Serious games for healthcare

Antoine TESNIERE
iLumens simulation department
Paris, France
Disclosure

- Industrials
  - None

- Institutionals
  - Associate professor of medicine
  - Scientific director iLumens
  - French Simulation society vice president
  - SESAM Secretary
  - FDV PhD Program Director
  - Healthcare authorities advisor
Training with a goal
Aspects of training in healthcare

- Medical and technical activities
- Fast changes and renewal of knowledge
- Teamwork activities
- Risks management
MILLER'S PRISM OF CLINICAL COMPETENCE (aka Miller's Pyramid)

it is only in the "does" triangle that the doctor truly performs

Based on work by Miller GE, The Assessment of Clinical Skills/Competence/Performance; Acad. Med. 1990; 65(9): 63-67
Adapted by Drs. R. Melha & R. Burns, UK (Jan 2009)
High access to knowledge and information
- Virtual universities
- MOOC
- Wiki etc.

Importance of complex cognitive levels
- Use and interface of knowledge

Skills

Behaviors
The trainer generation

- No computer
- No internet
- No TV
- No DVD
- No Mp3 of -4 speler
- No cellphone
- Few distraction
Matching tools and learners... The Y generation

Generation ‘X’ = most of you; formal education = the Trainer

Generation ‘Y’ = younger students = the Trainee

- rapid communication,
- peer orientation,
- instant gratification,
- stimulating working environment
- tech-savvy, ‘open’
By the time they are 21 years:

- 10,000 hrs of videogaming
- 20,000 hrs email – chat – blog
- 20,000 hrs watching TV
- 10,000 hrs mobile phone use
- Less than 5,000 hrs of reading

What do they need to be able to learn?

- Fast, high paced, stimulating environment
- Interactivity with content and fellow students/social network
- Information linked to interests
- Choice / options for gathering knowledge

Susan El-Shamy. Training for the new and emerging generations.
The generation gap
Four Generations: From 1946 to Present

1. The Baby Boom Generation
   January 1946 to December 1964—19 years, producing 77.2 million children or 23 percent of the U.S. population.

2. Generation X
   January 1965 to December 1976—12 years, producing 44.9 million children or 15 percent of the U.S. population. Also called the Baby Bust.

3. The Net Generation
   January 1977 to December 1997—21 years, producing approximately 81.1 million children or 27 percent of the U.S. population. Also called the Millennials or Generation Y.

4. Generation Next
   January 1998 to present—10 years, producing 40.1 million children or 13.4 percent of the U.S. population. Also called Generation Z.
Important factors that will increase learning

- Motivation
  - Engagement, active involvement
- Recall of situations / Experiential learning
- Self assessment
- Consequences of failures
- Independence in learning
  - Active form of learning
  - Use of experience

- Experiential learning / Matching experience
  - Learning through objectives
  - Aiming to complete a task or a skill

- Problem based learning more than content based learning

- Relevance of contextual learning and real situations
The gamer population

- “Gamers are fat, lazy, and afraid of sunlight"
The gamer population
What is a serious game?

“[any] computerized game whose chief mission is not entertainment, [including] entertainment games which can be reapplied to a different mission other than entertainment”

Ben Sawyer, 2004

First Serious Games Summit / yearly Game Developers Conference USA
The purpose of all video games is to train a player to work harder while still enjoying it....

And the success of online games demonstrates how seductive and concealed the work treadmill can be

Nick Yee
Software

Combination

- Serious aspects: learning content, training, communication etc.
- Game aspects: Video games derived techniques

Useful scenario + game scenario
- **Serious scenario: Learning content**
  - Defined objectives
  - Own working rules

- **Video game scenario: Learning vector**
  - Virtual environments
  - Interactive gamification
Differences between video games and serious games

- Difference on the purpose
  - Trauma Center / Pulse!!
  - Prehospital / Staying Alive

- « hidden » learning
  - language
  - Protocols, etc.

- Change in the purpose of the game / hacking
Training with virtual environments
Training with virtual environments
Game based learning
Creating virtual learning environments

- Learning content
- Virtual environments
- Integration and Gamification
Defining learning content

- Needs assessments
  - Training
  - Audience
  - platform

- Definition of the objectives

- Definition of the learning process

- Definition of the environment
Virtual environments
Serious Games
...et vous poussiez fort et longtemps sur l'expire en bas, là où la tête de votre bébé vous génère.
Gamification

- Guitar Hero
- 3D Free Look around
Working in a stressful environment: Flow Theory of Gamers’ Optimal Experience

The following image is taken from [www.ebl.org/flow_original.gif](http://www.ebl.org/flow_original.gif).
Gamification

- Leveling up
- Unlocking content
- Hall of fame, leaderboards
- Collaborative models
- Multi user games
The power of gaming

- Skills acquisition
  - Vision
  - Multi tasking
  - Spatial recognition
  - Focus
The power of gaming

- Behaviors
The power of gaming
- Actions and decisions tracking
- Learning by errors
- Automated tracking and analysis
- Clinical reference comparison
- **Higher Engagement** achievements, rewards and instant visual feedback

- **Immersive Experiences** high fidelity environments greater connect with the content, something

- **Self-Paced Learning**

- **Assessment** Progress and learning can be tracked and recorded through various assessment modules.

- **Exercises in Collaboration** Multi-user serious games are meant for collaborative (p2p) and Instructor led Training/Learning.
Scientific validation

- Learning
- Transfer
- Impact
Meta analysis of serious games publication

<table>
<thead>
<tr>
<th>Serious game</th>
<th>Game type</th>
<th>Platform</th>
<th>Purpose</th>
<th>Multiplayer</th>
<th>Target groups</th>
<th>Implemented in clinical practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute and critical care</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Team training in acute and critical care</td>
<td>Yes</td>
<td>Physicians, nurses</td>
<td>No</td>
</tr>
<tr>
<td>ClinSpace®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Team training in acute and critical care</td>
<td>Yes</td>
<td>Physicians, nurses</td>
<td>No</td>
</tr>
<tr>
<td>HumanSim®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Platform for scenario-based education, e.g., team training in acute care, critical care</td>
<td>Yes</td>
<td>Physicians, nurses, emergency medical personnel, students</td>
<td>No</td>
</tr>
<tr>
<td>Pulse®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Acute care and critical care</td>
<td>Yes</td>
<td>Physicians</td>
<td>No</td>
</tr>
<tr>
<td>Virtual ED®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Team training in acute and critical care</td>
<td>Yes</td>
<td>Physicians</td>
<td>No</td>
</tr>
<tr>
<td>Virtual ED®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Team training in acute care, triage in mass casualty events involving hazardous materials</td>
<td>Yes</td>
<td>Emergency, emergency physicians and nurses</td>
<td>No</td>
</tr>
<tr>
<td>Virtual operating room</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training operation steps for off-pump coronary artery bypass surgery</td>
<td>Yes</td>
<td>Surgical trainees</td>
<td>No</td>
</tr>
<tr>
<td>Off-pump Coronary Artery Bypass surgery game®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training operation steps for off-pump coronary artery bypass surgery</td>
<td>Yes</td>
<td>Surgical trainees</td>
<td>No</td>
</tr>
<tr>
<td>Total Knee Arthroplasty game®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training operation steps for total knee arthroplasty</td>
<td>Yes</td>
<td>Surgical trainees</td>
<td>No</td>
</tr>
<tr>
<td>Triage®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training operation steps for total knee arthroplasty</td>
<td>Yes</td>
<td>Surgical trainees</td>
<td>No</td>
</tr>
<tr>
<td>Code Orange®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training and organization in mass casualty incidents</td>
<td>Yes</td>
<td>Physicians</td>
<td>No</td>
</tr>
<tr>
<td>Nuclear Event Triage Challenge®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training in nuclear events</td>
<td>Yes</td>
<td>First responders</td>
<td>No</td>
</tr>
<tr>
<td>Pentacle City®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training in mass casualty events, hazardous materials</td>
<td>Yes</td>
<td>First responders</td>
<td>No</td>
</tr>
<tr>
<td>Triage Trainer®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training in mass casualty incidents</td>
<td>Yes</td>
<td>First responders</td>
<td>No</td>
</tr>
<tr>
<td>Other purpose</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training and evaluation of burned patients</td>
<td>No</td>
<td>Physicians, nurses students</td>
<td>No</td>
</tr>
<tr>
<td>Burn Center®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training and evaluation of burned patients</td>
<td>No</td>
<td>Multimodal training course</td>
<td>No</td>
</tr>
<tr>
<td>OLIVE cardiopulmonary resuscitation training®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Training basic life support</td>
<td>No</td>
<td>Medical personnel (not specified)</td>
<td>No</td>
</tr>
<tr>
<td>Project Touch®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Platform for scenario-based education, e.g., team training in acute care, critical care</td>
<td>Yes</td>
<td>Physicians, nurses, students</td>
<td>No</td>
</tr>
<tr>
<td>Radiation Hazards Assessment Challenge®</td>
<td>Game-based simulation</td>
<td>Computer</td>
<td>Assessment of radiation hazard after nuclear event</td>
<td>No</td>
<td>Physicians, nurses, emergency medical personnel</td>
<td>No</td>
</tr>
</tbody>
</table>
30 Serious games reflected in literature

- Acute care, including resuscitation of trauma patients and intensive care
- Triage in disaster situations
- Virtual operating room
- Other activities (CPR, burn care, radiation)
- Commercial games used to train eye hand coordination
# Validity

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content validity</strong></td>
</tr>
<tr>
<td>The degree to which game content adequately covers the dimensions of the</td>
</tr>
<tr>
<td>medical construct it aims to educate (or is associated with)</td>
</tr>
<tr>
<td><strong>Face validity</strong></td>
</tr>
<tr>
<td>Degree of resemblance between medical constructs featured in game play and</td>
</tr>
<tr>
<td>in reality, as assessed by novices (trainees) and experts (referents)</td>
</tr>
<tr>
<td><strong>Construct validity</strong></td>
</tr>
<tr>
<td>Inherent difference in outcome of experts and novices on game play outcome</td>
</tr>
<tr>
<td>parameters</td>
</tr>
<tr>
<td><strong>Concurrent validity</strong></td>
</tr>
<tr>
<td>Concordance of study results using a concept instrument (e.g. game) and</td>
</tr>
<tr>
<td>study results on an established instrument or method, believed to measure</td>
</tr>
<tr>
<td>the same medical theoretical construct</td>
</tr>
<tr>
<td><strong>Predictive validity</strong></td>
</tr>
<tr>
<td>The degree of concordance of a concept instrument (e.g. game) outcome and</td>
</tr>
<tr>
<td>task performance in reality, based on a validated scoring system</td>
</tr>
</tbody>
</table>
Interfaces: Today

- Mobility
  - Ipads, smartphones etc.

- Multi user
  - Collaboration locale ou à distance

- Haptic interfaces

- Evaluation
  - Standards to define
Interfaces: Tomorrow

- Immersive environments
- Interaction tools
- Control interfaces
- User friendly design programs
Open questions

- Interfaces
- Costs
- Availability and dissemination
- Debriefing and learning
- Evaluation
Perspectives

- Virtual environment is The future of simulation

- Serious games is not just about fun

- Part of the blended learning

- Still challenges to overcome and open questions to address
Use the power of games!