The Role of Serious Games in an Advanced Nursing Education

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Executive Summary

The use of serious games as a teaching strategy in an advanced nursing education is supported by a growing body of evidence. Research suggests that serious games promote active student participation, meet student learning needs, encourage critical thinking and problem solving, and improve student and patient outcomes. The integration of this type of innovative teaching strategy could ultimately result in the creation of more proficient and confident beginning providers who are capable of delivering optimal patient outcomes.

The purpose of this project was to develop an outline for a serious virtual reality game that could be used to form a bridge between instructor-supervised learning and independent clinical practice in an advanced nurse-midwifery education at the University of Utah. To accomplish this, this project involved the development of a game design document (GDD) that was intended to serve as the framework for the projected development of an innovative serious video game, Virtual Midwife, to be used by future student nurse midwives.

The GDD included one meticulously researched clinical case study (the Premature Rupture of Membranes (PROM) at Term Case Study) that incorporated current clinical practice guidelines, position statements, and University of Utah curriculum into the formation of a set of rules for the management of PROM. Development of the GDD also included:

- Determining game progression and developing an outcome pathway algorithm containing 18 patient presentations and 84 detailed outcome pathways.
- Describing what the game would look like, where it would take place, and the characters in the game.
- Developing 11 interactive menus to allow players to accomplish tasks such as taking a patient history, performing a physical assessment, ordering laboratory and imaging tests, medications, and/or interventions, monitoring mother and baby, and getting patient status updates.
- Evidence-based educational pop-ups to guide and reinforce student learning.
- Making the game fun by adding incentives, awards, and competition.

The development of the game design document and clinical case study for this project was accomplished through individual research and self-education and with the help of two content experts, Jason Faller and Susanna Cohen; project chair, Linda Bergstrom; and other executive committee members, Katherine Ward and Susanna Cohen.

This project was originally proposed after submitting a grant request for funding, and was intended to be the first step in a long-term plan to develop and integrate serious games into the College of Nursing’s graduate school curriculum. Although funding for this project has not yet been realized, this project was continued in the hopes that it will pave the way for future funding opportunities and serve as a preparatory step in helping the University of Utah develop innovative and effective ways of teaching evidence-based critical thinking and problem solving skills to future nurse midwives.

Follow-up projects for future doctor of nursing practice students could include: 1) Exploring and obtaining the funding necessary to get this project developed and implemented. 2) Developing additional curriculum-based case studies. Some suggestions for future case studies include: the diagnosis and management of pre-term labor, pre-eclampsia, postpartum depression, gestational diabetes, and/or spontaneous abortion; contraceptive counseling and management; identification and treatment of sexually transmitted infections; and treatment options for women with amenorrhea and infertility.
The Role of Serious Games in an Advanced Nursing Education

**Problem Statement**

"Gamification" is a new buzzword in the field of education, business, and marketing. Gamification is defined as “the application of game-play mechanics in nongame settings” (Danforth, 2011, p. 84). Gamification is widely used in business to improve marketing, sales, and productivity. It is also starting to make inroads into the area of higher education as an innovative teaching method (de Wit-Zuurendonk & Oei, 2011; Cason et al., 2010; Giddens, 2007; Jenson & Forsyth, 2012; Lynch-Sauer et al., 2011; Mayo, 2007; Merril & Barker, 1996; Primack et al., 2012; Stainton, Johnson, & Borodzič, 2010). Another term, “serious gaming,” was defined in 2005 as “games that are designed to entertain players as they educate, train, or change behavior” (de Wit-Zuurendonk & Oei, 2011, p. 17). Both terms represent similar concepts that may one day play a vital role in the future of health care education.

According to de Wit-Zuurendonk and Oei (2011), “games are already being developed for teaching specific clinical skills, for example in cardiology and orthopaedics” (p. 17). These researchers, who conducted a recent literature review in the area of serious gaming education in the healthcare industry, reported on the probable effectiveness of this type of instruction and hypothesized that serious games could allow instructors to provide clinical experiences for students that they might not be able to get in any other way.

Midwifery education at the doctoral level at the University of Utah College of Nursing occurs primarily through a combination of classroom-based didactic education, teacher-directed skills labs practice, and preceptor-guided in-clinic practicum training. Gamification of case-based clinical scenarios for the education of student nurse midwives (SNMs) has the potential to facilitate learning by providing SNMs the opportunity to practice their case-based clinical skills
in a risk free environment. Additionally, serious games have the potential to form a bridge between didactic and clinical instruction. This type of teaching tool, which is already being used with good efficacy in other departments in other institutes of higher learning, could propel nurse midwifery education at the University of Utah even further into the 21st century and positively impact patient outcomes for years to come.

**Significance**

Playing games has been an important part of the human experience for centuries. According to Blakely, Skirton, Cooper, Allum, and Nelmes (2009), we know, through archaeological discoveries, that the idea of game play dates back to at least 3500 B.C. The game of chess is mentioned in writings as early as 625 B.C. It is hypothesized that chess was developed as an early Chinese war game and, as such, is one of the first known examples of an educational game (Bartfay & Bartfay, 1994). In this context, it was thought that “by playing chess, military personnel could sense the consequences of their decisions without actually risking lives” (Bartfay & Bartfay, 1994, p. 438). Although game playing has persisted for centuries, the type of games that people play, the platform on which they are played, and the purpose that game playing serves has changed over time.

One of the newcomers in the gaming world is the electronic or video game. The first electronic game was created in 1952 and the first video game, *Tennis for Two*, was created six years later in 1958 (Bellis, 2012). Since that time, human interest in this aspect of game play has blossomed. According to a recent Technology Entertainment Design (TED) presentation, “we spend three billion hours a week as a planet playing videogames” (McGonigal, 2011). In the United States (U.S.) alone, 183 million people play computer or videogames at least one hour every day (McGonigal, 2011). The average game player in the U.S. is not a teen-age boy as
some might assume. Instead, the average game player is 30 years old, and 47% of game players are women (Entertainment Software Association (ESA), 2012).

Games have been used as an adjunct method of teaching by nurse educators since the early 1980s (Royse & Newton, 2007). Even though games have sometimes been incorporated into health science curriculum, educational gaming in this area is still in its infancy. This is especially true in the area of video gaming because most studies that involve the use of games in higher education and the health sciences involve the use of board games, paper and pencil activities, or other non-video or non-electronic games. A systematic review by researchers, that investigated the extent to which games facilitate learning, found that students enjoy games and that their use may help participants retain information for longer periods of time (Blakely et al., 2009, p. 259). Royse and Newton (2007) found that when gaming was part of the nursing curriculum, students were more motivated and engaged with learning, retained more information, and were more exposed to problem-based learning. Other researchers have found that students who were exposed to game-based learning had significantly higher posttest scores compared to controls (Cowen & Tesh, 2002). Other researchers also found significant positive differences between experimental and control groups that persisted well into the future (Ingram, Ray, Keane, & Landeen, 1998). Finally, in one study that investigated the attitude of students toward video and online gaming use in simulated health care situations, researchers found that both undergraduate and graduate students support the use of these types of teaching innovations (Lynch-Sauer et al., 2011).

Lynch-Sauer et al. (2011) reported that “one of the most pressing goals of nursing education is to prepare the student to provide safe and high-quality patient care” (p. 513). An overall goal of midwifery education at the University of Utah and at other institutes of higher
learning nationwide is to help students become competent, safe, and independent practitioners. Combining gaming and education makes sense for many reasons. The purpose of this paper is to explore the evidence-based foundation that supports the integration of serious games into an advanced education. Specifically, the author will provide evidence for how the gamification of some of the current case-based nurse midwifery curriculum will help advance the science of pedagogy and the teaching of doctoral nurse midwifery students at the University of Utah.

**Objectives**

1) Develop a game design document (GDD) to serve as a template for the future development of a serious video game, *Virtual Midwife*.

2) As part of that GDD, develop an in-depth case study, the *Premature Rupture of Membranes (PROM) at Term Case Study*, based on up-to-date position statements, practices guidelines, and University of Utah curriculum.

**Review of the Literature**

The purpose of this literature review was to examine and describe any recent evidence that supports the use of serious games in education.

**Evidence in Support of Serious Gaming in Education**

There is a growing body of evidence that supports the use of serious games in higher education. Serious games: 1) promote active learning; 2) meet learning needs; 3) provide an environment that stimulates the ability to learn; 4) encourage critical thinking and problem-solving; 5) allow task repetition and facilitate experimentation; 6) improve student outcomes; and 7) increase patient safety.

**Promote active learning.** Active learning is experiential learning. A statement attributed to Confucius (n.d.) and quoted by Gentry (1990) states: “I hear and I forget. I see and
I remember. I do and I understand.” (p. 9). A less philosophical, but equally valid thought is, “if you do it, you learn it” (Mayo, 2007, p. 33). These ideas encompass the idea of active learning and the thought that this type of learning can add value to the academic experience.

Royse and Newton (2007) reported that, “active learning is the way adults learn best” (p. 264). They also reported that “…adults prefer learning environments that promote active involvement and value gaming as a teaching strategy that demands their participation in solving problems” (Royse & Newton, 2007, p. 264). Adult learners are often motivated and committed learners who want to play an active part in their educations (Royse & Newton, 2007). Game play, as a teaching strategy, is important because researchers have shown that playing games helped maintain interest (Bartfay & Bartfay, 2004; Grimley, Green, Nilsen, Thompson, & Tomes, 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Pannese & Carlesi, 2007; Wrzesien & Raya, 2010), decreased boredom and reduced monotony (Blakely et al., 2009; Grimley et al., 2011; Royse & Newton, 2007), provided motivation (Bartfay & Bartfay, 2004; Blakely et al., 2009; Grimley et al., 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Mayo, 2007; Royse & Newton, 2007; Stainton et al., 2010; Wrzesien & Raya, 2010), led to longer participation times (Mayo, 2007), and increased the overall enjoyment of the learning experience (Bartfay & Bartfay, 2004; Blakely et al., 2009; Cowen & Tesh, 2002; de Wit-Zuurendonk & Oei, 2011; Grimley et al., 2011; Mayo, 2007; Pannese & Carlesi, 2007; Royce & Newton, 2007; Webb, Simpson, Denson, & Duthie, 2012; Wrzesien & Raya, 2010).

**Meet learning needs.** Because no single teaching strategy can meet the needs of all learners, serious games may enhance learning to some degree simply by providing another way for students to learn. Serious games also help meet the needs of adult learners by promoting active, student-centered learning both in and out of the classroom (Bartfay & Bartfay, 1994;
Giddens, 2007; Grimley et al., 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Pannese & Carlesi, 2007; Royse & Newton, 2007; Stainton et al., 2010; Wrzesien & Raya, 2010). Out-of-classroom gaming activities provide a way for students to fit their educational needs with the rest of their scheduled activities because games can be made available at home or in any other venue on the student’s own time. Because of this, serious games can help meet the needs of the growing body of non-traditional and distance learners (Lynch-Sauer et al., 2011).

As a new generation of students enters graduate school nursing programs, it is important to consider their skills and interests. The Millennial generation have been exposed to technology throughout their lives and are comfortable in both the real and virtual worlds. Lynch-Sauer et al. (2011) reported that “using new media and serious games in nursing education fits well with the learning styles of today’s Millennial students” (p. 514). When polled, a majority of students felt that video games and technology could enhance their educational experience and give them valuable simulation experience (Lynch-Sauer et al., 2011). Serious gaming is a teaching method that is embraced and desired by many students, and one in which students spend more time and have more desire to repeat (de Wit-Zuurendonk & Oei, 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Wrzesien & Raya, 2010).

**Provide an environment that stimulates the ability to learn.** Blakely et al. (2009) provided support for the idea that gaming “creates a conductive environment for increased learning and retention of knowledge” (p. 261). One of the advantages of serious games is that they have the potential to provide an environment of learning that provokes less stress and anxiety in the learner (Blakely et al., 2009; Renaud & Wagoner, 2011). One of the reasons for this may simply be that it is a familiar environment (Lynch-Sauer et al., 2011; Mayo, 2007). Most students are comfortable playing video games because they have been playing them since
childhood (Lynch-Sauer et al., 2011). Another possible reason for stress and anxiety reduction with serious games is that “when the teaching/learning process is perceived as fun, stress and anxiety may be reduced” (Royse & Newton, 2007, p. 264). Mayo (2007) points to findings from a 1998 study that provide some measure of explanation for this theory. In this study, researchers found that playing video games changed the chemistry of the brain by increasing the release of the neurohormone dopamine. Mayo (2007) pointed out that dopamine is a necessary precursor to the storage of memories. In this way, “it may be that video games are able to chemically ‘prime’ the brain for learning” (p. 33).

**Encourage critical thinking and problem solving.** Serious games can challenge students’ problem solving abilities and help them gain a greater understanding of the material being taught. Serious games encourage the development of critical thinking skills as students work to solve problems and make decisions. Through case-based learning, the student assumes the role of provider. In this role, they direct all aspects of patient care in real-life scenarios. Through this process, students develop critical problem-solving skills that were previously only acquired through in-clinic experience (Barab, Gresalfi, & Arici, 2009; Cowen & Tesh, 2002; de Wit-Zuurendonk & Oei, 2011; Giddens, 2007; Jenson & Forsyth, 2012; Mayo, 2007; Pannese & Carlesi, 2007; Royce & Newton, 2007).

**Allow task repetition and facilitate experimentation.** Another way gamification enhances learning is by providing the opportunity to re-experience a wide variety of clinical scenarios. When educational content is presented in game format, students may be more likely to experiment with different choices (Pannese & Carlesi, 2007). This type of freedom is something that is not available to the same degree in “real” clinical situations and can offer students the opportunity to experience things they might not otherwise experience in their
It also allows them the opportunity to make choices without judgment or fear of making a serious error (Jenson & Forsyth, 2012; Lynch-Sauer, 2011; Pannese & Carlesi, 2007; Renaud & Wagoner, 2011). Serious games also give students the opportunity for more repetition and practice than they would otherwise be given (de Wit-Zuurendonk & Oei, 2011; Giannotti et al., 2013; Jenson & Forsyth, 2012; Pannese & Carlesi, 2007). This, in turn, may not only increase their clinical knowledge and expertise, but may also boost their confidence in their own ability to succeed (de Wit-Zuurendonk & Oei, 2011; Jenson & Forsyth, 2012; Pannese & Carlesi, 2007).

**Improve student outcomes.** Improvement in student outcomes is arguably one of the most important considerations for the inclusion of serious games into an existing nursing curriculum. Even though research in the area of gaming and education is relatively new (and research that includes the use of video games is even more rare), there are a number of studies available that address this topic and give some good insight into the efficacy of gamification in improving student outcomes.

There is support for the idea that the use of serious games enhanced the acquisition of knowledge (in both accuracy and breadth) in statistically significant and educationally important ways in students at all academic levels (Bartfay & Bartfay, 1994; Blakely et al., 2009; Cowan & Tesh, 2002; Giannotti et al., 2013; Grimley et al., 2011; Guillen-Nieto & Aleson-Carbonell, 2012; Ingram et al., 1998; Mayo, 2007; Neef, Perrin, Haberlin, & Rodrigues, 2011; Primack et al., 2012; Royse & Newton, 2007; Webb et al., 2012; Wrzesien & Raya, 2010). In most research, significance was determined by the comparison of pre-test and post-test scores between the intervention (gaming) and control (non-gaming) groups. Interestingly, Mayo (2007) reported an even more significant difference following the use of a gaming intervention in girls’
achievement when compared to boys’ achievement. In two studies, the post-intervention difference between groups was significant enough to increase students’ scores by one grade level, raising scores from B’s in the control groups to A’s in the experimental groups (Cowen & Tesh, 2002; Mayo, 2007). Additionally, there is some evidence that underachieving students may benefit even more from this type of teaching (Mayo, 2007). Mayo (2007) reported that “underachieving students increased their test scores by as many as three grade levels by playing the game” (p. 34). It should be noted, however, that this effect is somewhat dependent on the type of gaming intervention (Blakely et al., 2009) and that this review included research involving all kinds of games (electronic and non-electronic) and all ages of students (grade school through adulthood) and may not be entirely generalizable to graduate nursing students.

An even more consistent benefit resulting from the use of serious games for educational purposes comes in the long-term retention of knowledge (Blakely et al., 2009; Ingram et al., 1998). When pre- and post-test scores were not found to differ in statistically significant ways, some researchers still found measurable and potentially important differences in students’ ability to retain material for longer amounts of time (Mitchell, 2010), in increased interest and desirability of the intervention (Royse & Newton, 2007), and in an increased depth and complexity of knowledge demonstrated by students in the intervention groups (Mayo, 2007).

**Increase patient safety.** Another important idea, supported by recent research, is the finding that serious games provide an effective way to learn clinical skills like decision-making, patient interaction, and other specific proficiencies (de Wit-Zuurendonk & Oei, 2011; Giannotti et al., 2013). The notion of added clinical skills practice has implications for improved patient safety. Merril and Baker (1996) reported that “doctors, nurses, and allied healthcare providers doing their first few to several dozen cases are much more likely to more errors” (p. 183).
Adequate practice in real-life situations could help ensure that fewer errors happen to “real” patients (Draycott et al., 2008; Jenson & Forsyth, 2012; Lynch-Sauer, 2011). It could also help new practitioners enter the workforce better trained and less error prone.

**Concluding Thoughts**

Those responsible for providing an advanced nursing education for today’s generation of learners have the responsibility to use a variety of teaching methods to ensure optimal learning outcomes for their students. In today’s technology-driven world, this can mean that universities, like the College of Nursing at the University of Utah, should incorporate serious games into their curriculum.

Serious games are an efficient and effective way to enhance learning outside the classroom and can be made available on demand for the convenience of the student. Serious games also have the potential to influence outcomes beyond the classroom as students gain greater clinical proficiency before entering practice. Serious games are not intended to replace current didactic and clinic learning, but could be used as an important adjunct teaching method that educators at the University of Utah, and other institutions, should consider incorporating into their graduate level nursing curriculums.

**Implementation**

1) Learned about the proper development of a GDD through individual research and through collaboration with a content expert. Completed the development of a GDD with in-depth appendix for *Virtual Midwife* that can now serve as a template for the future development of a serious video game. This document and appendix were too lengthy to include with this paper and are available from the author on request. A sample of game play has been included in this paper (see Appendix A).
2) Researched current practice guidelines, position statements, and University of Utah curriculum to provide an evidence base for a clinical case study. Developed an in-depth case study *(The Premature Rupture of Membranes (PROM) at Term Case Study)* that was included in the GDD.

**Evaluation Plan**

1. After development, the GDD for *Virtual Midwife* was submitted for review and evaluation to a content expert/game developer. This content expert’s suggestions for improvement were incorporated into the final GDD, which received overall content expert approval.

2. After development, the *PROM at Term Case Study* document was submitted for review and evaluation to a content expert who is also a University of Utah College of Nursing faculty member for the Nurse-Midwifery and Women's Health Nurse Practitioner Program. This content expert’s suggestions for improvement were incorporated into the final case study, which received overall content expert approval.

3. Both documents were presented in a doctor of nursing practice (DNP) defense poster session. A copy of this poster is included in the appendix (see Appendix B).

4. Additionally, the GDD was submitted to faculty at the University of Utah’s College of Nursing.
References


Appendix A

Example of Game Play

The student nurse midwife (SNM) player begins the game by selecting the *Premature Rupture of Membranes (PROM) at Term Case Study*. As she enters the game, the SNM (now acting in the role of certified nurse midwife (CNM)) finds herself standing in the hall outside an examination room in OB triage. (Note: SNM, CNM, and player are all used interchangeably from this point on.) A registered nurse (RN) is standing beside her. The player is immediately given a verbal report by the nurse. This report includes the patient’s chief complaint and a brief patient history. The CNM is asked (via talk bubble on the screen): “What are your differential diagnoses?” At this point, a list of possible differential diagnoses will appear. Once the player has chosen her list of differential diagnoses, her character automatically knocks on the exam room door and enters the OB triage room. In the room, the patient is sitting on the bed. The patient’s partner is seated in a chair at the bedside. The CNM is asked: “What would you like to do first?”

The player chooses her actions by clicking on one or more of the available menus. In this part of the scenario, the player must take steps to arrive at a diagnosis and formulate a plan of care. To do that, she should take a thorough patient history, look at the patient’s prenatal records, and do a physical examination. She may also decide to initiate maternal and/or fetal monitoring and may order laboratory testing or imaging. When she is confident that she has gathered enough information, she makes a diagnosis by choosing from the available selections.

After the player has made the correct diagnosis, play continues as the CNM is asked, “Which initial management option would you like to choose?” In the *PROM at Term Case Study*, there are two initial management options: expectant management and active management. Once
the player has chosen a management option, she is directed to one of 84 possible PROM management outcome pathways. Each of these outcome pathways provides players the opportunity to manage a different PROM patient presentation and/or to choose different personal management options.

As the game progresses, the patient moves closer to delivery. As she does so, both her and her baby’s conditions change in response to: 1) pre-established game rules for the management of PROM; 2) pre-determined conditions established within the specific outcome pathway in play; and 3) the player’s management choices. Additionally, as the player performs patient assessments and physical examinations and follows through on a plan of care, she will be presented with evidence-based education that can guide and reinforce (or refute) her chosen management plan. Throughout the game, the health of the mother and baby are on constant display, and the player earns a final score based on the patient status during the game and the overall outcome of the game (in this case achieving a successful spontaneous vaginal birth after either avoiding or treating chorioamnionitis). Play concludes with the birth of a baby, either by normal spontaneous vaginal birth or via cesarean section delivery.
Appendix B

DNP Poster

The Role of Serious Games in an Advanced Nursing Education

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PURPOSE (WHY BE SATISFIED WITH #7?)

“What we have to learn to do, we learn by doing.” (Aristotle)

To investigate the potential role that serious games play in forming a bridge between instructor-supervised learning and independent clinical practice in an advanced nurse midwifery education.

EVIDENCE IN SUPPORT OF SERIOUS GAMING

“I hear and I forgot. I see and I remember. I do and I understand.” (Confucius)

Serious games:
1. Promote active learning
   - Provide less stress and anxiety
   - Change brain chemistry and prime the brain for learning
2. Help meet learning needs
   - Fill educational needs of adult, distance, and Millennial learners
3. Encourage critical thinking and problem solving
4. Improve student outcomes
   - Test scores are higher
   - Understanding of material is deeper and more complex
   - Information is retained longer
5. Improve patient safety
   - First mistakes can occur in a safe, simulated environment

VIRTUAL MIDWIFE: PROM AT TERM CASE STUDY

“We are what we repeatedly do. Excellence, then, is not an act, but a habit.” (Aristotle)

Virtual Midwife is a PC-based, single-player, serious game that places the student nurse midwife (SNM) into a simulated clinical environment in which she assumes the role of an independent certified nurse midwife (CNM).

GAMEPLAY

“In every job that must be done there is an element of fun.
You find the fun and bring the job to a game.” (Molly Pappas)

In this serious game, the SNM player will do the following:
- Be exposed to a broad range of clinical situations
- Act independently in a safe, simulated environment
- Explore management options
- Understand evidence-based practices regarding her management plan
- See how her management affects patient outcomes
- React to changing clinical and patient circumstances
- Prevent infection and other adverse events, when possible, and treat them, if they occur
- Prevent fetal compromise, when possible, and treat it, if it occurs