

# **Learning Context: Games, Simulations, and Science Learning in the Classroom**

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# Opportunities/Challenges

- n Summarize opportunities and challenges of pre-college science classroom settings for effective implementation of games and simulations

The opportunities/challenges of classrooms as sites are often interwoven; strategies for use involve managing tradeoffs

# Four Organizing Questions

1. How can teachers integrate Internet-based games and simulations with more conventional forms of instruction and assessment in science?
2. What constraints and opportunities exist because of the science classroom setting?
3. What opportunities for deep, individualized learning do science classrooms provide?
4. What opportunities for psychosocial learning and motivation do science classrooms provide?

# Effective Pedagogy in Science Learning

- n To be effective, teachers should create a learning “ecology” with pedagogical niches that speak to students’ needs, strengths, and preferences
- n science teachers can use games and simulations (g/s) as a supplement to traditional or project-based instruction
- n a science curriculum unit can center on an extended g/s
- n Such an approach can involve cross-disciplinary instruction to build skills across the curriculum. Teachers of other subjects may even choose to use science g/s if these are powerful for engagement and learning in their subject area.

# Access to G/S Outside of School

- n Students often request access outside of school to
  - n increase immersion
  - n enhance engagement
  - n more closely align science instruction with students' informal learning strategies
- n Unsupervised access to games or simulations outside of school presents several challenges
  - n Students who have ready access to the necessary technology infrastructure have an advantage
  - n if the g/s is multi-user, then some students may engage in inappropriate behavior
- n Teachers are wary of out-of-school access to g/s because they are accountable for students' actions

# Teacher Opportunities/Constraints

- n The opportunity to use the science teacher as a resource, with the intertwined constraint of teachers who don't implement in the manner designers intended
- n Professional development is important in reducing issues with fidelity of implementation
- n Delivering effective professional development, even across distance, can increase students' educational performance
- n A range of models for online professional development are effective in aiding teachers with content knowledge, pedagogical processes, and a variety of other skills
- n "Next generation" teacher professional development models are likely to appear that will take advantage of Web 2.0 and immersive interfaces

# Infrastructure Opportunities/Constraints

- n School settings frequently have the constraint of inadequate technology infrastructures, as well as offering the intertwined opportunity of student technical support
- n Districts often have idiosyncratic, flawed ways of enabling network access to outside resources, some as extreme as simply blocking everything external
- n When technical problems arose, our *River City* science teachers reported that often their students were adept at resolving those issues

# Assessment Opportunities/Constraints

- n The responsibility of the science teacher to grade students is a double-edged sword
  - n When the learning experience was evaluated by the teacher as part of the course grade, some students took the game or simulation more seriously, while others grew disengaged
  - n In general, paper-and-pencil item-based tests do not measure learning from science g/s as accurately as do performance assessments, raising issues of practicality vs validity
  - n Need new types of assessments, such as those that draw on “cognitive audit trails” from event-logs and chat-logs

# Access Opportunities/Constraints

- n The opportunity to reach students unlikely to use science g/s for informal learning, as well as the interrelated challenge of gaining acceptance in an schooling system dominated by high stakes tests
- n An increasing proportion of students have learning strengths and preferences for using interactive media, but not all youth have these characteristics
- n Not all learners are well served by the pedagogies and motivational strategies that underlie science g/s
- n Teachers and administrators are reluctant to spend time using resources they perceive as less efficient in test preparation than teaching-by-telling

# Research Opportunities / Constraints

- n Classrooms present the opportunity to do controlled studies – pilots, design-based research, and randomized clinical trials – with more detailed pre/post measures and more controlled observations than possible in informal learning settings
- n The students in classroom settings are typically more representative of the overall population of learners than those who voluntarily elect to participate in science g/s outside of school, leading to better generalizability for research findings
- n That said, getting permission to do research in school settings is typically very difficult

# Scaling Up Opportunities/Constraints

- n Public schools offer the opportunity to deliver science g/s to the entire population of students, but pose formidable challenges to implementation at scale, as well as to longitudinal studies
- n Research findings typically show substantial influence of contextual variables (e.g., the teacher's content preparation, students' self-efficacy, prior academic achievement) in shaping the desirability, practicality, and effectiveness of educational interventions
- n Achieving scale in education requires designs that can flexibly adapt to effective use in a wide variety of contexts across a spectrum of learners and teachers

# The Scaling Framework

DIMENSIONS OF SCALE	DEPTH	SUSTAINABILITY	SPREAD	SHIFT	EVOLUTION
POWER OF DIMENSION	EVALUATION AND RESEARCH	ROBUST DESIGN	REDUCING NEEDS FOR RESOURCES AND EXPERTISE	MOVING BEYOND BRAND TO CO-OWNERSHIP	RETHINKING THE MODEL
TRAPS TO AVOID	TRAP OF PERFECTION	TRAP OF MUTATION	TRAP OF OPTIMALITY	TRAP OF ORIENTATION	TRAP OF UNLEARNING
ROLE OF TECHNOLOGY	CREATING POWERFUL LEARNING	MEETING SPECIAL NEEDS	PROVIDING EFFICIENCIES AND SUPPORTS	ADAPTING AND SHARING	STUDY OF ADAPTATIONS
NEXT STEPS TO EXPLORE	UNDERSTANDING EFFECTIVENESS	COPING WITH DIFFICULT SETTINGS	DEVELOPING "LIGHT" VERSIONS	FOSTERING CO-DESIGNERS	EVOLVING DESIGN ASSUMPTIONS

# Deep, Individualized Learning

- n Teachers can group students based on knowledge of learners' intellectual and psychosocial characteristics
- n In contrast to relatively unguided learning in contexts outside of school, science teachers can alter their classroom instruction and support based on the feedback g/s provide
- n G/S are adaptable to students with special needs, allowing them to be mainstreamed in science classrooms
- n G/S can prepare students to take full advantage of real world field trips in science classrooms
- n Teachers, through their knowledge of students, can relate virtual experiences in g/s to what is happening in their lives

# Psychosocial Learning and Motivation

- n School provides a context for informal discussions about the curriculum by students outside of classrooms.
  - n online discussions
  - n experiences with g/s before or after school or at lunch
- n School clubs and similar organizations offer fertile ground for science games and simulations
  - n Robotics as an analogy:  
Game-like Competitions and Modding

# Other Potential Issues for Dialogue

- n Research Agenda
  - n What niche do science g/s occupy in the learning ecology?
  - n For whom are g/s effective, when, and under what conditions?
  - n What types of initiatives for educational improvement do science g/s empower?
  - n By what online mechanisms could we continue dialogue past this face-to-face workshop?
- n Should science g/s be designed for “disruption”?

# Disruptive Innovation Theory

## Why Successful Companies Go Out of Business

- n *Sustaining innovations* are incremental improvements in a product
- n *Disruptive innovations* offer a new product initially not as effective as what is currently sold, but **immediately meeting a specialized need** (alternative is non-consumption) and **potentially better in the long-run**
- n Over time, the disruptive product drives out the standard product (e.g., mini-computers)

Disrupting Class Christensen, Horn, & Johnson,  
2008

# Transformation via Disruption

## My Altered Version of Christensen's Argument

- n *Schooling* is the sustaining innovation (based on industrial model)
- n *Customization* is the disruptive innovation (e.g., individual human tutors and the 2-sigma effect)
- n Customization in *online learning* is the initial product that competes against non-consumption
- n Inclusive, customized learning – *based on much more distributed “teaching”* – is the innovation that forces schooling to adapt

Video: <http://edusummit.nl/resultssummit/intro>

