

What Are We Playing At?



An Instructional Designer Looks at DGBL

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Part I: Theory

Schools Are Failing

83% below proficiency in science

82% below proficiency in mathematics

78% below proficiency in writing

64% of students below proficiency in reading

--NAEP ("The Education Challenge,"
retrieved January 17, 2006)

According to the NCES 2000:

U.S. ranks 14th of 31 in science literacy

U.S. ranks 15th of 31 in reading literacy

--NCES, 2000

U.S. ranks 28th out of 39 in math problem-solving

U.S. ranks 27 out of 39 in math literacy

--Education Statistics Quarterly, 6(4), 2004

39% of 18-24 failed geographic literacy test

49% could not identify New York state on map

--National Geographic Society, Global Geographic Literacy Survey, 2002

Kids Are Different Today

Operate at twitch speed rather than conventional speed

Are parallel processors, not linear processors

Privilege graphics and animation over text

Are random accessors of information

Prefer connected to stand-alone

Are active, not passive

Expect payoff for effort

See play as work, and work as play

Expect fantasy and reality in equal measure

View technology AS life, not a separate activity

--Marc Prensky, 2001

Kids Are Different Today

(six and under) spend as much on 'screen time' as they do playing outside and twice as much time as they do reading.

Work with multiple sources of information at the same time (IM, TV, Internet, & music)

(~75%) Use IM and email to keep in touch, conduct multiple conversations

Use computer technology almost as much as television

--Diana & James Oblinger, February, 2005

Watch 3 hours 41 minutes of television per day

--Nielsen Media Research, Spring 2005

Games Are Effective

“Computer Games May Foster Learning”

--School Library Journal.com, November 1, 2005

**"Game-Based Learning: How to Delight and Instruct
in the 21st Century"**

--Educause Review, 39(5), 2004

**“Schools look to learning powers of computer
games”**

--Silicon.com, August 10, 2005

“Educators Turn to Games for Help”

--Wired News, August 3, 2003

Games Are Effective

“Game for Learning: New studies have found that video games may become a powerful learning tool...”

--Technology Review, April 7, 2005

“High Score Education: Games, not school, are teaching kids to think.”

--Wired, May, 2003

“Video games 'valid learning tools'”

--BBC News, 29 April, 2000

“Close to 60% of UK Teachers want Computer Games in the Classroom”

--NESTA FutureLab, January 13, 2006

What's Next?

✓ If:

- ✓ games are effective learning tools, and
- ✓ our students prefer games, and
- ✓ our schools are failing . . .

✓ Then:

- ✓ DGBL is the obvious answer

✓ Is it really that simple?

The Promise & Challenge of DGBL



- ✓ DGBL requires careful analysis
 - ✓ Understand how, why, and with whom games are effective
 - ✓ Learn from past
 - ✓ Ask the right questions

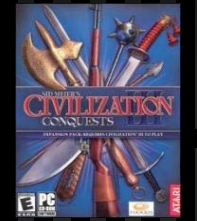
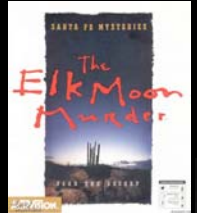
Be Careful What You Ask for....



- ✓ Are we asking the right questions about DGBL?
 - ✓ Two cases in point
 - ✓ Is interest in games widespread enough to make use in schools possible?
 - ✓ Are there empirical research studies about the efficacy of games?

Q1: Is There Enough Interest in Games?

- ✓ 248 million games sold in 2004
- ✓ 38% of game players are under 18; average age = 37
- ✓ Males and females play games equally
 - ✓ 55% are male, 43% are female
- ✓ Parents accept games
 - ✓ 75% of heads of households play games
 - ✓ 63% of parents believe games are positive part of children's lives
- ✓ Teachers accept games
 - ✓ Nearly 60% of teachers in UK willing to use games in classroom
- ✓ Yes, but...



Better Questions



- ✓ ...can we explain to parents and teachers
 - ✓ *how* games fit into schools?
 - ✓ *why* games are effective?
 - ✓ what our *plan* for integrating them is and how we know it will work?
- ✓ These are more important to the future of DGBL and education
 - ✓ If we can't do this, interest in games is (or will quickly become) irrelevant

Q2: Are There Empirical Studies?

- ✓ Many examples in education and industry:
 - ✓ **Mental rotation & spatial intelligence** (De Lisi & Wolford, 2002; Greenfield, 1994 & 2000)
 - ✓ **Hypothesis testing** (Greenfield, 2000)
 - ✓ **Symbol use and self-regulation** (Licona & Piccolotto, 2000)
 - ✓ **Knowledge structures and transfer** (Day, Arthur, & Gettman, 2001)
 - ✓ **Motor skills** (Fery & Ponserre, 2001)
 - ✓ **CAD training** (“Fun in CAD Training,” 2001)
 - ✓ **Cognitive skills** (Ko, 2002)
 - ✓ **Collaborative learning/Text processing** (Ravenscroft & Matheson, 2002).
 - ✓ **Biohazard response** (King, 2003)
 - ✓ **Job skills** (King, 2003)
- ✓ Yes, but...

Better Questions



- ✓ ...empirical studies miss the main point
 - ✓ Message is that games may be good for things like hand-eye coordination and visual processing
 - ✓ “When I read these ostensibly positive accounts of video games, they strike me as the equivalent of writing a story about the merits of the great novels and focusing on how reading them can improve your spelling.” (Johnson, 2005, page 24)
 - ✓ Promote narrowly defined, tightly controlled conditions
 - ✓ Leads to “small picture” results (necessary, but...)
 - ✓ ...miss the forest for the trees
- ✓ How and why do games teach?

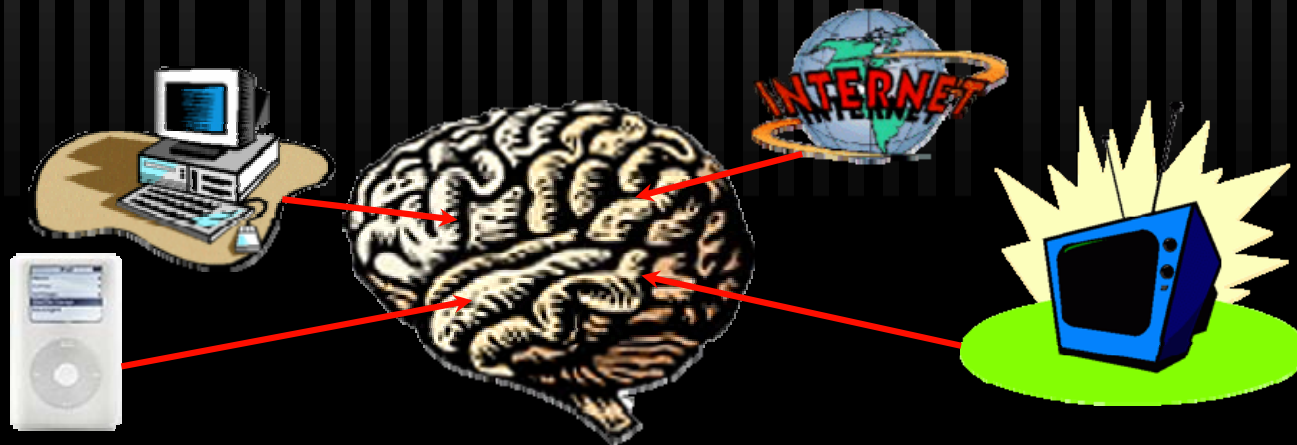
The Rest of the Story



- ✓ How do games work?
 - ✓ Theories, principles, and concepts
 - ✓ Fears of 'academizing' well intentioned, but misguided
 - ✓ Theory MUST guide (not trump) practice
- ✓ What can the past teach us about DBGGL?
 - ✓ And how can we avoid repeating our mistakes?

Cognitive Benefits of Games

- ✓ Flynn effect: Documented increase in IQ scores across all cultures that do standardized testing
 - ✓ Cannot easily be attributed to education, nutrition, or other factors
 - ✓ Cognitive complexity of mass entertainment like video games may be responsible (Johnson, 2005)



Theoretical Underpinnings of DGBL



- ✓ Play is effective learning paradigm
 - ✓ Crawford, 1982; Gee, 2004; Lepper & Chabay, 1985; Papert, 1998; Reiber, 1996)
- ✓ Situated cognition & learning
 - ✓ (Brown, Collins, & Duguid, 1989)
- ✓ Games keep player in the “zone”
 - ✓ Players want to be challenged and “figure it out” on own
 - ✓ For help, want only minimal hints, NOT the answer
 - ✓ Vygotsky’s “Zone of Proximal Development”
 - ✓ Games promote learner autonomy, metacognition

Games Are “Hard Fun” (Prensky, 2000)



✓ Piaget

- ✓ “Assimilation” (easiest) & “Accomodation” (hardest)
- ✓ “Cognitive Disequilibrium” (key to human development)
- ✓ Games thrive on cycles of CD & resolution
- ✓ Problem-solving (triggered by CD)
 - ✓ Scientific method (gather data, form hypothesis, test, revise)

A Rose by any Other Name . . .

✓ Theory leads to practice

- ✓ Knowledge of theoretical underpinnings enables analysis of different games

✓ Not all games alike

- ✓ Card games
 - ✓ Matching, numbers, patterns
- ✓ Jeopardy-style games
 - ✓ Verbal information, facts, concrete concepts
- ✓ Arcade style (“twitch” games)
 - ✓ Speed, visual processing, automaticity
- ✓ Adventure
 - ✓ Hypothesis testing, problem solving



Contributions of Instructional Design

✓ Gagne's Nine Events

- ✓ Derived from multiple learning disciplines
- ✓ Represent alignment of external instructional events with internal learning events

Instructional Event
Gain attention
Inform of objective
Stimulating recall
Present stimulus
Provide guidance
Elicit performance
Provide feedback
Assess performance
Enhance retention

Contributions of Instructional Design

✓ Oil & water or peaches and cream?

✓ Misperceptions of the 9 events:

1. **Gain Attention:** *Hey! Listen up, students*
2. **Inform of Objective:** *You are going to learn the following information during this lesson (insert objectives here)*
3. **Recall Prior Knowledge:** *Remember what we studied last week?*
4. **Present Instruction:** *(insert long-winded content here)*
5. **Provide Guidance:** *You can remember this best if you make up a story about it for yourself*
6. **Provide Practice:** *What did I just say about (content from 4 here)*
7. **Provide Feedback:** *That's (right or wrong) and here's why. You should study the things you missed. Read Chapter 15.*
8. **Assess Performance:** *Take this test*
9. **Enhance Retention and Transfer:** *Any time you encounter (content here), remember that it shares (insert common principles), and so you will always be able to apply (content here) when you learn about other (content here).*

Contributions of Instructional Design

✓ Games ALREADY embody the 9 events:

Instructional Event	Examples from Games
Gain attention	Motion, cut scenes, noise, music, character speech, health meters, attacks, death
Inform of objective	Documentation for the game, introductory movies, cut scenes, character speech, obstacles that limit movement or interaction
Stimulating recall	Environmental cues (e.g., in <i>Laura Croft: Tomb Raider</i> , ledges that look like those trained on in the earlier tutorial), obstacles (search for solutions involves recalling solutions and events from earlier in the game)
Present stimulus	All of the above (characters, environment, objects, puzzles and obstacles, conversation) arranged according to goals of game
Provide guidance	Cut scenes, non-player character (NPC) or player character (PC) speech, hint books, cheats and walkthroughs, friends, partial solutions to puzzles (pressing on the wall makes it rumble, but it does not open). Also, much comes from the learner themselves as they process what has occurred in the game, but the arrangement of the actors and objects in the environment and the structure of the story itself also provide implicit guidance
Elicit performance	Players cannot progress through the game without demonstrating what they know or think they know—all knowledge is demonstrated within the confines of the game narrative and structure.
Provide feedback	Character speech, sounds, motion, etc., Player gets past the obstacle or achieves the goal, or does not. Every action has immediate feedback, even if that feedback is that nothing happens.
Assess performance	Movement through the game IS assessment. Nothing is learned that is not also demonstrated.
Enhance retention	Things learned early in games are brought back in different, often more complex forms later. Players know that what they learn will be relevant in the short and long term.

Moving Beyond the Distinctions



- ✓ Games, ID, and learning are one and the same
- ✓ Successful games teach massive amounts of content
 - ✓ Cannot get through game without learning
 - ✓ Content is not “typical”
 - ✓ Do so through established learning theory and principles
 - ✓ cognitive disequilibrium (discontinuities prompted by a disparity between what is believed to be true and what is actually true)
 - ✓ problem-based learning
 - ✓ situated cognition and learning.
- ✓ Must stop thinking of learning and game worlds as separate activities; game designers already have!
- ✓ IDers & educators have just as much to learn from game designers

Four Principles of Learning in Games

- ✓ Are actually more
 - ✓ **Principle One:** *Games Employ Play Theory, Cycles of Learning, & Engagement*
 - ✓ **Principle 2:** *Games Employ Problem-Based Learning*
 - ✓ **Principle 3:** *Games Embody Situated Cognition & Learning*
 - ✓ **Principle 4:** *Games Encourage Question-Asking Through Cognitive Disequilibrium and Scaffolding*
- ✓ Can be used to build intelligent learning games
 - ✓ See chapter in *Games and Simulations in Online Learning: Research and Development Frameworks*, edited by David Gibson, Clark Aldrich, and Marc Prensky
- ✓ Understanding this helps guide practice

Theory leads to evaluation and practice

- ✓ How well is content situated within game?
 - ✓ Positive correlation with efficacy of learning and engagement
- ✓ How are challenge and support structured? (ZPD)
 - ✓ Challenge level must keep them in the zone
 - ✓ Support must be under teacher/learner control
- ✓ How often does game generate Cognitive Disequilibrium
 - ✓ Positive correlation with problem solving
- ✓ How do content & prior knowledge align?
 - ✓ More support, different strategies needed for accommodation than for assimilation
- ✓ How do learning and game taxonomies align?
 - ✓ Problem-solving at top, allows all levels
 - ✓ Adventure, strategy, & hybrids will be best
 - ✓ If teaching facts and verbal information, Jeopardy and frame games

Questions?

Three Approaches to DGBL



- ✓ Games are created by students
 - ✓ Students take on role of game designers
 - ✓ In building, learn content, problem-solving, programming
 - ✓ Campus School Gaming Project
 - ✓ Van Eck, R. (2006). *Journal of Computers in Mathematics and Science Teaching*, 25(2), 165-195

Three Approaches to DGBL



- ✓ Learning games are built from the ground up
 - ✓ We design games to seamlessly integrate learning and game play
 - ✓ Resource intensive, may lead to edutainment/Shavian Reversals (Papert, 1998)
 - ✓ Institutions should pursue this option
 - ✓ Alignment of taxonomies (VI and Lower level easiest to address quickly)
 - ✓ Intelligent learning games now within reach for many 4-year institutions
 - ✓ See chapter in *Games and Simulations in Online Learning: Research and Development Frameworks*, edited by David Gibson, Clark Aldrich, and Marc Prensky
 - ✓ Math Builders, CATE, Adventures in Problem Solving

Three Approaches to DGBL

- ✓ Commercial games are integrated into the curriculum
 - ✓ Support, deliver, and/or assess learning in the classroom
 - ✓ Most cost effective
 - ✓ Quality maximized: leave game play to designers, learning to teachers
 - ✓ Commercial Off-the-Shelf (COTS) DGBL
 - ✓ Have focused on this as primary means of DGBL for K-12
 - ✓ Van Eck, R. (2006). *EDUCAUSE Review*, 41(2).
- ✓ All three approaches must recognize and support integration of ID and DGBL to be most effective

Integrating COTS DGBL



✓ Has been shown to be effective:

✓ McFarlane, Sparrowhawk, & Heald, 2002

- ✓ Games provide forum in which learning arises as a result of tasks stimulated by the content of the game, in which knowledge is developed through the content of the game, and in which skills are developed as a result of playing the game

- ✓ [NESTA FutureLab](#) & EA study of games in classrooms (2005)

✓ Is the most practical

✓ Costs of commercial games far less than development

- ✓ Open-source engines and convergence is changing this

✓ More potential for widespread use

- ✓ Fewer obstacles, more games

✓ Can create “critical mass” of DGBL

- ✓ May encourage more game developers to pursue/invest in DGBL

What Are the Practical Issues?

- ✓ Can't cover them all
- ✓ Similarities to all technology integration
 - ✓ See Morrison & Lowther; Grabe & Grabe
- ✓ Some principles as heuristic for thinking about COTS DGBL
 - ✓ Aligning with the curriculum and the content
 - ✓ What to do about missing/inaccurate content
 - ✓ How to create extension activities

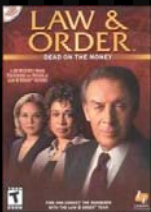
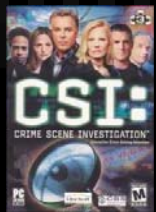
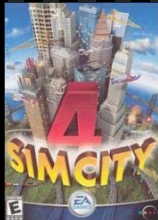
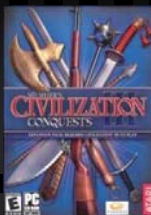
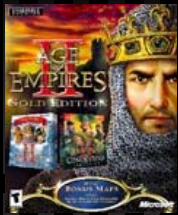
Challenges



- ✓ Commercial games are not designed to teach
 - ✓ Topics will be limited
 - ✓ But there are ways around this
 - ✓ Content will be inaccurate or incomplete
 - ✓ But this is actually a good thing
- ✓ Commercial games are expensive to purchase
 - ✓ But not as expensive as building from scratch
 - ✓ And not as expensive as implementing ineffective games
- ✓ Commercial games require analysis & matching
 - ✓ Matching is largest barrier (McClellan, 2005; McFarlane, 2002; (Van Eck & Gikas, 2004).

For Example: Choosing a Suitable Game

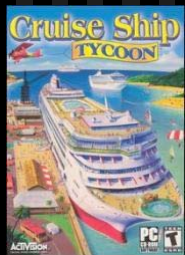
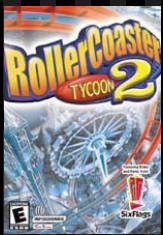
Sometimes topic matches content of course



Game	Game Content	Course Content
Age of Empires, Civilization	History	History
Sim City	Geography, Civil Engineering	Geography, Civil Engineering
Law & Order, C.S.I.	Criminal Justice, Forensic Sciences	Criminal Justice, Forensic Sciences

For Example: Choosing a Suitable Game

Other times, gameplay matches content of course



Game	Gameplay	Course Content
Contraption, Roller Coaster Tycoon	Build Machines To Specification & Tolerances	Physics, Mathematics, Engineering
Cruise Ship Tycoon	Manage Budgets, Purchase Supplies, Ensure Financial Success	Business, Economics, Resort Management

Aligning Game & Curriculum



- ✓ Top-down or bottom-up
 - ✓ Game as instructional medium
 - ✓ Game as frame for new learning (top-down)
 - ✓ Game as assessment
 - ✓ Game as chance to synthesize and apply prior knowledge (bottom-up)
 - ✓ Hybrid of both

Analyzing Game Content



✓ What IS covered?

- ✓ Breadth vs. depth (*Civilization* vs. *Call of Duty*)

✓ What is NOT covered?

- ✓ Missing topics (breadth); missing content within topic (depth); Pre-requisite knowledge required

✓ What is wrong? (teachable moments)

- ✓ Inaccurate information (poetic license)
- ✓ Misleading information
- ✓ Alternate viewpoints/interpretations (*Conquest of the Americas*)
- ✓ Inappropriate/incorrect strategies

Design & Evaluation



- ✓ Missing & inaccurate content
 - ✓ Which content will you have to add?
 - ✓ Who will provide this? (you, students, both)
 - ✓ Maximize learner responsibility
- ✓ How will you manage gameplay?
 - ✓ Saved games, play in/out of class
- ✓ What activities can be created to address weaknesses & gaps?
 - ✓ Do this all the time for other media
 - ✓ Textbooks, videos

Research Says: Stay in the Game

- ✓ Learning is integral to story in commercial games
- ✓ Leads to flow (Csikszentmihalyi, 1990: *The psychology of optimum experience*)
 - ✓ Optimal learning state
- ✓ Intrinsic motivation (Malone & Lepper, 1987)
 - ✓ Endogenous vs. exogenous fantasy (in relation to content)
 - ✓ Endogenous fantasy will promote flow
 - ✓ When not IN game, keep activities & roles endogenous TO game
 - ✓ Math & numbers: Budgets, spreadsheets, reports/charts, databases
 - ✓ Writing: Diary, reports, letters, legal briefs, faxes, multiple viewpoints
 - ✓ Science: Duplicate/conduct experiments (endogenously!); conduct feasibility studies
 - ✓ Research: Assess game veracity, provide missing data

Making the Call



- ✓ Is it worth the time?
 - ✓ Good games can easily take 30 to 50 hours
 - ✓ Can manage through saved games, transitions, but...
 - ✓ Is the amount of potential learning justified by the amount of work and time to implement the game?
 - ✓ Must be willing to admit it is not!

Truth or Consequences



- ✓ What happens if we don't look at DGBL in this way?
- ✓ Lots of examples in history of how NOT to implement technology-based learning
- ✓ History tells us what this approach leads to

Media Use in the Schools



- ✓ “AV & television in the schools will revolutionize learning!”
 - ✓ “kids are different today”
 - ✓ “media is more motivating”
 - ✓ “media reaches more learners”
- ✓ Hundreds of “horse race” studies
 - ✓ Meta-analyses show “no significant difference” (NSD)
- ✓ Why?
 - ✓ Never accounted for the strengths and weaknesses
 - ✓ Never aligned media with learning outcomes and pedagogy
 - ✓ Mistook use for integration

Computing Technology in the Schools



- ✓ “Computers in the schools will revolutionize learning!”
 - ✓ “kids are different today”
 - ✓ “computers are more motivating”
- ✓ Educators and IDers: “Where’s the Beef?”
 - ✓ Inconsistency of implementation, ID
- ✓ Hundreds of studies, some good
 - ✓ SOME evidence to support optimism, but
 - ✓ Overall, no significant difference
- ✓ Why?
 - ✓ Never examined how technology aligned with pedagogy and what we wanted students to DO
 - ✓ Mistook use for integration

How Do You Get Started?



- ✓ Write the Book on DGBL
 - ✓ Figure out what DGBL will look like at your institution
 - ✓ Find those locally doing research in games and learning
 - ✓ Instructional design, education, cognitive psychology
 - ✓ Gather DGBL resources, find local or external consultants
 - ✓ Create map for what you will need to implement DGBL
 - ✓ Create documentation
 - ✓ Heuristics and job aids for planning and analysis
 - ✓ Examples of best practices

Thank You!

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