Dialogue:

Learning and Motivation with Digital Games

PRO

CON

Valerie Shute (FSU)

AERA (4/10/11)

Here's your brain.

Here's your brain
on games!

Faces of engagement…

… on kids of all ages!

Engagement here?

Not so much.

Games and Learning

Claim 1: Good games can act as *transformative digital learning tools* to support skill development and deep/meaningful learning.

Claim 2: Learning is at its best when it is active, goal-oriented, contextualized, and interesting—the features of good games.

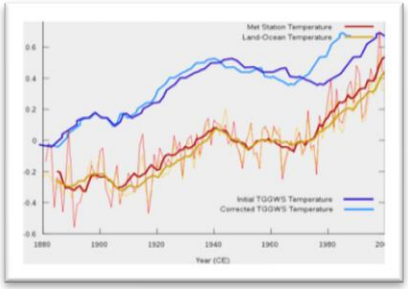
My Game Plan

Define Games

Define Learning

Discuss Issues

Show Results



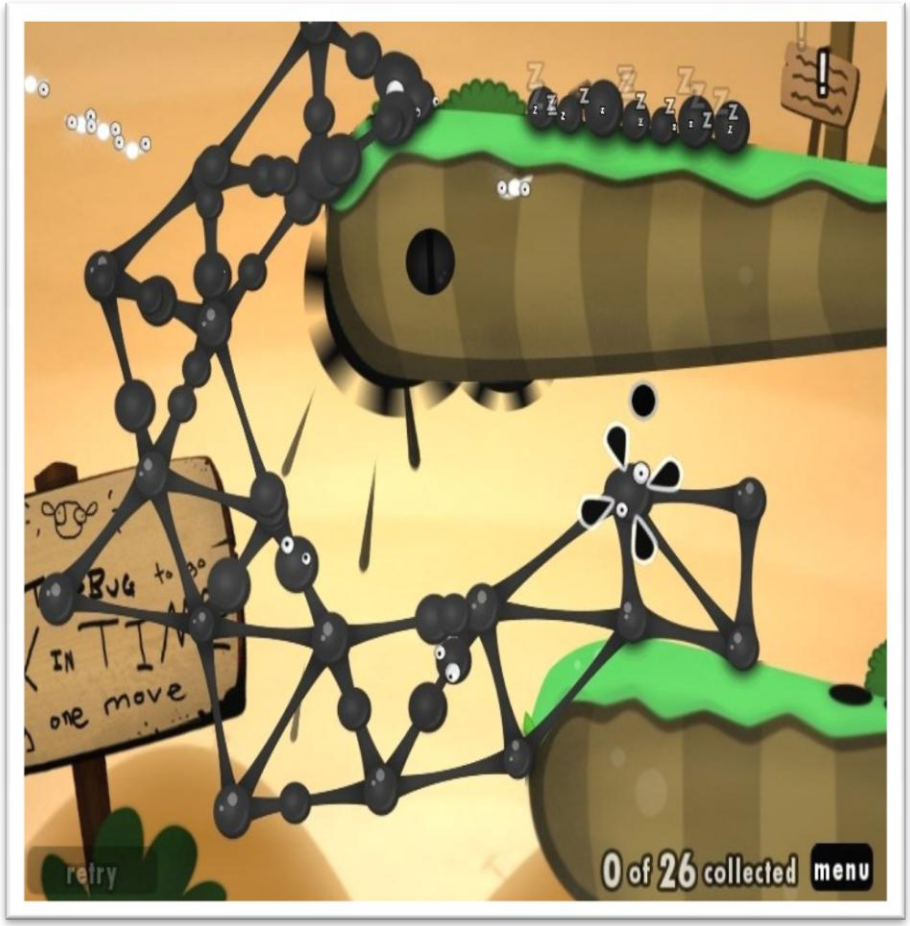

Games

Good Game Elements

- Interactive problem solving
- Specific goals/rules
- Adaptive challenges
- Control
- Ongoing feedback
- Uncertainty
- Sensory Stimuli

Interactive Problem Solving

- Games require *interaction* between player and game.
- Most games also require *problems* to be solved, which can be really complex.



Goals

- Games have goals which help the player focus on what to do and when.
- Goals in games may be implicit or explicit.

Adaptive Challenges

- Good games *balance difficulty levels* to match players' abilities (neither too hard nor too easy).
- The best games & instruction hover at the boundary of a student's ability (ZPD).

Control

- Control in games has two faces:
  - Player's influence over gameplay and environment (Belanich et al., 2004; Garris et al., 2002)
  - Player's control of the learning experience (in contrast to classrooms)

Control (How I Roll…)

Feedback

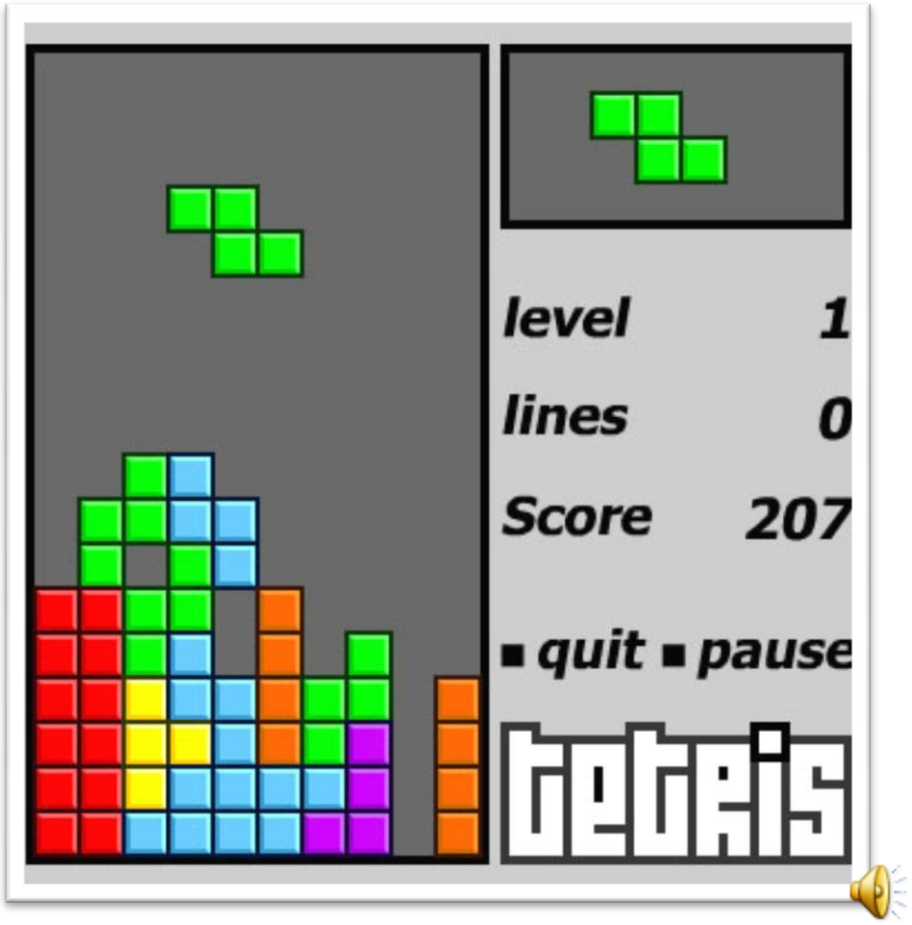
- Info or rewards to players about their performance.
- Feedback may be either explicit or implicit.
- Timely feedback has positive effects on learning (Chen & Michael, 2005; Shute, 2008).

Uncertainty

- Uncertainty evokes suspense & engagement.
- Systemic uncertainty is different from narrative uncertainty – but both important.
- If a game 'telegraphs' its outcome, or can be seen as predictable, it will lose its appeal (Fullerton, 2011).

Sensory Stimuli

- Refers to the combination of *graphics*, *sounds*, and/or *storyline* used to excite the senses.
- This doesn't require "professional" graphics or sound to be compelling.

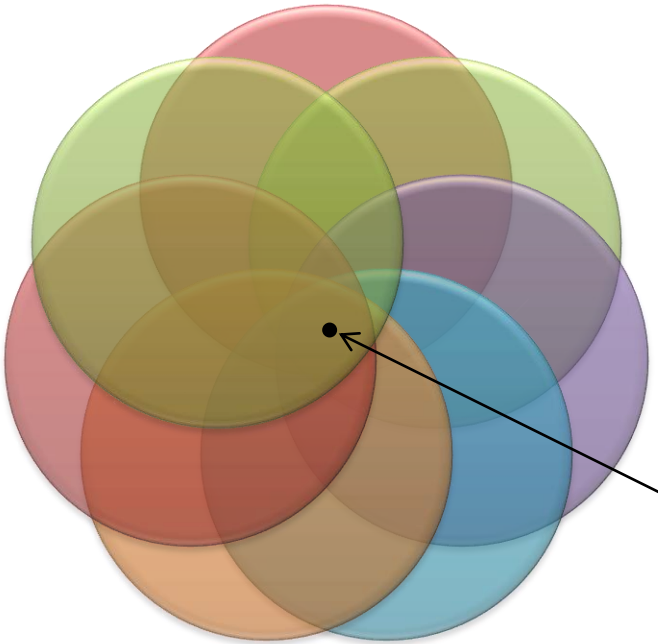


Gestalt of games

Interactivity

Stimuli

Goals



Uncertainty

Challenges

Feedback

Control


Learning

Learning

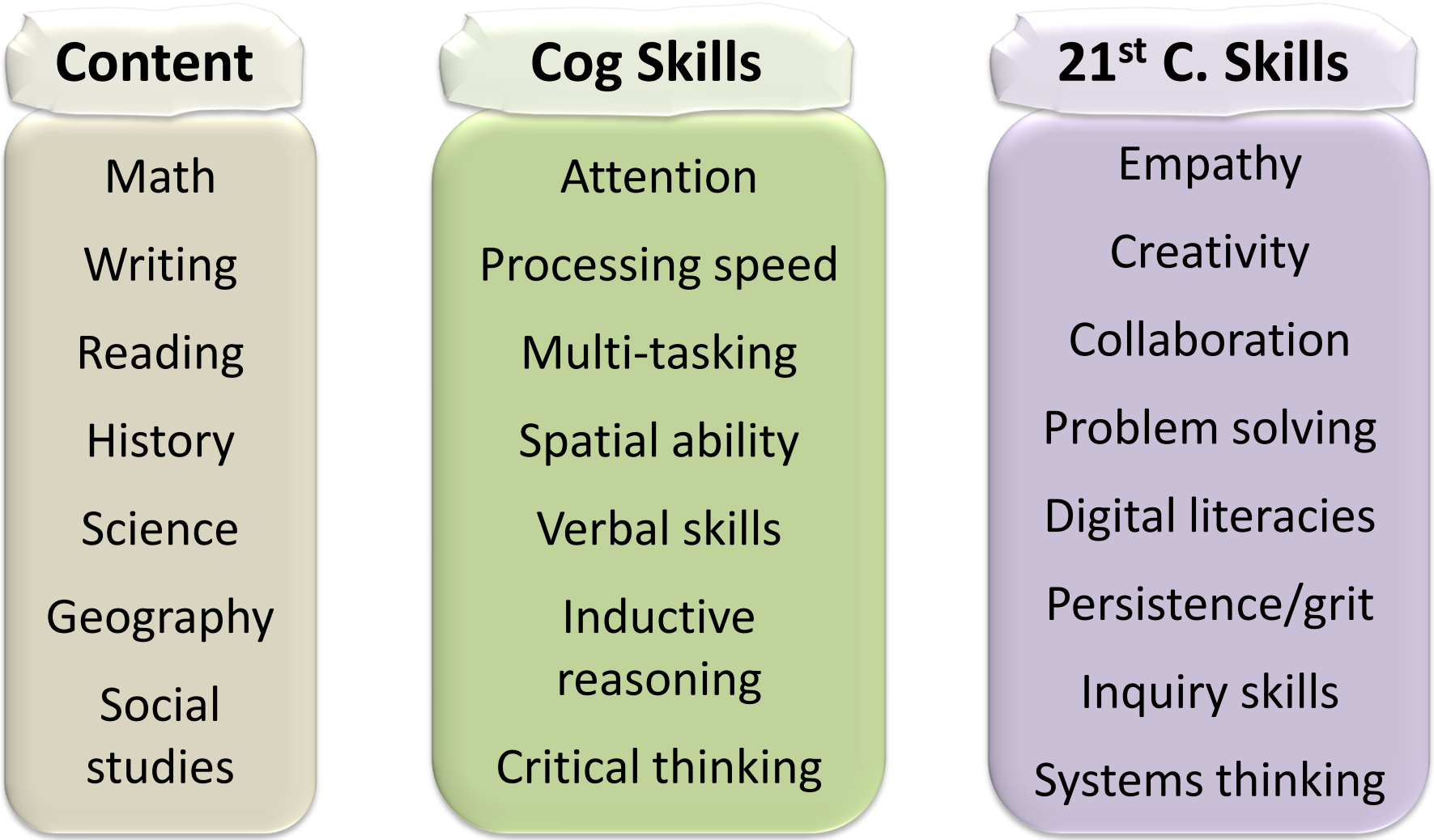
- ***Lifelong process*** of accessing, interpreting, and evaluating info & experiences into knowledge, skills, values, dispositions, etc.

- ***Change*** from one point in time to another in terms of knowing, doing, believing, feeling, etc.

Learning Theories

- Constructivism and situated learning.
- Learner is active in the learning process; learning is the result of interaction with a problem context where learners construct meaning.

Kinds of Learning



Learning Outcomes

20th C. Outcomes

↑ Test scores

↑ Test scores

↑ Test scores

↑ Test scores

↑ Test scores

↑ Test scores

↑ Test scores

21st Century Outcomes

↑ College enrollment

↑ Digital literacies

↑ Kindness

↓ HS dropouts

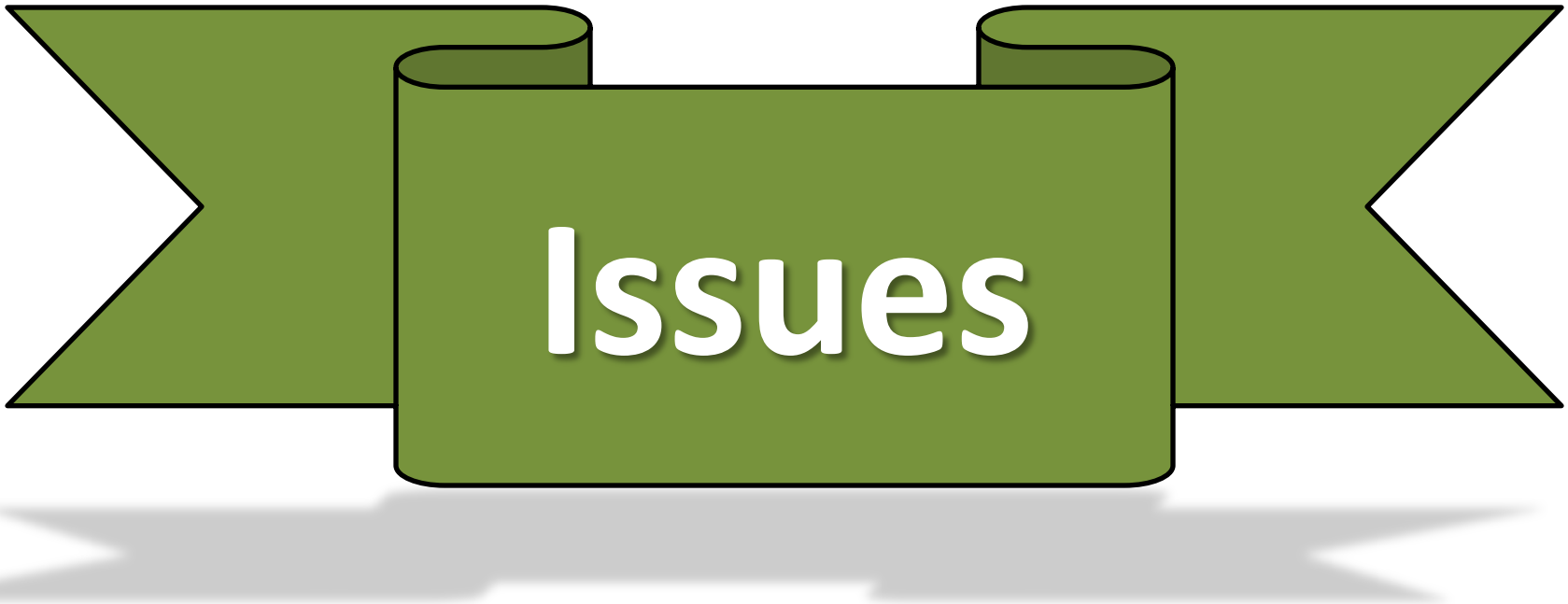
↓ Intolerance/Bigotry

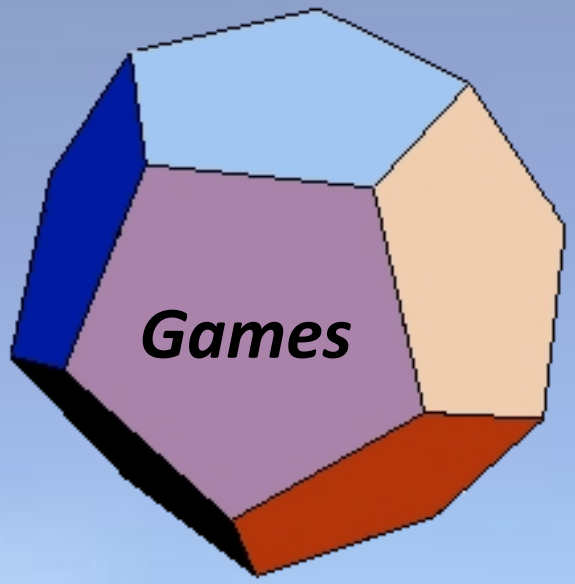
↑ Adaptivity

↑ Civic engagement

↑ Happiness

"Building a more just, verdant, and peaceful world"


Issues



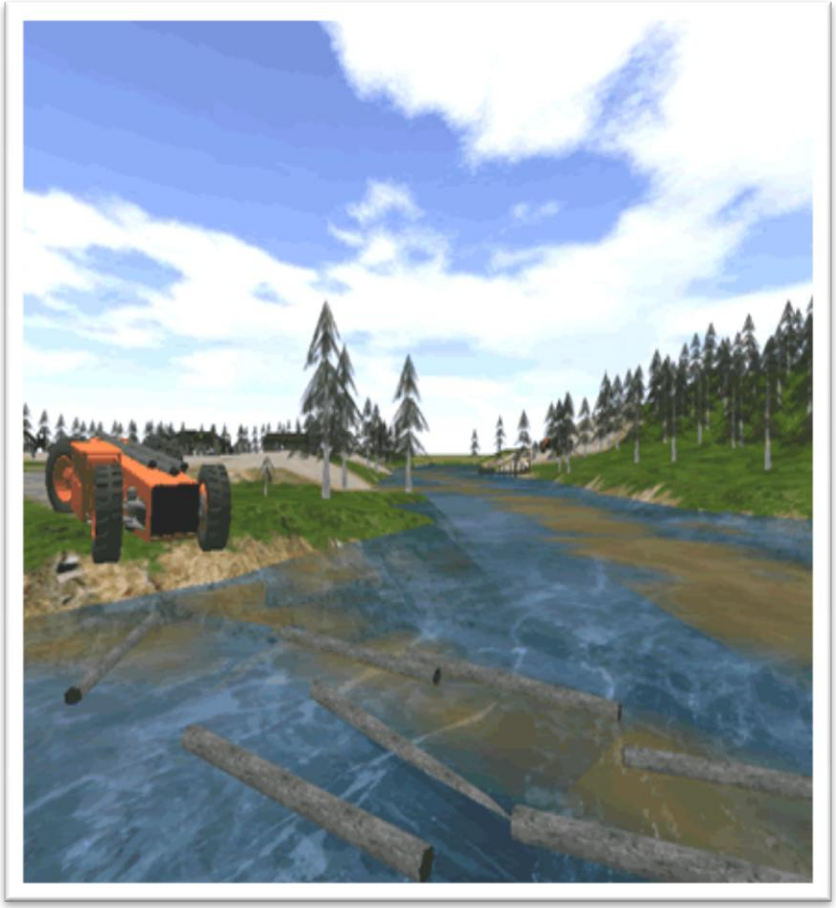
Narrow View of Learning


Findings

Content Learning

Taiga Park (Barab et al., 2010)

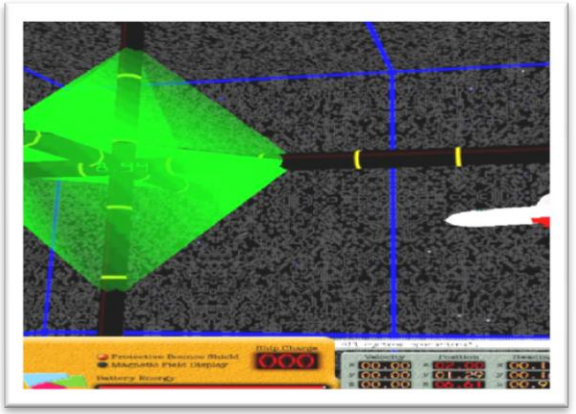
- **Problem**: Fish dying in TP. Players must figure out why.
- **Learning**: Water quality knowledge.
- **Findings**: Significantly greater *learning* by TP group than classroom ($p < .01$). Also in the *delayed posttest,* TP showed gains over classroom ($p < .001$) in novel task (thus better retention & transfer).



Content Learning

Supercharged (Squire et al., 2004)

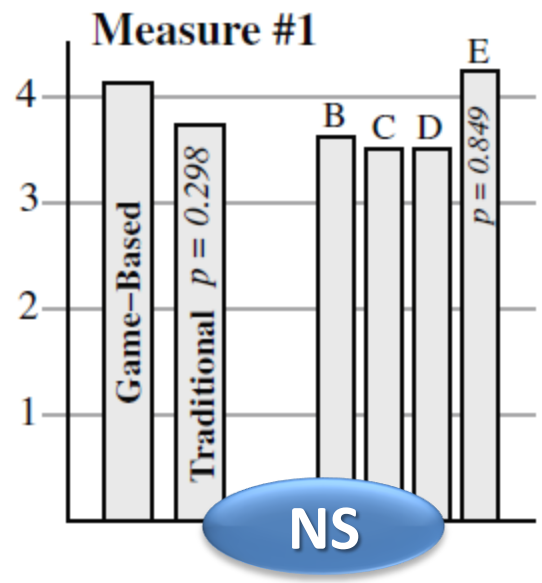
- **Problem**: Control a spaceship in electromagnetic mazes by placing charged particles around the space.
- **Learning**: Understanding how charged particles interact.
- **Findings**: Experimental study (*n*=96). Game condition vs. control (interactive lectures, experiments, & observations). Game group > control on electromagnetism exam ($p < .05$).

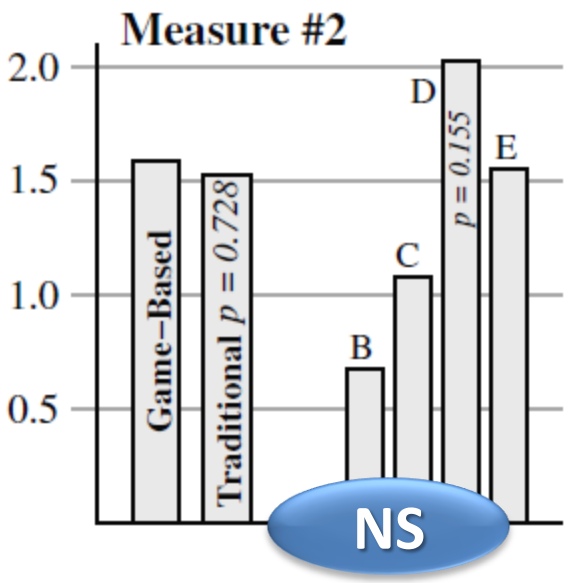


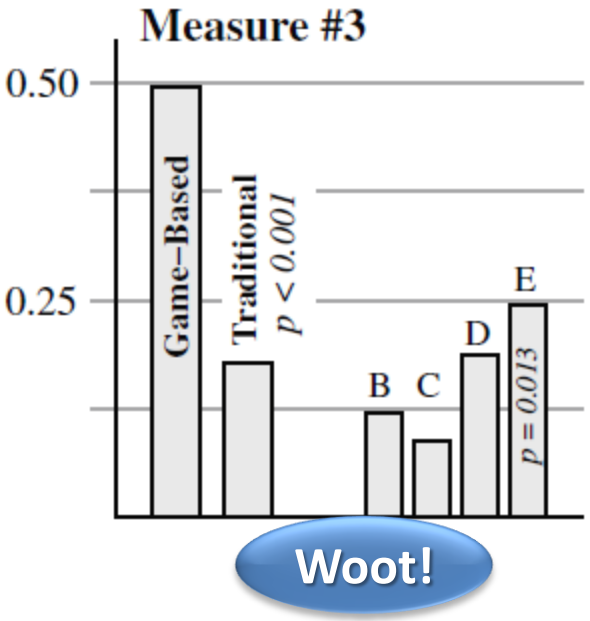
Content Learning

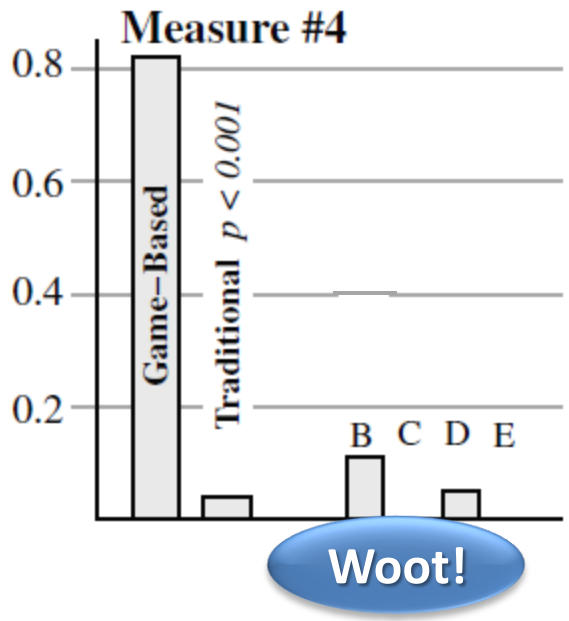
NIU-Torcs (Coller & Scott, 2009)

- **Problem**: Create control algorithms to make virtual cars execute nimble maneuvers and stay balanced.
- **Learning**: Mechanical engineering *(numerical methods: root finding)* and programming skills.
- **Findings**: Game-based classroom scored significantly higher than 4 traditional classrooms in a *concept map assessment* (see next slide).









Measure 1: Low-level knowledge (number of concepts recalled).

Measure 2: Number of techniques per topic recalled.

Measure 3: Depth of hierarchy per major topic (defining features and their connections).

Measure 4: Connections among branches in hierarchy—deep level of understanding.

Content Learning

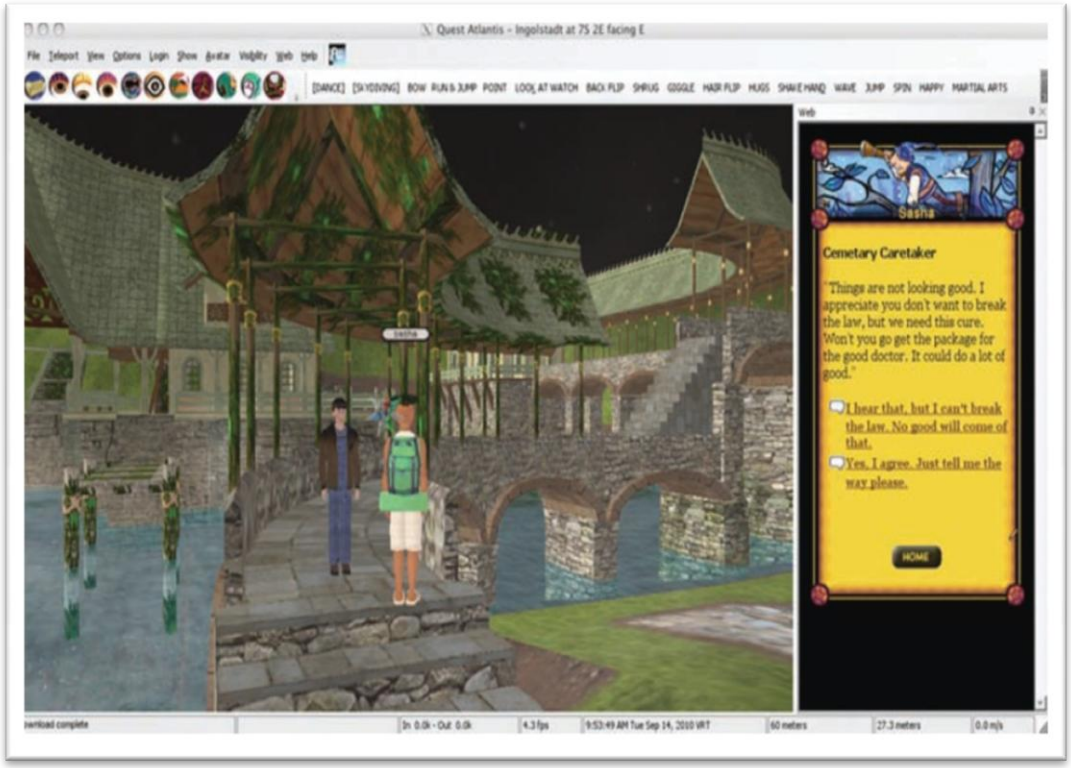
DimensionM™ (Kebritchi, Hirumi, & Bai, 2010)

- Urban HS (*n*=117 game; *n*=76 control)
- Students attended Algebra I classes twice a week (18 wk) and played game 30 min/wk.
- In DimensionM™, students use math concepts to complete missions in a 3D environment.
- Pre/post district-wide benchmark exams. Game group: significantly higher achievement than control ($F(1,188) = 6.93$, $p < .01$)

Content Learning

Modern Prometheus (Barab et al., 2010)

- **Problem**: Students must convince others in the fictional village about how to deal with the monster—resolving an ethical dilemma.
- **Learning**: Persuasive writing skills.



Content Learning (cont.)

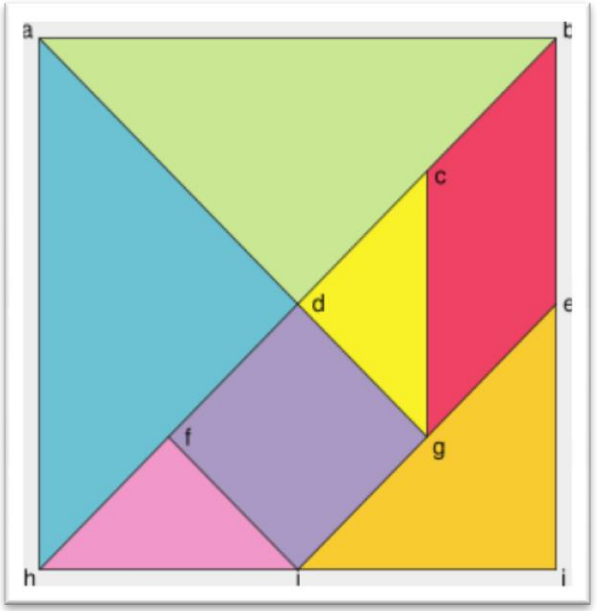
Modern Prometheus (Barab et al., 2010)

	Traditional classroom	Game condition
Pre - posttest differences	$d = 1.22$	***d* = 1.83**
Quality of persuasive essays	Game group significantly outperformed control group ($p < .001$)	

Transfer—Kindness

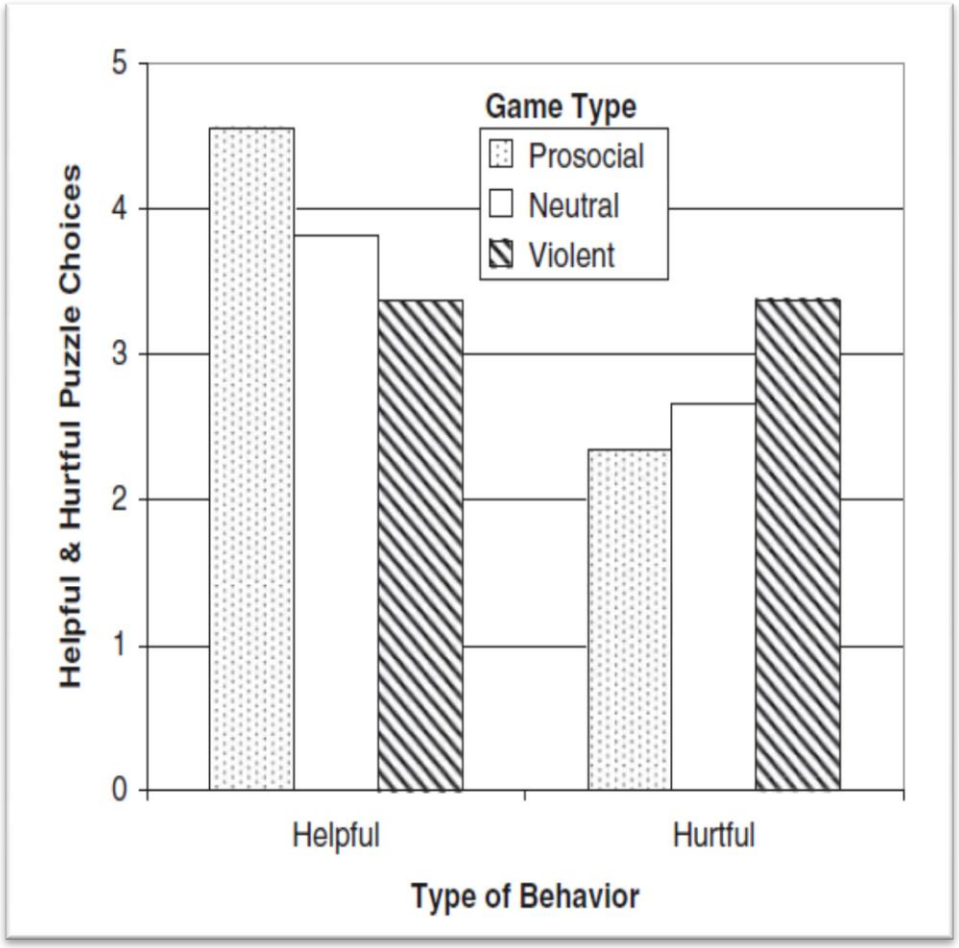
Prosocial Games & Behavior (Gentile et al., 2009)

- 121 students randomly assigned to play prosocial, violent, or neutral game (20 min.)
- After game, player chose 11 Tangram puzzles for partner (from 10 easy, 10 medium, and 10 hard). Players told that if their partner finishes 10 puzzles in 10 min., partner gets $10.
- Player could **help** (assign easy puzzles), or **hurt** partner (assign hard ones).



Transfer (cont.)

Prosocial Games & Behavior (Gentile et al., 2009)



- Game-type x behavior-type interaction significant. Those who played *prosocial game* were more helpful than those who had not played prosocial game, $F(1, 155) = 8.94, p < .005, d = 0.48$.
- Three studies showed same finding (using diverse populations: ages, sexes, cultures).

Games & Motivation

Games motivate students to learn valuable content and skills, within and outside of the game.

Motivation

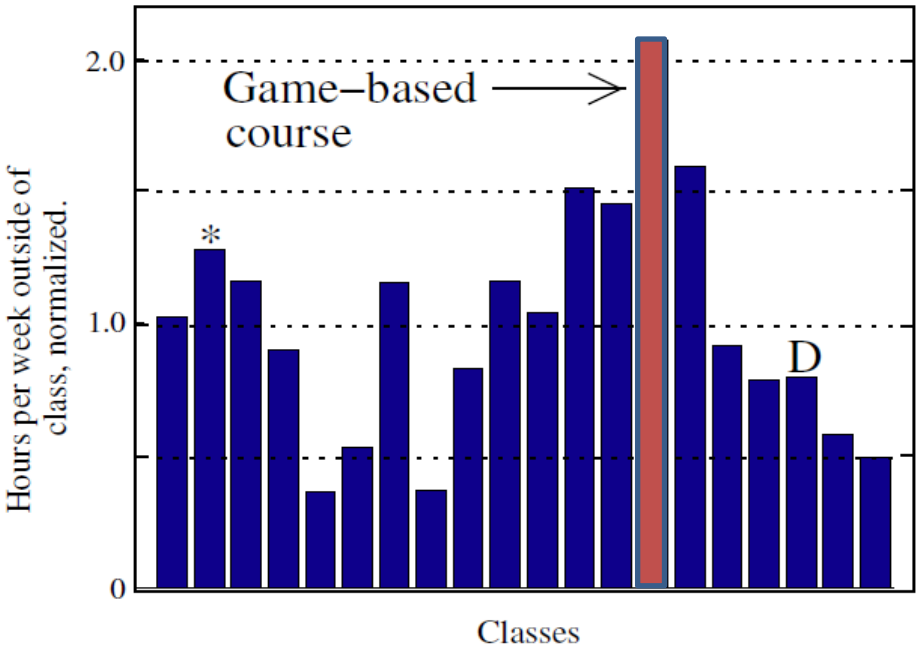
Modern Prometheus (Barab et al., 2010)

- **Problem**: Players help villagers decide if they should let Dr. Frank to continue his experiments.
- **Learning**: Persuasive writing skills.
- **Findings**: Game group scored almost *2 SDs* higher than control group [$t(35)=7.61$, $p<.001$] on survey showing significantly higher engagement. For example:
  - 86% of game group *enjoyed* or *strongly enjoyed* the activity, 22% of the control group did.
  - Re: wishing they were doing something else, 71% of the game group said “not at all!” but 70% of the control group said “definitely.”

Motivation

NIU-Torcs (Coller & Scott, 2009)

- Survey: How many hr/wk on coursework per class?
- Students in game-based course, about *twice* the average amount time than other courses ($p < .001$).
- More than 90% of the students taking game-based course said they'd sign up for the same type of class again.



D--Senior capstone design course

*--Another ME course taught by same instructor as game-course.

Conclusions

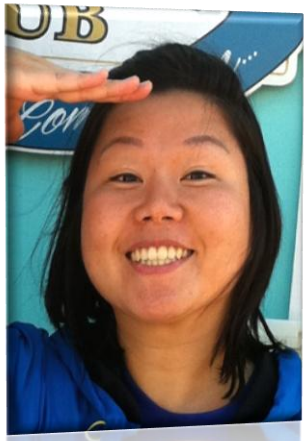
- **Games can support learning**. They're also engaging and motivate students to want to play/learn. Conflicts in the literature because (a) "games" defined erratically, (b) interactions present (e.g., *game x content x person x context*), and (c) focus on low-level knowledge.
- **Need more research**. From Clark (2007), I agree that we need the following in future research:
  - *Measurement*: direct (not self-report), reliable and valid tests of learning and motivation (before, during, after games). Consider stealth assessments—reliable, valid, and ongoing throughout learning.

Conclusions

- *Game Pedagogy*: If both game & control produce similar "learning" but students love the game and play it voluntarily, use game! (cf: Coller learning/motiv. findings; delayed effects; Vogel et al., 2006)
- *Research Design*: Instead of traditional pre-posttest design, more qualitative, design-based research better to capture range of effects of games on learners (and types of learning). Manipulating single game features not helpful (cf: DeRouin-Jessen, 2008; game gestalt).
- *Learning (Types & Outcomes)*: Focusing solely on knowledge-test-scores-as-outcomes tooooo limited. Games' strength – supporting emergent complex skills with student-centered models and dynamic assessment techniques.
- *Cost-benefit ratios*: Provide cost estimates of game and alternative treatment. Results may surprise you!

Sine Qua Non!

Matthew Ventura



Yoon Jeon Kim

Rim Razzouk

Flora Wang

The End

vshute@fsu.edu