Emergent Design:
Bringing the Learner Close to the Experience

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Abstract. The creative process of design is at the foundation of serious game and simulation development. Using a systematic approach, the designer of serious simulations or games analyzes the best approach that would deliver an interactive learning experience; one that will harnesses growing forms of behavior, requiring both the learner and technology to engage in an open-ended cycle of productive feedback and exchange. According to Collins [1], "Beyond simply providing an on/off switch or a menu of options leading to 'canned' content, users should be able to interact intuitively with a system in ways that produce new information. Interacting with a system that produces emergent phenomena is what I am calling interactive emergence" (4th Annual Digital Arts Symposium: Neural Net{work}).

Keywords: creative process, emergent design, serious game design, health education simulation.

1   Introduction

The healthcare profession is heavily task-and performance-based where clinical reasoning is paramount with integrity, empathy and compassion. Many of these attributes are difficult to teach and assess in a traditional classroom. Patient safety has to be the ultimate outcome of any healthcare curriculum. As Khan, Pattison, and Sherwood state, "Recently, a range of simulation techniques have surfaced that allow the learner to 'enhance learning of healthcare professionals in safe environments, without compromising the patient safety, while maintaining a high degree of realism.'" [2]. Serious simulation design and development is just one example of this technique.

   Serious games and simulations have started to permeate the healthcare arena. Zyda provides a definition of serious games as: "a mental contest, played with a computer in accordance with specific rules, that use entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives." [3]. This mental contest is an interactive dialog that allows the learner (gamer) to navigate through a serious of vignettes (digital stories) and challenges in order to attain achieve learning outcomes designed within the simulation experience.

The *Suicide: Prevention, Intervention* simulation is a work-in-progress that uses emergent design; the intuitive interactive experience coupled with a focus on usability to build this simulation. The authors' intention is to provide learners with an educational experience while engaging in interactive dialogue with virtual characters in situations that increase potential suicidal behavioral awareness, promote and encourage effective communication with members of specific populations at risk, and enhance participation and activation skills in working with the members of a population thereby increasing positive mental health outcomes.

2   The Creative Process of Emergent Design

The creative process of emergent design is essentially a problem-solving process. In the creative process the designer is actively engaged in systematic problem analysis much as an architectural designer would design a blueprint for a building or a computer scientist would develop programming code structures for an application. Emergent design is an evolutionary process. The simulation begins to reveal its structure and performance attributes as the design evolves. According to EmergentDesign.org, "Emergent design holds both emergence—the bubbling up of new phenomena from the random interaction of individuals—and design—the planned progression of events towards a goal—in a dynamic embrace that maintains a higher level view of the process, and thus transcends the apparent duality by facilitating the interaction between the two approaches. It seeks to reduce the friction points that inhibit the free flow of information and to allow for experimentation towards a goal, so that product development is more like the leaves of trees reaching for the light than central planning." [4].

In emergent design, this serious health education simulation serves as a way of testing specific hypotheses within the Interpersonal-Psychological Theory of Suicide, which posits that the motivation for suicide is a function of two psychological factors: belongingness and burdensomeness. For example, the interactive simulation could be tweaked to only intervene on belongingness or only on burdensomeness and then these versions of the game could be compared in terms of their impact in reducing suicide risk (e.g., two versions of the simulation could be compared at two different college campuses). This would answer empirical questions about which psychological need has a greater impact on suicidality. Moreover, hypotheses could be tested as to whether there is an additive benefit to intervening on both burdensomeness and belongingness, or if intervening on just one is sufficient to reduce risk for suicide. The goals for the *Suicide: Intervention, Prevention* simulation are presented in Table 1. Obviously, studying suicide is a difficult endeavor given the ethical and moral issues surrounding it. Hence, it is difficult to conduct much research that involves experimental manipulation in order to determine causality. With this interactive serious health education simulation however, researchers could experimentally manipulate important variables while still behaving in an ethical manner. In summary, this simulation would provide a modifiable tool that could be used to answer specific research questions related to suicide and expand our understanding of the mechanisms involved in suicidality.

Table 1. Goals for the Suicide: Intervention, Prevention Simulation

Goal	Example
Raise awareness of risk factors	Marked change in behavior or appearance
Model Appropriate intervention & help-seeking behaviors	Caring, empathy, compassion
Inform of resources of help-seeking	Present sources for help and guidance
Model appropriate follow-up behaviors	Follow-up, provide continual support

Cavallo claims that emergent design manages the overall process [5]. Emergent design uses the visual messages from artifacts in the process of systematic analysis. Kitamura, Kakuda, & Tamki also provide supporting claim that emergent design uses "The concepts of evolution, adaptation, learning, and coordination" [6] which are addressed iteratively.

3   Using Artifacts to Inform the Design

In the design and development of simulations in health education the authors use available turnkey systems for animators, content creators, visualization and special effects. Applications can be developed easily which allow 3D motion data, volumetric 3D mesh, and video surface textures for game design team to reduce production time. For game developers, the entire production pipeline is shortened, production-ready animation data is available instantly, and animators can now implement character, graphics, and animated sequences without extensive design and development

Fig. 1. 3D Modeled Character   **Fig. 2.** Street Scene

production. For game designers, instant 3D characters are created in seconds. Game and simulation designers and developers have access to faster, cheaper, and better motion capture for 3D applications.

The process of design incorporates both representation of the artifact being designed and the process or development by which the design is completed [7]. Design can be defined as the intention of making original plans, patterns, and/or schemes towards an aim or goal. For example, Figure 1 shows a 3D character designed using Mixamo. Figure 2 shows a screen capture from Sims 3 and Figure 3 shows the character embedded into the street scene [14]. The character developed in Mixamo is an animated character in a walk-cycle. This animated character can be tweened to move according to the sidewalk path depicted in the street scene.

Fig. 3. Embedded Character/Scene

Although Seels and Richey define design in the context of instructional design; "The planning phase in which specifications are constructed" [8], the same premise can be used for serious game and simulation design. Development can be defined as a stage or phase in the gradual growth, evolution, or advancement towards an aim or goal. Development is "The process of translating the design specifications into physical form" [8]. Design and development are related processes and both have goals and outcomes for the product to be developed.

One of the biggest time-constraints in game and simulation design and development is the design and animation of a 3D character. "Animating an articulated 3D character currently requires manual rigging to specify its internal skeletal structure and to define how the input motion deforms its surface" [9].

Within the emergent design process, the authors engaged in rapid game development as the main context for design and development. The authors explored several game engines and software applications that would allow quick prototyping and development. Mixamo [10] was used for character development and animation. The Sims3 simulation game was used for graphics, backgrounds, and assets (e.g., furniture, home content, etc.)

The development of serious educational games and simulations has proven to be complex, time-consuming and costly [11], [12]. Serious game and simulation designers and developers are continually facing time constraints and demands on delivery of the end product. One of the issues at the forefront is how to reduce development and production time. According to Pagulayan et.al. "There is a great deal of pressure on designers to utilize new technologies which may break old interaction models" [13]. The authors recognize these limitations and have adopted emergent design as the driving factor in the design of the educational simulation titled, Suicide: Prevention, Intervention.

4 Conclusions

The goals for the *Suicide: Prevention, Intervention* simulation are to provide an engaging interactive experience that will educate the learner about suicide prevention. The objectives include: 1) raise awareness of risk factors (e.g., marked change in behavior or appearance, agitated or depressed mood, drug or alcohol abuse, etc.); 2) model appropriate intervention & help-seeking behaviors; 3) inform of resources for help-seeking; and 4) model appropriate follow-up behaviors.

The authors of this article are actively designing and developing a serious simulation titled, *Suicide: Intervention, Prevention.* This work-in-progress is being developed as an educational simulation (serious game) that includes skills, knowledge, and values that allow the learner to interact with virtual characters who demonstrate mental health issues (e.g., suicide or harmful behavior). Learners are able to think, interact, and solve behavioral problems in social situations that demand effective communication, analysis, and response in various health education scenarios. Using four programmed scenarios, the learner will engage in distinct issues regarding suicidal thoughts as portrayed by characters in the simulation. This article focuses on the creative process of emergent design and usability issues affecting the overall production flow of this serious simulation.

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