; however, the complexity can be overwhelming. While VR can alleviate deficits posed by traditional training methods to maximize its benefits, a general framework that practitioners can use needs to be developed.

In this paper, we offer guidance for developing technological approaches to training using VR-based platforms designed to increase skills training effectiveness. We provide two case examples from our work in training child welfare workers. The first is called Virtual Home Simulation (VHS; (Social Research Institute & Games & Applications Lab, 2021a), which uses 360-degree photography of real homes to provide learners the opportunity to practice identifying environmental indicators of possible risks and protective factors/capacities during a home visit. The second application, VRoom (Raines, 2020), features a 360-degree/6 degrees of freedom immersive animated simulation that tasks users with performing a home health and safety assessment. Both tools can be used for initial teaching as well as extended skills practice.

Finally, we discuss the design and development ideas we believe are important to address when creating VR-based training. These ideas are based on our lessons learned from developing the training tools. The following four areas are covered: (1) incorporating evidence-based learning theories, (2) gaining and maintaining learner engagement, (3) working successfully with technology development teams, and (4) addressing ethical issues related to technology-based training.

VR training

In-person simulation training in social work, including roleplaying and simulation labs, is increasingly effective at facilitating skills development as more effective learning principles are integrated (Bogo et al., 2012). In child welfare, increasing numbers of workers have experienced standardized client in-person simulation labs during their training (Bogo, Shlonsky, Lee, & Serbinski, 2014). Badger and MacNeil (2002) found that the use of standardized clients led to greater increases in clinical skill compared to practice-only learning that did not include standardized clients. Research has also found that simulated scenarios using trained actors provide more clinical benefit than students practicing on each other in roleplay activities(Powell, Fisher, & Hughes-Scholes, 2008).

While simulation training can increase skill development, in-person simulations are labor and cost-intensive, increasing the difficulty of offering the widespread and repeated practice needed for skill acquisition. For example, child welfare employees may only experience simulations a few times, at

best, before entering the field. The complexity of potential assessment situations that new/training employees may face, absent extended practice opportunities, makes competency-based simulation training especially difficult. The complexity of possible assessment situations that new/training employees may face makes competency-based simulation training especially difficult. Some have argued that training curriculum must remain theory-focused while students are left to acquire on-the-job skills solely during their practicum (Fortune & Abramson, 1993) or after new-hire training. Either approach—solely theory-based or theory-based plus minimal skills practice—leaves new social workers unprepared for many challenging situations and puts the burden on supervisors to provide on-the-job skills training.

For several decades, VR technology has been used as a training tool in industries such as aviation (Hays, Jacobs, Prince, & Salas, 1992), sports (Pagé, Bernier, & Trempe, 2019), and medicine (Gaba, 2007; Zhu & Wu, 2016). Recent advances in VR, such as reproducing realistic learning environments, higher fidelity displays, and cost-effective headsets, have made VR an accessible educational tool. Modern VR systems have the power to produce immersive, 3 D environments in ever greater levels of detail; thus, providing educators and trainers the ability to develop complex and reproducible events with high degrees of fidelity. We believe the use of VR to create realistic simulations where skills can be repeatedly practiced under ideal learning conditions is a training strategy that may be used to address the barriers to skill acquisition presented by in-person simulations.

Two case examples: VHS and vroom

This section provides an overview of the training tools that inform our design and development recommendations. VHS (Social Research Institute & Games & Applications Lab, 2021a) developed at the University of Utah is presented first, followed by VRoom, developed by Raineman Solutions (Raines, 2020). Our definition of VR follows that of Jerald (2015, p. 9), who states VR is "a computer-generated digital environment that can be experienced and interacted with as if that environment were real." In this paper, we include VR programs presented on a computer monitor and a head-mounted display (HMD). VR provides "a way for humans to visualize, manipulate, and interact with computers and extremely complex data" (Aukstakalnis & Blatner, 1992), allowing us to narrow the gap between "real" experience and mediated experience (Bailenson, 2018).

VHS

VHS is part of a suite of skills training modules, called the Virtual Social Work Trainer (VSWT; Social Research Institute & Games & Applications

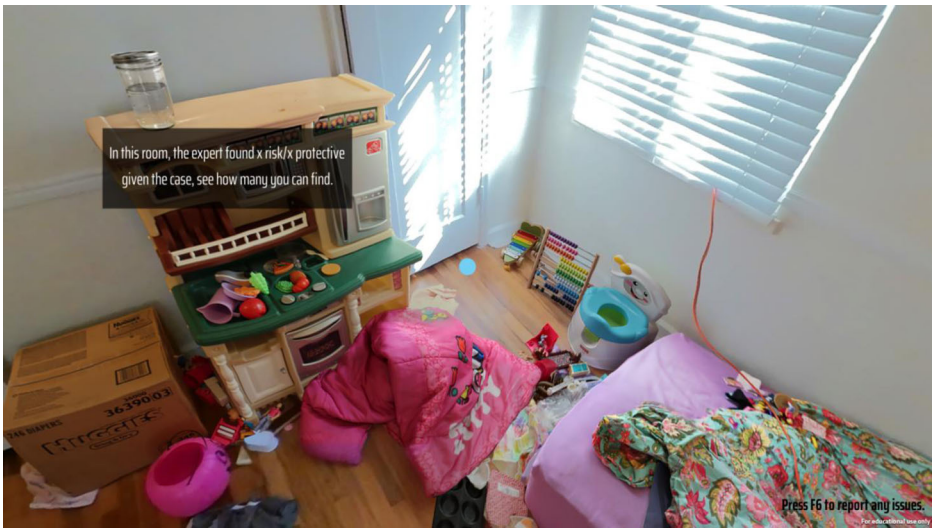

Figure 1. Child's bedroom in VHS.

Lab, 2021b), which is being developed for training child welfare workers. The software provides users with the opportunity to practice identifying possible risk and protective factors/capacities that may be observed during a home visit. The homes in VHS are made using 360° photographs. Although there is some staging of the houses, they present a range of typical home environments that a worker might find themselves in. Users can use a VR headset, computer, or laptop to interact with the software.

The learning task requires users to conduct observations of family living environments by moving about each home, one room at a time, observing and marking items they feel may be a possible risk to the safety of children or an indication of protective factors/capacities of the caregivers. While the protective factors and protective capacities are two distinct concepts, during our discussion, we combine these concepts, referring to them collectively as *protective factors* or simply *protection* (Capacity Building Center for States, 2020). Figure 1 shows a child's bedroom in one of the homes.

Considering the case circumstances, users identify all items they believe indicate possible risk or protection and document their reasons for these decisions (see Figure 2 for a screenshot of this process). Feedback is provided after each practice session based on the consensus of a group of child welfare experts who have completed the VR simulation previously. Additionally, a virtual coach guides novice users by providing immediate feedback on every item they select and asking thought questions. The thought questions require learners to critically think through the principles involved in making decisions of risk or protective factors/capacities. Performance over time is tracked so users can measure their progress toward competence.

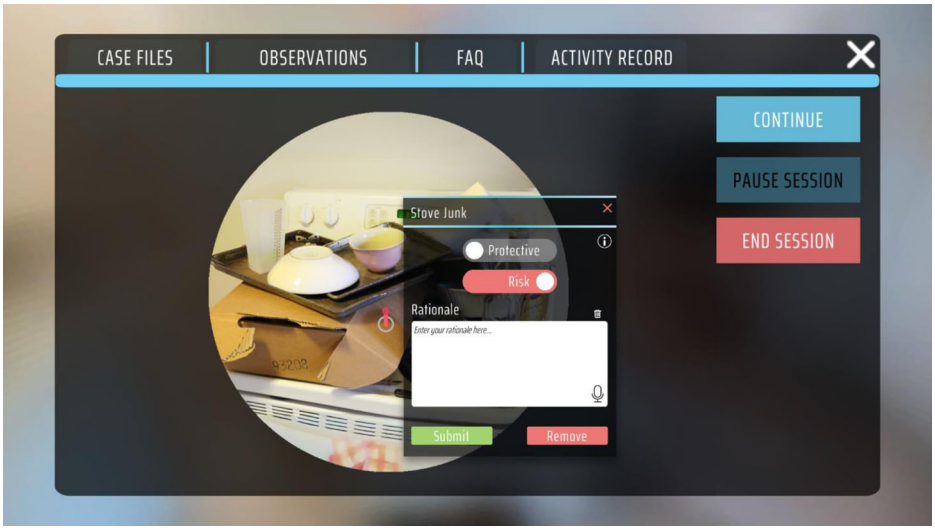

Figure 2. Interaction in VHS for identifying an item as indicative of either risk or protection.

VHS has been developed over the past three years with a focus on incorporating evidence-based learning theories combined with video game-based design. We designed the initial specifications for the user experience in VHS using an approach called a Design Box (Altizer et al., 2017), an inductive design tool for specifying the technical and user experience needs before development (detailed information is provided in the recommendations section). As part of this process, multiple focus groups with BSW students and agency stakeholders ($N = 21$) were conducted. This participatory process allowed social work students and practitioners to be partners in the design process as co-designers who could not only tell us about their needs and constraints but could pitch solutions and features. Major findings from the Design Box indicated that the technology and user interface needed to be "very user friendly" as many users identified as "not tech-savvy." A realistic user interface such as virtual photography was preferred over a virtually animated platform.

Following the initial design phase, the software was developed following the Agile approach (Beck et al., 2001) to project management. Under this approach, rapid development and testing cycles with frequent feedback from learning and content experts are employed to quickly identify what works best. Given the importance of realism and user-friendliness identified during the Design Box, much of the development process focused on solving these two issues.

Our initial prototype was then tested on a sample of BSW students to assess usability and acceptability. Data were collected by observing individual practice sessions and through a post-practice survey. Several challenges were identified, most notably, the difficulty of creating conceptually distinct

items for users to identify (for either threats to safety or protective factors/capacities) when the classification of an item is dependent on the absence or presence of other items and/or gains meaning only in the context in which the item is situated.

After further prototype development, a working beta version of the tool was subjected to further usability and acceptability testing ($N = 8$). This round of testing provided evidence that the most pressing design issues were solved, with almost all users agreeing the tool was realistic, easy to understand, and easy to use.

VRoom

The VRoom Virtual Home Visit is a suite of VR applications that takes users inside different virtual client homes to introduce them to basic skills related to conducting health and safety assessments. Developed by Raines (Raines, 2020), this suite of human service exercises is accessible through several popular VR headsets, including the HTC Vive, Oculus Rift, and Oculus GO headsets. It is also available on desktop computers and is designed for pre-internship students/entry port human service professionals that provide in-home services. Simulation sessions range in length from 10 to 60+ minutes (Note: some VR experiences that utilize head-mounted displays are limited to a best-practice standard of 20–30 minutes per user through a timer built into the experience, with desktop applications allowing for more lengthy/untimed investigations). These exercises were built with the Unity software development platform (Unity Technologies, 2021), piloted in the spring of 2018, and the mobile version (via the Oculus GO) was released into a nationally scaled alpha release in spring 2019. Importantly, the VRoom leverages the computational potential from recording professional behaviors from a diverse set of users. As such, all participating universities and organizations either reviewed or completed a reciprocity agreement for the data collected by the VRoom simulations.

The design methods for the VRoom suite of training tools primarily relied on the Agile system of project management. This iterative design process engaged students and professionals from several human service disciplines to inform the development of key performance indicators, program features/activities, and feedback mechanisms. The software and its features were continually optimized, throughout the software's entire release cycle, including the license and release stages.

An example of the user test's influence on simulation design can be seen in Figure 3. Specifically, several different wayfinding and interaction methods were tested before deciding to use a traditional "cursor" with raycasting to point at environmental objects of interest. This helped users better navigate and interact with the space, conduct more thorough investigations,

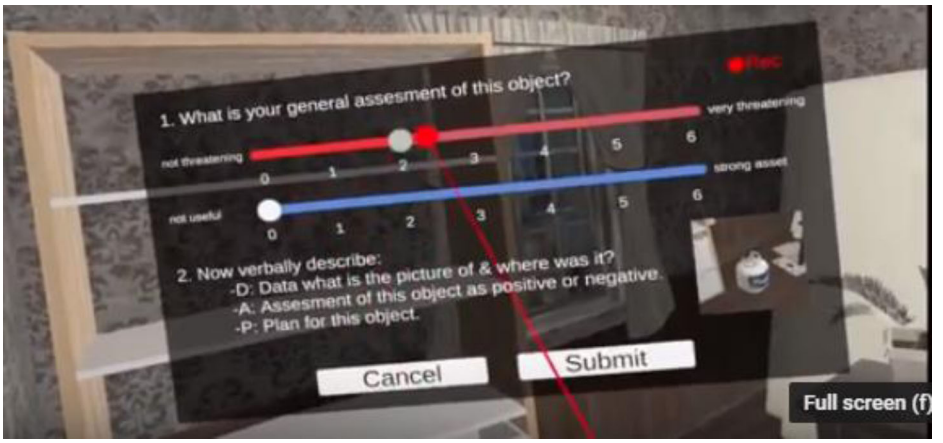

Figure 3. VRoom scene demonstrating impact of focused user tests on design.

spend less time learning processes and controls. The design team tested various colors, phrasings, and other user interface elements before finalizing its design.

The VRoom suite places users in immersive environments with six degrees-of-freedom, blending contiguous, multi-sensory information (visual, auditory, tactile), and begins with a tutorial that blends exposition with context. (The tutorial included activities that simultaneously emphasized both the technology *and* the simulation controls. This adds an element of human-centered design efficiency to the experience, allowing more time in HMDs to be spent on domain-specific learning activities rather than learning unfamiliar controls. Also, this contextual tutorial emphasizes coherence in the applications, whereby multimedia instruction on the technology itself is kept to a minimum (Mayer, 2009). Notably, the VRoom was designed so that instructors could use the experiences independently or together as part of a more detailed skills training progression.

The VRoom applications begin by giving users a hypothetical case description before performing any assessment activities. One key feature of the VRoom suite is its research and practice potential. More specifically, the VRoom software was designed to randomly vary predetermined case details, such as demographic characteristics of clients [as programmed]. This embedded experimental design allows instructors the opportunity to introduce complex practice topics such as bias in decision-making while having the opportunity to collect research data as well. As student users repeat the exercise, both instructors and students can observe the impact of various biases on their simulation performance (provided by user performance reports generated by the software).

The home health and safety assessment activity take users into one of several client's unoccupied homes. Users are equipped with a virtual

camera that they use to photograph any risk or protective factor. Each time users snap a photo, a user interface window displays a rating scale, allowing users to rate the relative strength of the risk or protective factor. Users are also instructed to complete a verbal field note, where their voice notes are recorded and stored in an individualized feedback report. As users complete the simulation activities, automatic reports are generated and then distributed immediately to users following the simulation exercise. This embedded design characteristic provides a critical element of the deliberate practice methodology: immediate feedback. User reports included each in-sim photo taken, the object's rating, the audio field note recorded for each item cataloged, and the user's average [positive and negative] object ratings.

Feedback reports from the simulation can be used in a variety of ways and were broadly designed to serve as an "after-action report," similar to those used in military debriefings (such as the United States Navy Strike Fighter Tactics Instructor program, or "Top Gun School" where high stakes training and simulation activities are immediately processed with instructors/experts). Once the program was released nationally, we realized that the VRoom was used in several additional ways. One instructor used the reports as a transcription exercise, whereby users transcribed their field notes in an activity designed to improve their strengths-based language. Taking this further, another instructor assigned her learners an "implementation report," whereby they used their individualized feedback reports to identify concrete examples of strengths and weaknesses they discovered and the *implementation intentions* developed to strengthen their practice behavior.

In sum, the VRoom suite was designed as a high-fidelity, multi-sensory reinforcement tool, providing instant feedback, whose design was heavily influenced by Ericsson et al.'s (1993) notion of deliberate practice (Ericsson, 1996, 2006, 2016), and Mayer's Cognitive Theory of Multimedia Learning (2005). Feature sets developed for the VRoom simulations were guided by human-centered design principles, such as understanding user needs, designing activities to directly address these needs relative to affordances, signifiers, constraints, mappings, and feedback (Norman, 2013). This included the placement of items within the programmed environment. Another key result of user-testing occurred when field professionals (e.g., police, practicing social workers, home health professionals) provided feedback. Early efforts to determine the content and placement of risk factors were made, with weight given to first responders. This user group represented a key source of design information with high levels of experiential validity. Figure 4 presents a VRoom scene that is an active meth lab, demonstrating the utility of focused user tests.

Early challenges surrounding the novelty of HMDs were realized through the control tutorials. One design challenge was how to make design

Figure 4. VRoom's active meth lab scene, design informed by first responders.

controls intuitive for users (many of whom were experiencing VR for the first time). Going beyond "which-button-should-do-what," we executed user tests across feature sets that helped validate locomotion controls, way-finding, and object placement/interaction. As more and more skills are taught using virtual training exercises, the variable experience level of users will continue to challenge designers and users alike.

Developing VR tools for skills training in social work

Our recommendations are based on lessons learned while creating the two described tools above and the experiences of other professional domains that have utilized VR for skills training. The following four areas are covered: (1) incorporating evidence-based learning theories, (2) working successfully with technology development teams, (3) gaining and maintaining learner engagement, and (4) addressing ethical issues related to technology-based training.

Evidence-based learning theories

Creating a valid learning environment where on-the-job skills are transferred to motivated learners is an ideal learning objective, although difficult to achieve. Using technology as a tool for creating effective training methods is often put forth as a promising approach to creating valid learning environments that will lead to an extended transfer of knowledge or skills (i.e., skilled performance on-the-job; Brubacher, Powell, Skouteris, & Guadagno, 2015). While VR technology is a viable training option in human services applications, the use of VR in and of itself is insufficient. It is the manner and environment in which the educational material is designed and presented to the learner, *in conjunction with* the delivery

method that will have the most meaningful learning and skill outcomes. Clark (2019) summarizes this well by stating:

> For more than 70 years, instructional scientists have attempted to prove the superiority of each new technology over old-fashioned classroom instruction. When we plan instruction solely to leverage the latest technology, we ignore the psychology of human learning … That's because the psychological active ingredients of your lessons are what cause people to learn, regardless of what media you are using. (Location No. 182)

Several reviews provide helpful summaries of learning theories impacting skill acquisition (for example, see Anderson, 2016; Ericsson & Pool, 2016; Ross, 2016). In both simulations presented here, we have focused on the application of one learning theory in particular to guide development and deployment. Ericsson et al.'s Theory of Deliberate Practice (2006) seems most helpful given our goal of creating a method for extended skills practice that allows users to reach a level of competency before on-the-job performance.

Drawing upon research into how expert-level skills can be reliably developed, the Theory of Deliberate Practice presents an evidence-based framework for high-level skill acquisition (Ericsson, 2008; Ericsson, Krampe, & Tesch-Römer, 1993; Ericsson & Pool, 2016). Deliberate Practice is similar to experience-based models of expert skill acquisition in that expertise is viewed as coming after many years of practice. However, the structure of practice is crucial. In many professional domains, such as music, chess, and sports, expertise is reached through extensive practice of discrete, targeted skills. Examples of this type of practice include a violinist practicing musical scales or a basketball player shooting endless practice shots (Ericsson, 2006). Those who reach expert levels of performance spend hours a day practicing in a very structured way for many years (Ericsson, 2006). In addition to practicing specific skills, deliberate practice has the following characteristics: (1) practice targets skills that are just beyond the current level of performance; (2) practice occurs under the guidance of a teacher; (3) limited cognitive demands are placed on the learner during an individual session; (4) practice opportunities are provided that require problem solving and exploration of alternative solutions; (5) frequent feedback and opportunities for self-reflection are provided during practice (Ericsson, 2006).

Deliberate practice is hypothesized to reliably lead to skill acquisition by breaking up complex tasks into smaller ones that are more amenable to the constraints of a person's ability to learn. It is designed to occur in ways that consistently challenge the learner and thoughtfully increase the difficulty of tasks. Finally, immediate and precise feedback from a coach guides a learner to the most effective strategy.

Motivational strategies to gain and maintain learning engagement

Implementing the characteristics of deliberate practice in a VR simulation requires a learner to practice extensively. Therefore, it is also required that a learner has a high level of motivation to learn. Effective simulations, then, need to integrate features that increase motivation to engage in the repetitive nature of deliberate practice. Gamification can be used to reinforce several key features of deliberate practice activities. It is useful to acknowledge the notion of what a "game" is in the educational context and its broad interpretation over time, especially across disciplines (Plass, Homer, & Kinzer, 2015). The use of gamification and game-based learning (GBL) principles has a long and diverse history in VR simulation. Gamification refers to layering game or play-like elements or events on top of non-game learning activities, whereas GBL uses entire games (and often simile and metaphor) to deliver instruction to users (Wiggins, 2016). In medical, military, and most recently employee education programs, VR simulations have been employing gamification principles to reinforce practice repetition from within their design.

Gamifying a VR tool requires the implementation of an incentive or reward system. This is typically accomplished through structured activities that satisfy a user's needs or desires. It is helpful to distinguish between types of rewards as either *internal* or *external* to the simulation experience. *Internal incentives* are used to classify gamified activities or gameful design features that are embedded within the VR training. For example, internal incentives can be components of in-simulation controls and features. Additionally, scoring or "badges" are examples of an internal incentive. *External incentives* refer to features or activities that exist *around* the VR training and include assignments, grades, or debriefing exercises.

To maximize learning, the attention of learners must be focused, and users must return to the learning activities. Thus, it is important to construct simulation activities and features that emphasize both kinds of incentives. VHS and VRoom utilize first-person controls, provide immediate user feedback, feature interactive rating scales, and utilize engaging user interfaces to emphasize internal rewards. Moreover, incentives based on simulation performance such as grades, individualized performance summaries, after-action reports, and other in-class activities are all examples of external incentives utilized in both simulations.

In addition to taking a gamification approach to increasing user motivation, principles that increase psychological engagement can also be helpful. Clark and Mayer (2016) define psychological engagement as activities that require a learner to engage with the material so that deeper cognitive processing occurs. Examples of psychological engagement might be requiring learners to integrate new knowledge into previously learned knowledge or

mentally organizing instructional activities into broader principles or schemas. In VHS, psychological processing is activated by having users not only identify indicators of risk and protection in the home environment but also explain, via thought questions and rationales, their reasoning behind a selection. Similarly, the VRoom collects verbal field notes from users, engaging their reasoning for a rating, and importantly, what should be done to encourage or resolve identified factors. Over time this leads to deeper psychological engagement, where learners can critically examine their own assessment behaviors, establishing a link between their actions and the professional principles underlying their choices.

Working with technology and development teams

There are challenges in developing VR training tools because multiple disciplines must interact closely. In both cases, our design teams include social workers, psychologists, game developers, data scientists, computer coders, and database engineers. The close collaboration required during the development process can be difficult, given the disparate approaches, vocabularies, and cultures in which these specialists are trained. Thus, thoughtful and open communication is a critical element in VR simulation design.

For example, creating learning software from a perspective that focuses primarily on engagement, gratification, or entertainment may neglect the characteristics necessary for learning (i.e., the characteristics of deliberate practice). On the other hand, a breadth of knowledge regarding learning theory does not always translate to effective, engaging, or accessible software. Further, subject matter experts are crucial members of the development team if training materials are to reflect the skills to be learned accurately. Given the above, it is crucial to establish a teaming structure that allows multiple disciplines to work toward a united goal that utilizes each entity's strengths. In our experience, this requires a willingness to delve into the culture of different disciplines and a significant degree of patience on each participant's part. For example, VHS gaming engineers are trained to implement an abundance of "bells and whistles" to keep users interested. Conversely, learning specialists view these characteristics as distractions, pulling attention and cognitive resources away from aspects that facilitate learning. Yet to keep users engaged, a balance of unique/novel features must accompany the simulated task. Understanding each discipline's goals and best practices reduces the potential for conflicts that can produce confusing or ineffective training activities.

One method VHS found useful in addressing the differences between disciplines and between other stakeholders, is the Design Box mentioned previously (Altizer et al., 2017; Altizer & Zagal, 2014). The Design Box is an iterative participatory design methodology intended to bring users,

subject matter experts, and developers together in the design and development process. Rather than leveraging a client/developer model in which a list of requirements is created, which the developers then interpret, the Design Box brings all users to the table as partners. This allows the users, subject matter experts, and designers to engage in designing the game together. The users frequently bring up barriers to use and access that the subject matter experts and developers may overlook. The experts and developers teach each other the language, best practices, expectations, and ethics of each other's fields in the process. As with any partnership, attention must be paid to communication. Language and values between different groups start in quite different places, but through iterative design and development, a project emerges that reflects both the expertise and lived knowledge of all partners. While this process at times is messy, as all partners participate in domains they are unfamiliar with, it allows for all parties to gain a working understanding of each other's fields and languages that enables all to participate in the co-design of the application. This not only allows for software the end-user is more likely to engage with, but that administrators are more likely to distribute and support as not only their concerns but their ideas about the game are included

In short, the Design Box serves as a tool to bridge gaps in participation, knowledge, culture, and expectations through participatory design. Instead of coming up with a design document, the development team works in sprints to develop the project quickly, then meets with the partners to redirect and refocus the project. This method allows for frequent and rapid changes to the software that reflect the needs of all partners as well as current software design practices, which otherwise may be neglected when following a script. While the client/contractor model relies on setting an agreed-upon destination, the Design Box model allows for partners to coincide and negotiate terrain as it appears.

Ethical considerations of VR in human services

In our experience, ethical considerations of innovative training approaches are often minimized more than they should be. There is a cost to increasing ubiquity; that same proliferation that brings potential benefits also brings potentially negative outcomes and can spread negative outcomes more widely than traditional training methods. One bad trainer not only influences his/her students but the population those students will serve. Similarly, one bad piece of software can increase this harm exponentially. The nature of virtual technology engages the sensibilities toward instant gratification, presence, immersion, and emphasizes learning and practice at a neural level (see: Adamovich, August, Merians, & Tunik, 2009; Witmer & Singer, 1998; Won, Bailenson, Lee, & Lanier, 2015). While several

organizations have released guidelines for ethical practice for simulation developers, there is currently little guidance toward a robust framework for the ethical, efficient, and effective design of virtual simulations in human services (Trahan, Smith, & Benton, 2017). Thus, we present three foundational principles to forward the discussion: professional integrity and inclusion, transparency, and accountability.

Professional integrity and inclusion is the base principle of ethical simulation design and must include frequent and thoughtful user testing to validate the simulated activities' usability and acceptability. Users should also be considered partners and involved in the design process. This is not only because users provide directly relevant design feedback; it also shifts them from being subjects to being partners who co-design the simulation. The potential for programming bias is notable here, whereas developers' personal thoughts and beliefs can be 'coded' into the simulations or scoring mechanisms. For example, some may view a child's mattress on the floor during a VR home assessment as a direct safety violation, while others will see the success of providing a place to sleep for every individual in the home. Each of these perspectives is based on a complex series of personal interactions, biases, and experiences. It is crucial that these sorts of differences are realized, addressed, and ultimately used to improve the overall quality of the simulation product.

Further, skills trained through the rote repetition of deliberate practice often include unintended artifacts, some of which can be counter-intuitive and negative. Termed "training scars," the unintended negative consequences of repetition/muscle memory can cause obvious (and even dangerous) performance inefficiencies (Christian & Griffiths, 2016). These types of ethical and performance inefficiencies are typically discovered through the thoughtful integration of users into the design process.

Transparency is the open communication of interests, activities, and results associated with a program's design. Open, transparent communication presents the opportunity to review all the different regulatory approaches required by each collaborator. Subject matter experts often work alongside software developers to design high-fidelity user experiences. As reviewed above, this collaborative structure can create a source of confusion, misunderstanding, and tension. Data and privacy concerns differ among public and private enterprises and can become an ethical issue when developing VR simulations to capture and manage user performance data. Higher education institutions often require rigorous, principle-based review(s) of a project's data/information collection features (i.e., research protocol review by an institutional review board). In contrast, the rules governing electronic data privacy practices, their review, and subsequent

enforcement are different for private software developers, existing, in part, as a matter of contractual or licensing procedures. Knowing if or how these regulations might work in conjunction and/or opposition is key to the efficient design of ethical virtual simulations.

The complexity of these relationships can be increased by the physical location or distance between subject matter experts and software developers. For example, the efficiency and effectiveness of translating feature requests and change orders between subject matter experts and developers already present challenges. As each collaborator also has separate data privacy and storage practices, building group consensus and understanding of all applicable regulations is vital to collecting, handling, and properly storing simulation performance metrics. In our experience, because social work and software development have different norms, lexicons, and values, a partnership model may serve better than a client/contractor one. Working together to develop software allows all parties to bring their expertise to the design; and the collaborative dialog often leads to the identification of issues that neither party would independently observe, resulting in an overall improvement of the work's quality.

Finally, we address the importance of *accountability* in the design of human service simulations. As virtual technology reaches ever greater ubiquity, affordability, and computational power, the need for large amounts of content will also increase. Fast growth and product saturation often lead to greater variations in product quality. To ensure both the reliability and validity from *within a program's* design, adherence becomes a key concept. Broadly, we refer to adherence as the degree to which visual, physical, and emotional cues can be thoughtfully placed in conjunction with one another to maximize the goals of the virtual training experience. Any program designed to register performance or learning improvements should employ a principled approach, engage relevant learning theories, and focus efforts on collecting evidence to guide design with evidence. Studies of simulation technology, including recent investigations of human services VR experiences, demonstrate a consistent positive relationship between fidelity and learning outcomes (Harris, Bird, Smart, Wilson, & Vine, 2020; Markowitz, Laha, Perone, Pea, & Bailenson, 2018). As technologically assisted instructional methods proliferate and evolve, we must act within the ethical best-interests of both users and disciplines.

Conclusion and future approaches to VR development for skills training in human services

VR approaches to skills training promise to enable human services workers to reach a level of competence prior to on-the-job performance. From our experience developing these two VR approaches for training human service

skills, we argue it is important to address four aspects to create effective VR skills training: (1) evidence-based learning theories, (2) motivational strategies, (3) collaboration with technology development teams, and (4) ethical issues.

As with all skills training methods, effective VR-based skills training should use an evidence-based learning theory as a foundation. A crucial area of focus is structuring practice to increase skill levels reliably. Deliberate Practice is a proven method for doing this and provides training developers with clearly operationalized steps to develop effective practice sessions.

Developing VR skills training applications is a complex process requiring expertise from multiple disciplines. Therefore, developing an effective team takes time and attention. Many pitfalls can be avoided if team members learn how to bridge the professional cultures and lenses each brings to the project. Among other considerations, effective team development requires establishing a safe learning environment with frequent communication between team members.

Maintaining the motivation needed to practice skills to the point of competence can be difficult to sustain. Therefore, gaining and maintaining high levels of learner engagement is vital. Using elements of game-based learning, designers can create experiences that help users stay engaged. For example, points and level systems can activate inherent reward systems that increase learners' desire to continue "playing." Additionally, learning interactions that are psychologically engaging help learners sustain the motivation for continued practice by requiring cognitive effort at a deep level.

Finally, VR skills training approaches can be widely disseminated and reused for long periods. Therefore, ethical considerations play a larger role than in other kinds of training. Development teams need to carefully consider the long-term impact of all training content and activities. All VR skills training products should thoroughly address aspects such as professional integrity and inclusion. Toward this end, developers should be transparent about goals and design and accountable to the users' interests.

Future studies of the effectiveness of VR skills training, particularly in comparison with current learning methods, will confirm that investments in this learning technology reliably produce highly skilled human service workers. To determine the active ingredients in VR approaches to skills training in human services, researchers should detail the process of designing and developing their products. A key challenge in measuring expert job performance in human services is connecting an individual's training outcomes to on-the-job performance measures. As the goal is a well-trained human services workforce, effectiveness studies should consider how to define positive outcomes best. Future research on complex task training in VR should include more longitudinal (vs. cross-sectional) outcomes, blending users' training and job performance outcomes.

Finally, creating multidisciplinary design teams opens up several opportunities for deeper learning when applied to human services training. Differences in how computer scientists, social workers, and data scientists measure performance indicators can be leveraged to design, integrate, and consistently improve the scalability of promising training interventions. For example, machine learning techniques are familiar to computer scientists and can help social workers design training applications, identify and monitor patterns in learner behavior, and provide individualized learning interventions that improve upon deliberate practice and improve the state of human services simulations in virtual reality.

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