Brain Points: A Deeper Look at a Growth Mindset Incentive Structure for an Educational Game

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Online educational tools can scale to reach massive numbers of students.
Most MOOCs have retention rates under 13%

http://www.katyjordan.com/MOOCproject.html
Video games can be used as engaging educational tools.
Game incentives can motivate students

- Coins
- Points
- Badges

Gamification in Education

[Kapp 2012]
[Morrison and DiSalvo, 2014]

Educational psychology shows that some incentives can **harm** student learning
Dweck showed that mindsets about intelligence affect motivation and leaning

**Fixed Mindset**
- Intelligence is fixed
- If you’re smart, work should come easily
- Mistakes indicate that you’re not smart

**Growth Mindset**
- Intelligence grows
- Challenge means that you’re learning
- Mistakes are part of the learning process

[Dweck 2006, Muller and Dweck 1998, Blackwell et al. 2007]
Growth Mindset Research

Mindsets can be measured with surveys.
Mindsets predict academic performance
($\beta = .53, p < .05$)  
[Blackwell et al. 2007]

Praising students for their effort rather than their intelligence promotes the growth mindset.

[Mueller and Dweck, 1998]
[Gunderson et al. 2013]
Game incentives can motivate students

Gamification in Education

[Kapp 2012]
[Morrison and DiSalvo, 2014]

Most incentives reward players for performing well and completing tasks quickly
Can we design incentives that encourage the growth mindset?

Our initial work shows that we can:

*Brain Points: A Growth Mindset Incentive Structure Boosts Persistence in an Educational Game*

Eleanor O’Rourke, Kyla Haimovitz, Christy Ballweber, Carol S. Dweck, Zoran Popovic, CHI 2014
Refraction
Refraction
Growth Mindset Refraction

Introductory animation

Brain points incentive structure

Progress visualization
Did you know that when you work hard and struggle, your brain gets stronger and **SMARTER**!
Brain Points Incentive Structure
“New Idea” Trying a new two-move hypothesis
Brain Points Incentive Structure

“New Idea”  Trying a new two-move hypothesis
“Fresh Start”  Clearing the board to start again
Brain Points Incentive Structure

“New Idea”  Trying a new two-move hypothesis
“Fresh Start”  Clearing the board to start again
“Math Effort”  Solving a math sub-problem
Brain Points Incentive Structure

“New Idea”  Trying a new two-move hypothesis
“Fresh Start”  Clearing the board to start again
“Math Effort”  Solving a math sub-problem
“Working Hard”  Making ten distinct new moves
"New Idea" Trying a new two-move hypothesis
"Fresh Start" Clearing the board to start again
"Math Effort" Solving a math sub-problem
"Working Hard" Making ten distinct new moves
How do we keep students from gaming the system?

Players only earn points when they trigger two metrics
You just earned 10 Brain Points!

You challenged your brain!
Approach: study the intervention through experiments on Brain POP
Outcome Measures

- Active time played (minutes)
- Number of levels played
- Average number of brain points metrics triggered per minute
Are growth mindset incentives more effective than traditional ones?

**Randomized A/B Study**
**15,000 Participants**

Brain Points Condition

Level Points Condition
Are growth mindset incentives more effective than traditional ones?

Brain points encourage persistence and growth mindset behaviors
Why does the brain points intervention work?
Which of the intervention components has the strongest impact on behavior?

Randomized A/B Study
25,000 Participants
RQ1: Does the growth mindset narrative matter?

Hypothesis: The narrative will increase persistence and growth mindset behavior

Mod #1: No Narrative Animations
RQ1: Does the growth mindset narrative matter?

Brain points encourage persistence and growth mindset behaviors.

Brain points encourage persistence and growth mindset behaviors.
RQ1: Does the growth mindset narrative matter?

Follow-Up Analysis:
Include only players who completed the first level

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<th>Time Played</th>
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(Z=1.32, n.s.)

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(Z=-0.14, n.s.)

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<th>Metrics Per Minute</th>
<th>Mindset Behaviors</th>
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<tr>
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<td>Original</td>
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<td></td>
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<td>3</td>
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(Z=0.57, n.s.)

Growth mindset narrative harms persistence and provides no added benefit
RQ2: Do brain points matter?

Hypothesis: Brain points will increase persistence and growth mindset behaviors

Mod #2: No Points
RQ2: Do brain points matter?

Brain points increase student persistence
RQ3: Does rewarding growth mindset behaviors matter?

Hypothesis: Rewarding growth mindset behaviors contributes to the observed effects

Mod #3: Random Points
RQ3: Does rewarding growth mindset behaviors matter?

![Graphs showing metrics per minute, mindset behaviors, and levels played.](image)

- **Time Played**: Original 2.5, Random 2
  - $Z=-2.66, p<0.01, r=0.03$

- **Levels Played**: Original 4, Random 3
  - $Z=-5.62, p<0.0001, r=0.06$

- **Mindset Behaviors**: Original 2.5, Random 2
  - $Z=-7.22, p<0.0001, r=0.07$

*Rewarding players randomly is not effective*
RQ4: Does the progress visualization matter?

Hypothesis: The progress visualization will increase persistence

Mod #4: No Progress Visualization
RQ4: Does the progress visualization matter?

![Bar charts showing the comparison between Original and No Viz groups for Time Played, Levels Played, and Mindset Behaviors metrics.

The progress visualization increases retention.

- **Time Played**: (Z=-3.80, p<0.001, r=0.04)
- **Levels Played**: (Z=-2.89, p<0.005, r=0.03)
- **Mindset Behaviors**: (Z=0.63, n.s.)
Summary of Findings

• The mindset animations harm retention, provide no added benefit
• Brain points increase retention
• Rewarding players randomly is not effective
• The progress visualization increases retention
Experimentation can produce data-driven design guidelines
Thank You!

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