The Way Ahead in Game-Based Learning

Jan Cannon-Bowers, Ph.D.

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**Report Documentation Page**

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*Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39-18*
Overview

- Background
- A Case for Game-Based Learning
  - Science of Learning
- Developing Game-Based Learning
- Challenges & Issues
- Example
- The Way Ahead
Background

- Popularity of Video Games
  - > $10 Billion Industry yearly
  - Top game budgets exceed $50 Million
    - GTA IV is estimated at $100 Million
  - Maple Story has > 50 Million registered players!
  - Second Life has > 3 million residents

- Demographics
  - “Digital Natives”
Background

BUT, serious games are:

- Mostly Hype…NOT science
- Lack of guidelines

Opportunity to exploit technology is tremendous!
Background

- Definitions:
  - Game
  - Serious game
  - Simulation vs Virtual World vs Game

- Elemental
  - Hidden Agenda Games

- The Binary Game
  - Cisco

- Darfur is Dying
  - MTV-U

- Fatworld
  - Persuasive Games
Background

Games

Simulations

Learning Games

Pedagogy
A Case for Game-Based Learning

From the Science of Learning:

- Anchored Instruction/experiential learning
  - Situated learning
- Meaningfulness of material
- Authenticity/Fidelity
A Case for Game-Based Learning

From the Science of Learning:

- Compelling narrative
- Story
A Case for Game-Based Learning

*From the Science of Learning:*

- Active Participation
- Learner Control
A Case for Game-Based Learning

From the Science of Learning:

- Model-based Reasoning
- Metacognition
- Self-Regulation
A Case for Game-Based Learning

From the Science of Learning:

- Self-efficacy
- Goal Setting
- Intrinsic Motivation
A Case for Game-Based Learning

From the Science of Learning:

- Continuous Assessment
- Frequent Feedback
- Reward
A Case for Game-Based Learning

*From the Science of Learning:*

- Immersion/Engagement
- Emotional Context
- Embodiment
- Personalization
A Case for Game-Based Learning

From the Science of Learning:

- Collaborative Learning
- Social Status
- Vicarious Learning
- Coaching/Mentoring
Why games should teach...

- Players learn in context by interacting with objects in a complex world.

- Consistent with anchored, experiential learning, learners can make connections among concepts.
  - Players build sound mental models of a domain.

- Games are excellent model-based environments to foster complex reasoning.
  - Students observe system behavior over time; draw and test hypotheses.

- Games provide the players with constant challenge—many parallel achievements feed into an overriding goal.

- Goals are concrete and immediate.
Why games *should* teach...

- Players negotiate successive, proximal goals—result is a feeling of **constant accomplishment**.
  - Likely to have a positive effect on **self-efficacy**.

- Games provide a **continuous source of assessment and feedback** so that players know where they stand with respect to their goal accomplishment.

- Game play is **self-regulating**.

- Players are **intrinsically motivated** to accomplish the next challenge and will readily acquire new knowledge as required to do it.
  - Moreover, mechanisms to track and plan **successive achievement** are often used (e.g., skill trees).
Why games *should* teach…

- Gaming is fundamentally a **social phenomenon**
  - It often results in distributed social groups that foster **collaborative learning** and resemble communities of practice.

- The **embodiment of the student** in the story enhances the players’ sense of connection to the game
  - This enhances engagement.
  - **Personalization** of a player’s avatar may do so as well.

- A player’s accomplishments can easily be made public in a game format.
  - Such **public rewards** and recognition provide a **sense of competence, challenge and motivation** to achieve more.
Driving Question

So, how should we build games that teach?
Incorporating the Science of Learning

- Include Domain/Subject Matter Experts on the team
- Include Learning experts on the team
- Make a **deliberate** attempt to incorporate sound learning principles:
  - Provide compelling narrative to enhance motivation
  - Provide compelling visuals to increase immersion
  - Embed learning into a meaningful context
  - Provide continuous feedback
  - Make goal accomplishment salient to foster metacognition, self regulation
  - Include public recognition and reward to enhance motivation
  - Incorporate collaborative learning

*Exploit game features so that they teach!!*
Challenges & Issues

- User Acceptance
- "Coolness"
- Cost
- Ease of Modification & Reuse
Challenges & Issues

User Acceptance:

- Sometimes using the term “game” is off-putting
- Collect empirical evidence of effectiveness
- Attempt to estimate ROI
- Work closely with targeted users
- Iterate based on user feedback
- Create adjuncts to traditional methods
Challenges & Issues

Ensuring “Coolness”:

- Hire designers/developers who understand what makes games compelling
  - Hire “cool” people
- Involve users in all phases of design

IS IT FUN!??
Challenges & Issues

Containing Costs:

- Use low cost game engines
- Employ students for programming & graphics
  - Internships
- Consider “modding” an existing game
- Re-use content
  - Best done at asset level
Challenges & Issues

Enhancing Ease of Modification:

- Develop scenario generation tools
- Use game engines that allow easy mods
- Develop/adhere to standards (SCORM-like)
- Embed content into “mini games”
  - Lunar Quest Example
Example: Lunar Quest

- Funded by NSF
- Targeted at college-freshmen level Physics
- Adjunct to classroom
- Alternate Timeline: Retro 50s
Addressing the Challenges

Modification:

- Hybrid Approach
  - 3-D Massively Multiplayer On-line Game
  - 2D Flash-based Mini Games

- Learning content in “light weight” mini games
  - Cheap to create
  - Easy to modify
  - Enhances reuse of assets, scalability

- Modular Content
  - Scalable to multiple domains (e.g., chemistry, geology, social sciences) inside the same virtual world
Addressing the Challenges

Cost:

- Selection of Multiverse Engine ([www.multiverse.net](http://www.multiverse.net))
  - Profit share model (e.g., we don’t pay)
- Hybrid MMO/minigame approach
  - Learning content embedded in light weight minigames
  - Minimizes degree of advanced coding in favor of Flash-based content
  - Can be done (well) by undergrads
- Use of off-the-shelf and student-created art assets
The Way Ahead

Research Issues:

- Enhanced assessment routines
  - Automated tracking
  - Dynamic assessment of performance
- Intelligent Tutoring
  - Draw inferences about mastery
  - Automatic feedback/remediation
- Establish a Science of Game-Based Learning
  - Which features are most important?
  - What provides the biggest bang for the buck?
The Way Ahead

- Game-based technologies hold great promise as teaching tools
- More empirical research is needed
- Mechanisms to share results are needed
- Better business models are sorely needed
  - Need to make compelling business case
  - May help encourage funding
- Ultimately, scientific studies must be translated into useful design guidance

Let the (Serious) Games Begin…