Educational Games and Data
Hands On

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PROFESSOR/DIRECTOR
MIT SCHELLER TEACHER
EDUCATION PROGRAM
THE EDUCATION ARCADE
Designed for the Mobile Web
Paced to encourage short and frequent game play
Played in the “interstitial” spaces in school
Connected to specific class learning goals through curriculum
Mobile Social Games

- Clash Royale
- Candy Crush Saga
UbiqBio Research Study

• Teachers
  • 7 Teachers from 4 Boston Area Schools
  • All schools were urban low SES
  • Games implemented each over ~1 week, with varying style

• Students
  • 156 experimental students - provided with phones
  • 83 control students (same teachers from prior year)
Game Play by Gender

Male vs. Female Gameplay by Game

- BB*
- Beasties
- Island Hoppers
- Chomp!**

Mintes Played

Game

Male
Female

Chart showing game play by gender for different games.
Game Impact on Test Scores

Control vs Experimental Quiz Scores by Game

Quiz Subscore

Game/Topic Area

- Genetics
- Evolution
- DNA
- Ecology

Control Mean
Experimental Mean
Leveling Up?

• How is score on each section impacted by...
  – Time spent playing
  – Levels completed

<table>
<thead>
<tr>
<th></th>
<th>Genetics</th>
<th>DNA</th>
<th>Evolution</th>
<th>Ecology</th>
</tr>
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<tbody>
<tr>
<td>Time (10K)</td>
<td>-.039</td>
<td>.0647</td>
<td>-.223</td>
<td>x</td>
</tr>
<tr>
<td>Level</td>
<td>.245</td>
<td>x</td>
<td>.0138</td>
<td>x</td>
</tr>
</tbody>
</table>
Do Games Work?

Not all games are the same

Graph showing different difficulty levels (Difficulty A, Difficulty B, Difficulty C) with varying values and steps.
What Makes Games Work?

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- Graph showing relationships between levels and difficulty:
  - Difficulty A: Green triangles
  - Difficulty B: Blue squares
  - Difficulty C: Teal diamonds

- Time (10K) values:
  - Level 1: -.039
  - Level 2: .0647
  - Level 3: -.223

- Level values:
  - Level 4: .245
  - Level 5: x
  - Level 6: .0138
  - Level 7: x
Traditional Toys May Beat Gadgets in Language Development

By PAM BELLUCK  DECEMBER 23, 2015 9:43 PM  133 Comments
Learning
Action Reflection Cycle

Experience

Resources
Reflection
MMOs and Learning
Steinkuehler and Duncan 2008
MMOs and Learning
Steinkuehler and Duncan 2008

By **Binary** (2,587 – 1.13.26) on 2006/12/08 (Patch 2.0.1)
Given by Sten Stoutarm at (29,71).
The highest concentration of wolves can be found directly south from the quest start.

By **Murloc69** (332 – 4) on 2008/03/12 (Patch 2.3.3)
Given at [29,71] by Sten Stoutarm. Simple quest, just go kill the wolves just around the quest giver. Drop rate is high, takes about 9 kills.

By **Smokinchnceh** (1,376 – 4.7) on 2009/06/10 (Patch 3.1.3)
For those without co-ords, travel SSE of questgiver, staying south of road.
Slay Ragged Young Wolf mobs who drop the Tough Wolf Meat and who have a 66% droprate or Ragged Timber Wolf mobs who are more sparsely located SSW of the questgiver and have a 57% droprate.
MMOs and Learning

<table>
<thead>
<tr>
<th>scientific habit of mind</th>
<th>percentage of posts exhibiting each characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>social knowledge construction</td>
<td>86%</td>
</tr>
<tr>
<td>build on others’ ideas</td>
<td></td>
</tr>
<tr>
<td>use of counterarguments</td>
<td>37%</td>
</tr>
<tr>
<td>use of data / evidence</td>
<td></td>
</tr>
<tr>
<td>alternative explanations of data</td>
<td></td>
</tr>
<tr>
<td>references outside resources</td>
<td></td>
</tr>
<tr>
<td>systems based reasoning</td>
<td></td>
</tr>
<tr>
<td>understanding feedback</td>
<td></td>
</tr>
<tr>
<td>model based reasoning</td>
<td></td>
</tr>
<tr>
<td>model testing and prediction</td>
<td></td>
</tr>
<tr>
<td>mathematical modeling</td>
<td></td>
</tr>
<tr>
<td>mathematical computation</td>
<td></td>
</tr>
<tr>
<td>absolutist</td>
<td>30%</td>
</tr>
<tr>
<td>relativist</td>
<td></td>
</tr>
<tr>
<td>evaluative</td>
<td>65%</td>
</tr>
</tbody>
</table>

• Steinkuehler and Duncan 2008
Why an MMOG
(Massively Multiplayer Online Game)

Self-directed
Collaborative
Role-playing
Inquiry-based
Contextual
Quests and Tools

It's good for animals with claws! It means they can climb trees to get food and get away from other animals that want to eat them, which helps them stay alive.
Radix Demo
Physical Models
Biological Models
Experiment Centered Design

Student model
Evidence model
Task model
Community
Parties - Data Sharing
Providing Formative Assessment and Data

Failure Report for T Four

Student Response

• Menji

Taking the Trash Out Attempt 1

Students collect information about traits for a certain environment.

Learning Objectives:

• Recognize species variation
• Create data summary

Failure:

Student did not turn in the correct data summary or they turned in the wrong animal. There are 3 possible reasons why their data summary...
Learning
Action Reflection Cycle

Experience

Resources

Reflection
## Teacher Usage

<table>
<thead>
<tr>
<th></th>
<th>For all teachers that did this (n=~300 but varies)</th>
<th>For subset of teachers that also took the survey (n=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td># of classes created (mean)</td>
<td>1.9</td>
<td>3.2</td>
</tr>
<tr>
<td># questlines assigned (mean)</td>
<td>2.86</td>
<td>3.5</td>
</tr>
<tr>
<td># students who completed a quest (mean)</td>
<td>20.75 (median=8)</td>
<td>49.7 (median=39)</td>
</tr>
<tr>
<td>time span of quest activity (in days, mean)</td>
<td>62 (median=16)</td>
<td>153.6</td>
</tr>
<tr>
<td>average session length (in minutes, mean)</td>
<td>28.3</td>
<td>28.1</td>
</tr>
<tr>
<td>total play time (in hours, mean)</td>
<td>4079</td>
<td>16683</td>
</tr>
<tr>
<td>total quests completed (mean)</td>
<td>218.9</td>
<td>770</td>
</tr>
<tr>
<td>quests per student (mean)</td>
<td>9.3</td>
<td>13.6</td>
</tr>
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</table>
Popular Quests

quests completed

- TUT1
- GN1
- HB1
- GM1
- EC1
- AL1
- HB2
- EV2
- EV1
- GM3
- ST1
- GM2
- EV3
- AL2
- Tool Quests
- Hybrid Quests
Teacher Implementation

Where

Teacher Implementation - Where

Homework | In Class | Other

AL1 | AL2 | EC1 | EV1 | EV2 | EV3 | GM1 | GM2 | GM3 | GN1 | HB1 | HB2 | HY1 | HY2 | ST1

0 | 50 | 100 | 150 | 200 | 250 | 300
Teacher Implementation

When
Success and Failure

Evolution vs Stats

Evolution Success

Stats Success
Where and When Are Successes

Evolution and Statistics

Mean Percent Correct

Mean Percent Correct

Mean Percent Correct

Mean Percent Correct
Pre-Post Results

Biology

Human Body Systems
T-test showed significant difference from pre to post $t=3.803$, $p=.000$. Effect size=.49

Genetics
T-test showed significant difference from pre to post $t=6.878$, $p=.000$. Effect size=0.67

Ecology
T-test showed significant difference from pre to post $t=2.585$, $p=.011$. Effect size=.297
Multiple Pathways to Success

c/o Montzy Cheng
# Analyzing Failure

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Second Attempt</th>
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<tbody>
<tr>
<td></td>
<td>success</td>
</tr>
<tr>
<td>NA</td>
<td>7</td>
</tr>
<tr>
<td>1st</td>
<td>F0</td>
</tr>
<tr>
<td>Attempt</td>
<td>F1</td>
</tr>
<tr>
<td>Fail Code</td>
<td>F2</td>
</tr>
<tr>
<td>FT</td>
<td>27</td>
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- Percentage

<table>
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<td>Fail Code</td>
<td>F2</td>
</tr>
<tr>
<td>FT</td>
<td>62.8</td>
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Effective Use Cases?

Proportion of Students using Radix by Teacher and Day
Days 1-100
Integrate this STEM MMOG as supplemental curriculum into math and science classrooms and lessons.

A MASSIVELY MULTIPLAYER ONLINE GAME (MMOG) WITH SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) TOPICS FOR MIDDLE AND HIGH SCHOOL CURRICULUM.