Goals for Discussion

- Explore what’s learned in existing educational games
  - Be prepared to search on the web for answers to some questions
  - Play some short games
- Learn a method to design assessments for your games
  - Be prepared to think about, share, and build upon your game designs

Who We Are

- Provide capabilities to
  - Collect in-game data
  - Analyze and mine data
  - Adapt games in real-time
- Our goal is to use these capabilities to enhance educational games
- My background:
  - Cognitive science, educational technology, computer science
  - Development Scientist at Educational Testing Service

Selected Partnerships

- G4LI
  - Focus on content knowledge & self-regulation
- Army
  - America’s Army 2.0 and AA3
  - Virtual Army Experience
- Kinection – adaptive training environments
  - Office of Naval Research – language learning
  - Additional proposals pending on Cultural Training
- Educational Testing Service
  - Social networking around math games
- Harvard
  - Visual data mining

What is learned in existing educational games?
Classroom Use of Games

**Good:** Students seem to be learning
**But:** Not sure how the environment contributes to learning

Learning Environments as Assessment

**Good:** The assessments are engaging
**But:** Not integrated into a learning environment

Virtual Environments

**Good:** Linked to curriculum
**But:** Not sure how the environment contributes to learning

The Interesting Cases

- Learning Environments
- Puzzle and Drill Games

Learning/Curricular Environments

- Quest Atlantis
  - [http://atlantis.crlt.indiana.edu/site/view/Researchers](http://atlantis.crlt.indiana.edu/site/view/Researchers)
- River City
  - [http://muve.gse.harvard.edu/rivercityproject/index.html](http://muve.gse.harvard.edu/rivercityproject/index.html)

**What is the educational goal?**
**What is done with the results?**
**What do players learn?**
**How do we know?**
**Could the game be designed differently to gauge learning better (or at all)?**

Puzzle/Drill Games

- Fun Brain
- Nobel Prize Games
  - [http://nobelprize.org/educational_games/](http://nobelprize.org/educational_games/)

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Embedded Assessment

Embedded Assessment: Measuring knowledge and ability as part of a learning activity

What are the goals of embedded assessment?

- Assess process and infer behavior, not just knowledge
- Develop a dynamic profile of a user’s performance
- Guide individualized content and activity sequencing

“If you are testing outside of the game, you better have a good reason for doing it… The very act of completing a game should serve as an assessment of whatever the intervention was designed to teach or measure…”
— Jim Gee, AERA, April 15, 2009

Q: What can be measured through embedded assessment?

- Knowledge
  - Math facts
  - History knowledge
  - Foreign language directions
- Easy
  - But still needs to be embedded and use game mechanics.
Procedures
- Solving math problems, paths taken before making hypotheses, racing a car, constructing a bridge, hitting a target

A little harder:
- Can easily look at the outcome, but can’t say for sure how good or efficient the process was, or even if it’s the process that was taught.
- Naturally embedded.

21st Century Skills
- Teamwork, leadership, strategic thinking

Very hard
- No right answers to guide the analysis
- Naturally embedded

Q: How do you know what data to collect? How do you design embedded assessments?

Evidence-Centered Design
- What do we want to do with the results of the gameplay/assessment?
- What claims do we want to make about the users after gameplay?
- What observations of learner actions would provide evidence for the claims?
- These steps offer efficiency of design and the making of a validity argument

Your Games: Goals
- What are the educational goals of the game?
- What will you do with the game’s outcome?
  - e.g., report it to learner, adapt game, suggest another game, feedback, move to next level
- Record your answers

Your Games: Claims
- What would you like to say about the learners after they complete the game, or a level in the game?
- For example:
  - Mastered the content (what comprises mastery?)
  - Got more efficient at a procedure
  - Played well with others
- Does it agree with the educational goal?
Your Games: Evidence

• What kinds of evidence would display the learning (claims) you would like to see?
  – Single data point of doing something correctly?
  – A pattern of actions?
  – Post-game writing?
• Do you need to modify your claims?

Your Games: Activities

• Get creative – what kinds of activities would allow a learner to display the kinds of evidence you identified?
  – Don’t limit yourself to what you think the technology can do.
  – Assume the technology can be created.
• Do you need to rethink the identified evidence?

Assessment Challenges

• How do you know that users are learning what you claim they are learning?
• How do you know you are measuring what you think you are measuring?
• How do you mine data to discover behavior, beyond knowledge and procedures?
• How do you deal with the long tail of learners?

Summary

• ECD is a good approach to start with and continually revisit
  – What to do with the outcomes of the game
  – The educational goals of the game
  – How to define and identify evidence of learning and behavior
  – The design of the activities that will provide the evidence

Analytics

Leverage Analysis:

• Rule-based statistical summarization
• Statistics, including correlation, regression and factor analysis
• Model demographic attributes in terms of in-game behaviors
• Visual data mining
• Inference
Inference

Leverage Inflection

- Makes inferences based on in-game behavior
- Uses genetic algorithms to form solutions to classification problems and make predictions
- Is this person a team player?
- Are different problem-solving approaches evident?
- Which side is probably going to win?
- Is the player a strong visual-spatial thinker?
- End result: intelligent inferences about a person based on in-game behavior

Case Studies:

River City
- Predicted gender based on game play with 75% accuracy
- Found 90% prediction of early hypothesis forming, based on teacher expectations
- Found some indication of free-reduced lunch participation
- Army Game VAE
- Found 70% indicator of military interest as reported by VAE, based on behavior within the Army Game

Assessment

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