Foldit, Refraction, and Changing the Game of Education

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Center for Game Science

- Newly formed at UW
- Using video games to solve hard problems
- Combine science + game design
Center for Game Science

Team
- graduate students, undergraduate students, developers, and artists (~30 people)

Working with:
- world class game designers (ex-Bungie), learning scientists (John Bransford), biochemists (David Baker)
The Challenge:

- hard to make an entertaining game
- even harder to do this and solve a problem
  - constraints on game design
  - do real biochemistry, really learn something
- cannot separate the two objectives
Foldit
Education

- Foldit BETA: Solve Puzzles for Science
  - Kuhlman Class Puzzle 1
    - Status: Closed
    - Summary:
      - Name: Kuhlman Class Puzzle 1
      - Status: Closed
      - Created: 03/11/2009
      - Difficulty: Intermediate
      - Description: This is a homology model for Kuhlman's class, though all others are welcome to play. The puzzle will be scored as usual.
    - Top Groups:
      | RANK GROUP                  | SCORE | POINTS |
      |------------------------------|-------|--------|
      | 1 Void Crushers              | 11,526| 100    |
      | 2 Another Hour Another Point | 11,515| 87     |
      | 3 Oma Gawd                   | 11,430| 75     |
      | 4 Richard Dawkins Foundation | 11,282| 64     |

- Introductory Biophysics: Perspectives on the Living State
  - By James Claycomb • Jonathan Tran
Find the Core Problem

- problem solving is fun
- let players know what they are working on
- abstract away details
  - but give access
Find the Core Problem
Iterate and Experiment

- not going to get it right first time
- performed design as an experiment
- game evolves as players do
Iterate and Experiment
Iterate and Experiment

![Graph showing level completion percentage over time for various levels like One Small Clash, Swing It Around, Hide the Hydrophobic, and others. The graph includes a linear trend line labeled as Linear trend (R.B.R. only).]
Develop Community Expertise

- from knowing nothing to being an expert
- engaged an involved for an extended period of time
- support community, collaboration, competition, social elements
  - chat, forums; leaderboard; groups
Develop Community Expertise
Develop Community Expertise
Evaluation

- Foldit players can solve problems
- Even when computers can’t
Solving Hard Problems with Human-Computer Symbiosis

Coadaptation:
1. People → Experts
2. Programs/Games → Optimal problem tools

Games are an ideal vehicle of coadaptation
Transforming Educational Research: Optimal Learning Pathways to Expertise
Target Young Kids

Time in School

Population

Professionals in math and science

Middle School

Elementary School

Kids interested in math and science
“Difficulty with fractions… is pervasive and is a major obstacle to further progress in mathematics.”

Approaches to Teaching Fractions

$$\frac{1}{4} = 0.25$$

Educators argue about which is the best
Crisis in Evidence

- Many fields drowning in data
- Education research – opposite problem

- No rigorous studies
  - To inform instructional practice
  - To understand learning process
To make an effective fractions game

Need to find:

optimal pathways
student-specific adaptations
Games for Learning
Games for Massive Data-gathering to Optimize Learning Pathways
In-game assessment and refinement
Students

- Online game world
- Accessible to any child with a web browser
- K12 Virtual Academies
- Public school Systems
  - Washington
  - Texas
Refraction
Refraction

Disney Learning Challenge
Grand Prize
Answer Interesting Questions

- What pathways do kids take to learn?
- What is the partial ordering of concepts that must follow one another?
- How do we modify the game for a specific subset of students?
- What's the best thing to do at specific point of confusion?
- What's the best level to present at any point?
Visual Analysis

How can we see patterns in the massive high-dimensional data from gameplay?

Developing visual data analytics tools for all educators and learning scientists
“Playtraces”
“Playtraces”

Start

Goal
“Playtraces”
“Playtraces”

- **Goal**
- **Start**
- **Confusion?**

Distance to goal
Textbooks -> Games
Textbooks -> Games
Parent + Teacher Portal

Student’s Progress

- Understand 1/b as a whole partitioned into b parts
- Represent a fraction 1/b on a number line
- Represent a fraction a/b on a number line
- Recognize and generate simple equivalent fractions
- Express whole numbers as fractions
- Compare two fractions with the same numerator or the same denominator
- Understand why a/b is equivalent to (n*a) / (n*b)

Game Focus

Back to Title
Fun and engaging games
Massive data gathering
Continually adapting
Optimal pathways for novices -> experts
http://fold.it

http://www.kongregate.com/games/gamescience/refraction

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