Authentic Learning Experiences Through Play: Games, Simulations and the Construction of Knowledge

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ABSTRACT
A chorus of proclamations have arisen in recent years about the potential of games and simulations to facilitate learning. Yet few discussions focus on the fundamental issue surrounding the implementation of games and simulations: to what learning objectives and pedagogical strategies are they most relevant? Through an examination of perspectives on the suitability of games for learning, as well as recent examples of digital game-based training in two vocational settings, this paper examines the design of authentic learning experiences as a way of thinking about the appropriateness and unique potential of games and simulations in a range of educational and training settings.

Keywords
learning, games, simulations, constructivist, construction, education, training, knowledge.

INTRODUCTION
Games and simulations have become the learning resource du jour in e-learning circles, suggested as the solution to a wide range of learning objectives. However, the results of previous endeavors in this arena have been mixed, causing many educators and corporate trainers to approach games with some trepidation. Coupled with the overly-hyped and only marginally effective 'edutainment' market in the 1990s, educators and trainers have been left with a skeptical view of what is popularly regarded as another attempt to merge learning and fun.

Yet there is an important consideration that is often overlooked as we lump learning games and simulations into one general category of learning resource, though possibly referred to by a wide range of monikers. Games and simulations are only as effective as the pedagogical approach that is employed in their design and development. Furthermore, their effectiveness must be measured against the learning objectives and methods selected vis a vis the needs of the resource's learners. Unfortunately, this is often not the case.

Many learning games from both the 'edutainment' era and today offer only traditional didactic methods in disguise, a practice described by game designer and writer Brenda Laurel as serving

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'chocolate-covered broccoli' [8]. In these cases, the content and teaching method are entirely unchanged from their non-game origins, so only the presentation style differs. Linear content is repurposed into an open-ended game context, a bit like shoving a square peg into a round hole.

This is not to say that these sorts of learning games have no place. They can often provide the motivation to learn in cases where the learners have no other motivation to engage with the materials. Wrapping "boring" content in a trivia or shoot-em-up game format might make material that just needs to memorized a bit easier to "swallow". Likewise, repeated engagement with interactive drill-and-practice environments provides the repetition that may be needed for learners to memorize and retain certain types of content. Just as I have argued previously, "the first step towards constructing one's knowledge is being open to the experience of learning. An unmotivated learner is simply incapable of taking enough interest in something to engage in the process of construction" [3].

To fully leverage the potential of games and simulations, however, one must look at what they do best, and at what they can possibly do better than any other type of learning resource. In the past, we have tended to focus primarily on games' aforementioned ability to motivate and engage. While certainly an important component of the learning experience, to say that games simply motivate does them a tremendous disservice. We are now coming to understand that games and simulated environments may afford superior opportunities for learning, particularly for those accustomed to play in videogame environments. For instance, Professor James Paul Gee has remarked on game designers' ability to build games as 'learning machines', observing that 'the theory of learning in good videogames fits better with the modern, high-tech, global world today's children live in than the theories (and practices) of learning that they see in school'. [4, 5]

Game-promoting pundits like Marc Prensky have tended to focus more on the need to engage the younger, multimedia-stimulated generation, but he also acknowledges constructivist approaches to learning when he argues that 'stuff to be learned – information, concepts, relationships, and so on, cannot just be 'told' to these people. It must be learned *by* [original emphasis] them, through questions, discovery, construction, interaction and above all, fun.'[10] So while part of the motivation may stem from novelty effects, competitive enjoyment, or the stimulation younger generations have grown accustomed to, the best types of engagement stem from the learner's enjoyment of a more effective learning experience, one that puts them in control and encourages active participation, exploration, reflection, and the individual construction of meaning. It might be described as fun, as Prensky says, or it might be the phenomenon that Seymour Papert refers to as 'hard fun', enjoyment derived from a challenging but meaningful learning experience, or as Gee says, an experience that 'is or should be both frustrating and life-enhancing'. [9, 4]

EFFECTIVE LEARNING

It is obvious that we expect the outcome of our education and training efforts to result in more skilled or capable people, a process we tend to describe as 'learning'. Yet in practice, learning means quite different things to different people. For instance, does what many educators regard as learning, the memorization of information, really constitute learning if the learner does not have the ability to apply that information correctly given a range of contexts? Have they learned if they can produce a fact, but cannot accurately cross-reference that piece of information with

something previously 'learned? A learner who can recite every bone in the human body cannot necessarily diagnose a problem with a given bone, nor know how to splint one if an accident occurred. Even if taken through a number of steps necessary in splinting a bone, it's unlikely that a person would do it correctly without having experienced it either first-hand, or vicariously, by observing another person in the learning process Lave and Wenger refer to as 'legitimate peripheral participation' [7]. There is a huge disconnect between knowing something in abstract and being able to make that knowledge actionable. In fact, emerging ideas about learning are beginning to suggest that learning is the act of making knowledge tangible through action, or what George Siemens refers to as 'forming connections' between islands of knowledge. [12]

Given this definition of learning as connection-forming, then all learning must result from experience, for experience underlies the process of forming said connections. In this regard, therefore, effective learning is a redundant statement. If one has learned, the experience has been effective. The question therefore becomes, how can we design experiences that allow learners to experiment with knowledge in context, encouraging them to form connections by experiencing a wide range of experiential possibilities around any given piece of information?

AUTHENTIC LEARNING EXPERIENCES

We can start by building on a fundamental component of constructivist learning approaches: the idea that a learner is challenged to construct their own knowledge via an 'authentic' learning experience. There are varying views on what constitutes authenticity, but Ann Carlson succinctly describes the pedagogy of authentic learning as one which values learner-centredness, active learning, and authentic tasks in which the learning experience takes place around real-world situations. [2]

Siemens, however, distinguishes between authentic experiences for meaning-making in the traditional constructivist sense and what he refers to as a sophisticated form of pattern recognition where the meaning is not constructed solely in the learner's head, but there to be derived from a process of analysis via a range of experiences:

> Unlike constructivism, which states that learners attempt to foster understanding by meaning making tasks, chaos states that the meaning exists – the learner's challenge is to recognize the patterns which appear to be hidden. Meaning-making and forming connections between specialized communities are important activities. [12]

Despite this distinction in the nature of construction, the approach is nonetheless the same. Place the learner firmly at the centre of the learning experience, encourage him or her to take an active role, and make sure that the learning situation is not abstracted from reality, but is placed directly in a real-world context, either physically or virtually. This environment may or may not include other learners, or it may simulate the responses and behaviors of other individuals. Though some structure will be in place, the learner will not progress entirely linearly, as with traditional content, but will play in this environment, encountering both success and failure along the way. Failure may, in fact, be the most critical aspect of this play.

Roger Schank, among others, has championed the idea that failure is a critical component of

learning. [11] This is an area where games and simulations shine, affording a wide range of possibilities, or failure-states, given a wide range of player actions. Through simulation we can understand the complexities and intricacies of systems that we impact in myriad ways, perhaps leading to an obvious domino effect, or to a more subtle butterfly effect only observable in the context of a large simulated reality. The simulation is only limited by its designer's intent or resources to play out a wide range of possibilities that contribute to a learner's ability to recognize the patters that emerge from his or her actions. As Schank explains, these failures can offer unexpected benefits when it comes to learning, 'Simulations that evoke real emotions become real memories. A failure is a failure, and whether in a simulation or a work experience, if it feels real, it helps us learn.' [11]

Simulations afford the unique possibility of designing an authentic learning experience when it is impossible or impractical to foster such an experience in the physical world. Still, simulation alone may not be sufficient. Author Clark Aldrich believes that there are three important structural aspects of the ideal learning experience: pedagogical elements, simulation elements and game elements. [1] In his view, pedagogical elements wrap the other elements in a directed learning context, providing a theoretical basis, assessment, and opportunities for reflection. Simulation elements refer to the components that make the simulation executable, be it a simple branching simulation or more complex game-like simulation. Game elements, on the other hand, refer to the aspects that are simply there to make a game fun: competition, reward, discovery, etc. A good learning game represents a fragile balance between these three poles. A strong pedagogical foundation is a must. But too many simulation elements and the game is boring. Or, too many game elements and the learning opportunity is lost to a shallow, didactic learning experience interspersed with some interactive glitz.

In this respect, the most important component of an educational game is the simulation, that which mimics or allows the virtual equivalent of a real-world experience. This is precisely what a great deal of play is about, simulating real-world possibilities to act, as Brian Sutton-Smith puts it, as a 'consoling phenomenon' that makes the player feel more confident in his or her ability to handle a similar situation, should it present itself in real life. [13] Most people will agree that it is 'life experience' that makes people capable of handling future situations. In this regard, learners can only benefit from repeated exposure to a range of scenarios that encourage them to flex their capabilities. And in the process, they may also learn to be more flexible, handle greater ambiguity, manage resources, and solve problems, all difficult-to-measure but easily recognizable abilities afforded us by play in physical and virtual environments.

Another characteristic benefit of simulated environments, with or without game elements, is their ability as a programmed platform to, given the appropriate input, simulate any learner's zone of proximal development, Vygotsky's construct of the context in which maximum learning is possible for a particular learner. [14] The learner's decision-making as they navigate the simulation can itself be an input that allows the simulation's logic to tune itself to an appropriate level of difficulty and explicit scaffolding. Some work is being undertaken in the area of dynamic difficulty adjustment in the first person shooter genre of games. [6] It does not seem farfetched to imagine a time in the near future when many educational games and simulations feature this level of learner responsiveness and customization, an aspect that will place the learner even more firmly at the centre of the learning experience.

DESIGNING AUTHENTIC LEARNING EXPERIENCES

I recently participated in designing and developing two simulation products that were specifically designed to adhere to the principles of authentic learning outlined above. The first was based on a brief outlined by the teaching staff of a theoretical and practical course in building and carpentry offered at the Christchurch Polytechnic Institute of Technology in New Zealand. The staff was concerned about some students' inability to grasp certain concepts related to laying out a building site, a skill that requires an internalized and actionable understanding of various geometrical concepts, including the hefty Pythagorean theorem. Traditional didactic methods were not effective in getting the message across consistently, leading to a range of outcomes when the students reached the physical building site.

Our solution was to create a virtual environment where the students could see each step of the process performed via video and animation, thus enabling legitimate peripheral participation through virtual means, then allowing them to take control and step themselves through the animated process of laying out the building site. (See Figure 1.1) This solution placed the learner firmly at the centre of the learning opportunity, allowed him or her to act on prior theoretical knowledge, and provided the learning experience within a virtual environment simulating the real-world context they would encounter later in the course.

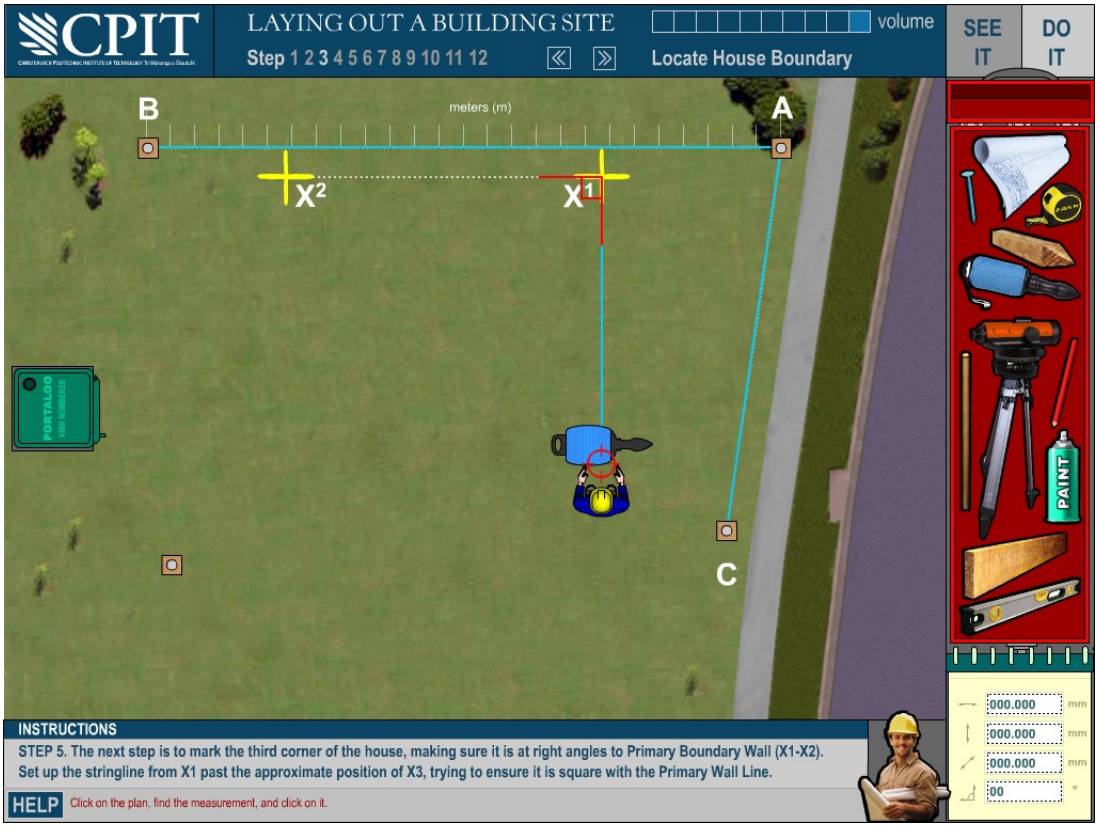

Figure 1.1: A building and carpentry simulation

The second project employed a branching simulation technique that allowed mental health professionals to apply theoretical principles related to the calming and restraint of difficult patients to scenarios they might encounter, again in a simulated real-world context using, in this case, video enactments of the outcomes within each scenario. (Figure 2.2) In addition, the simulation employed some common adventure game conventions, allowing the learner to seek out additional clues or information to assist them in dealing with the situation. A further game element is the escalation meter in the upper left hand corner that lets the learner know whether they are escalating (failure) or de-escalating (success) the situation based on their choices.

Figure 1.2: Mental health professionals scenario-based training

These learning objectives were particularly tricky because the learners not only needed to understand and apply a wide range of techniques, but needed to evaluate situations thoroughly to assess which techniques would be most useful and least inflammatory in any given situation. One technique might work quite well with one patient in one situation, but create significant distress in another patient, or the same patient in a different situation. The conventional paper-based materials had simply outlined a list of techniques, with minimal comment as to the appropriate context for them. Our solution demonstrated to learners that the techniques were not a one-size-fits-all proposition, but uniquely suited to particular patients and situations, something that could only be learned from experience. As Siemens might be interpreted to mean, learning is

as much about knowing what not to do as it is about knowing what to do, and about readjusting strategies when new information comes to light:

> Connectivism is driven by the understanding that decisions are based on rapidly altering foundations. New information is continually being acquired. The ability to draw distinctions between important and unimportant information is vital. The ability to recognize when new information alters the landscape based on decisions made yesterday is also critical. [12]

One hugely significant benefit of both of these solutions is that they allow assessment to be built right into the experience. Educators and trainers can log learner progress through the resources in order to see what decisions they make, whether they improve over time, and how long they take to achieve the tasks. This type of assessment is much more capable of evaluating learning than traditional summative assessment that generally only tests the ability to regurgitate information, often well out of context.

Of course, the real test is whether the learners are actually more capable when placed in the real-world situations that these simulated experiences attempt to mimic. Evaluation data is not yet available for these solutions in practice, but early feedback from the clients indicates that these solutions may provide a much-needed bridge between the abstraction of necessary technical knowledge and the practical application of said knowledge in daily practice.

Authentic learning experiences of the sort described in this paper are most relevant to situations where the learner needs not only to learn something, but also needs to learn to what contexts that information or knowledge is most relevant. In a sense, this is how information and knowledge become wisdom, a critical need in this chaotic time when information abounds and critical scrutiny is key. And while it is certainly not possible for someone to learn everything they need to from a simulation, as even pilots leave their simulators for real planes eventually, attempts to leverage them in the manner outlined above may provide some crucial first steps in bridging the gap between abstract, theoretical knowledge and the real-world contexts in which we inevitably must operate. As I see it, this is the sweet spot for games and simulations, allowing us to play with myriad possibilities embedded in the situations we experience or might encounter, so that we may achieve greater confidence in our abilities and capabilities, both present and future.

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