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What Are We Playing At? What It Means to Integrate Games into the Curriculum, and Why We Should Do It

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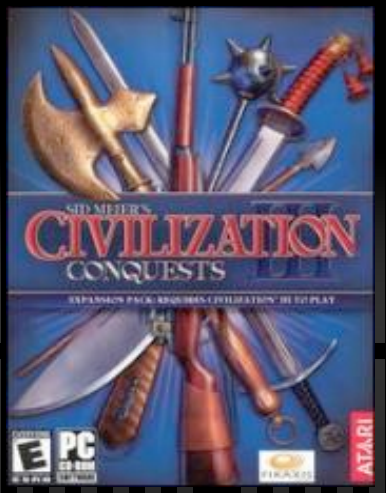
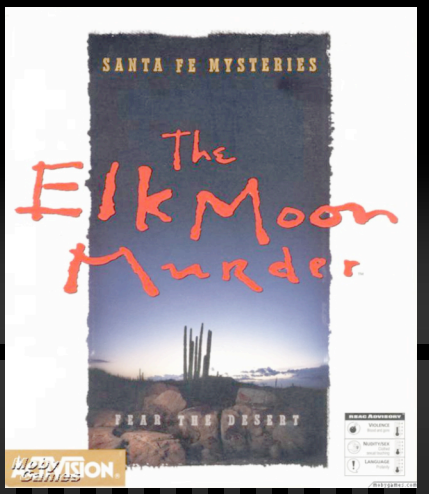
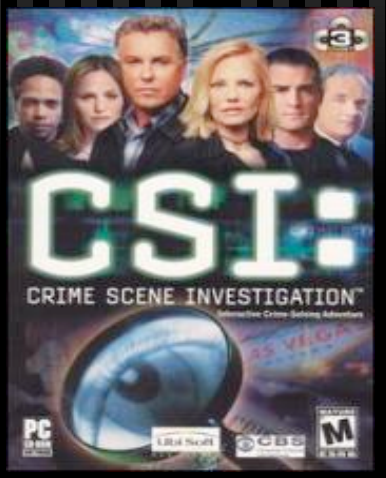
Increased Popular Interest in Games

- Interactive Digital Software Association:
  - 47% of all Americans bought or will buy at least one computer game in 2005
  - 248 million games were sold last year
  - 35% of game players are under 18
  - 43% are 18-49
  - 55% are male,43% are female







Games & Learning

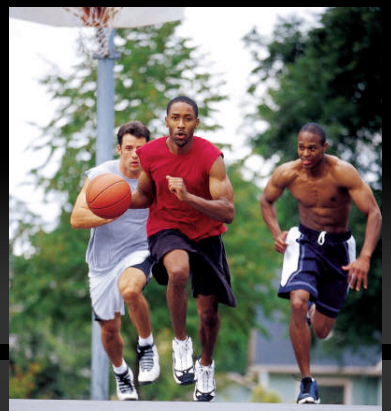
- Many examples in education and industry (e.g., Aldrich, 2004; Gee, 2003; Prensky, 2000)
  - Knowledge structures and transfer (Day, Arthur, & Gettman, 2001), Mental Rotation & Spatial Intelligence (De Lisi & Wolford, 2002; Greenfield, 1994 & 2000), Motor Skills (Fery & Ponserre, 2001), CAD training ("Fun in CAD Training," 2001), Hypothesis Testing (Greenfield, 2000), Job Skills (King, 2003), Biohazard Response (King, 2003), Cognitive Skills (Ko, 2002), Symbol Use and Self-Regulation (Licona & Piccolotto, 2000), and Collaborative Learning and Text Processing (Ravenscroft & Matheson, 2002).
  - Education Arcade: Environmental Detectives
  - Virtual U
- But why and how do they work?

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)
- Games require higher-order cognition*
  - Cognitive disequilibrium
  - Problem-solving, hypothesis formulation and testing, rule formulation, concept learning

* Not necessarily in a recognized content domain

Theoretical Support for Games



- ✓ Play is effective learning paradigm (Lepper & Chabay, 1985; Crawford, 1982; Reiber, 1996; Papert, 1998; Gee, 2004)
- ✓ Situated cognition & learning (Brown, Collins, & Duguid, 1989)
- ✓ Anchored instruction (Bransford et al., 1990)

So What IS Digital Game-Based Learning?

- Three approaches to DGBL
  - Games are created by students
    - Students take on role of game designers
    - In building game, they learn the content, problem-solving, programming, etc.
    - Time intensive and limited domains
  - Educational games could be built from scratch*
    - We design games to seamlessly integrate learning and game play
    - Resource intensive, and lead to edutainment (Shavian Reversals--Papert, 1998)
  - Commercial games* are integrated into the curriculum
    - Support, deliver, and/or assess learning in the classroom
    - Most cost effective
    - Quality maximized by leaving game play up to game designers, and learning up to teachers

* As distinguished from edutainment titles

Integrating Commercial Games & Learning

- Requires careful analysis (Van Eck & Gikas, 2004)
- Matching is largest barrier (McClellan, 2005; McFarlane, 2002).
- Must recognize not all games are 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

Matching Taxonomies

Bates' Taxonomy of Games	Explanation of Genre	Gagne's Intellectual Skills	Bloom's Taxonomy
Action	Keep the player moving and involved at all times. Primary skills are eye/hand coordination and quick reflexes. Deep thinking is generally not required. Examples: Dark Age of Camelot, Jedi Knight	Defined Concepts Concrete Concepts Discriminations	Application Comprehension Knowledge
Role Playing	Revolves around characters, story and combat and takes place in large, expansive worlds and played out over hundreds of hours. Examples: Baldur's Gate, Diablo, Icewind Dale	Problem Solving Higher Order Rules Defined Concepts Concrete Concepts Discriminations (All)	Evaluation Synthesis Analysis Application Comprehension Knowledge (All)
Adventure	Story based on exploration and puzzle solving where the player is the hero. Examples: CSI, Law & Order, Myst	All	All
Strategy	Effective strategy games are balanced. Just enough information is provided for motivation and interest. Too much information, the player doesn't make effective decisions; too little information the player spends time worrying about what to exclude. Examples: Rise of Nations, Civilization	All	All
Simulations	The purest form of wish fulfillment; fulfill the player's fantasy of what he can't do in real life. Examples: The Sims, Cruise Ship Tycoon, Flight Simulator	All	All
Sports	Allows players to play their favorite sports activity to their heart's content. Examples: Tiger Woods PGA Tour, NHL 2004	Defined Concepts Concrete Concepts Discriminations	Application Comprehension Knowledge
Fighting Games	Allows players to taunt their rival who is playing beside them. Special moves and signature moves are a must. Examples: Quake II & III, Star Wars	Defined Concepts Concrete Concepts Discriminations	Application Comprehension Knowledge
Casual	Games for the "new gamers" – easy to learn and not difficult to master. Examples: Who Wants to be a Millionaire?, Monopoly	Defined Concepts Concrete Concepts Discriminations	Application Comprehension Knowledge

Challenges to Integrating Games

- 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

The Biggest Challenge Is…

- ✓ Doing it right
- ✓ Lots of examples in history of how NOT to implement technology-based learning
- ✓ “Moore’s Law” has led to a “build it and they (better learners) will come” philosophy
- ✓ History tells us what this approach leads to

Media Use in the Schools

- 1960s & 1970s
  - Audio and video in the schools
  - Televisions in the schools
  - Hundreds of “horse race” studies of media impact on learning
  - Experimental and anecdotal evidence of efficacy reach popular press
- 1980s
  - Meta-analyses show “no significant difference” (NSD)
- Why?
  - Never accounted for the strengths and weaknesses of the media
  - Never analyzed media in relation to learning outcomes, strategies, and pedagogy
  - Mistook use for integration

Technology Integration

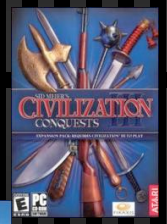
- 1970s
  - Birth of the PC
- 1980s
  - Purchase of the PC for schools
  - Anecdotal and experimental evidence reach the popular press
- 1990s
  - Studies of the impact and use of PCs continue
- 00s
  - No significant difference
- Why?
  - Never examined how technology aligned with pedagogy and what we wanted students to DO
  - Mistook use for integration

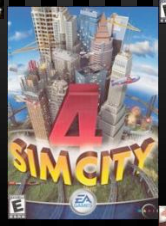
Games in Learning Environments

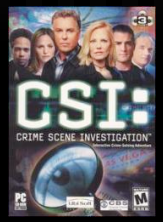
- 1970s
  - Birth of the video game industry
- 1980s
  - Games meet the PC
- 1990s
  - Games outstrip movies in sales
  - Technology allows for interactive worlds and environments
  - Experimental & anecdotal evidence on efficacy reaches popular media
- 00s?
  - Must learn from our past
  - Games can be:
    - Exceptionally powerful learning tools
    - Or a waste of time and resources
  - Cannot mistake use for integration

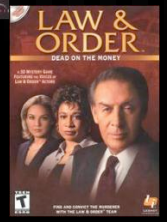
For Example: Choosing a Suitable Game

- Sometimes topic matches content of course





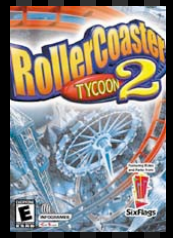


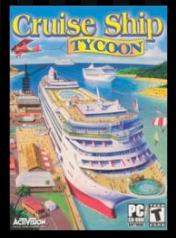


Game	Game Content	Course Content
Age of Empires, Civilization	History	History
Sim City	Geography, Civil Engineering	Geography, Civil Engineering
Law & Order, C.S.I.	Criminal Justice, Forensic Sciences	Criminal Justice, Forensic Sciences

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

How Is Game Aligned With Curriculum?

- ✓ Top-down or bottom-up
  - ✓ Game as frame for new learning (top-down)
  - ✓ Game as chance to synthesize and apply prior knowledge (bottom-up)
  - ✓ Hybrid of both
    - ✓ Will see an example with *Physicus*, later

How Is Game Aligned With Content?

- What IS covered?
  - Breadth vs. depth; sub-set of topics to focus on
- 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 (fosters inaccurate/incomplete information)
  - Alternate viewpoints/interpretations (one of many views or theories)
  - Inappropriate/incorrect strategies (method of deriving information/conclusions inaccurate/incomplete)

Design & Evaluation

- Missing & inaccurate content
  - Which content will you have to add?
  - Who will provide this? (you, students, both)
  - Maximize learner responsibility
- What activities can be created to address weaknesses?
  - Learning is integral to story in commercial games
  - Cycles of cognitive disequilibrium & resolution
  - 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

Designing Instructional Activities

- Examples of activities
  - Math & numbers: Budgets, spreadsheets, reports/charts, databases
  - Writing: Diary, scientific report, letters, legal briefs, dictionary, faxes; multiple viewpoints
  - Science: Design, duplicate, conduct experiments (endogenously!); conduct/write up feasibility studies; hypothesis testing
  - Research: Assess veracity of game information, provide missing data (Internet, library, encyclopedia, etc.)
- Making the call: Is it worth the time?
  - 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!

An Example of DGBL

- *Physicus*
  - Assessment/application, or new learning
  - Inaccurate elements, combined with accurate
  - Mixture of content blended with game & separate

Support

- ✓ Documentation & training support
  - ✓ Established model of what games in classroom looks like
  - ✓ Heuristics and job aids for planning and analysis
    - ✓ See Game Analysis Packet at idt.und.edu; follow the “News” link
  - ✓ Training for faculty & support staff
  - ✓ Examples of best practices

Support

- Pedagogical support
  - Hire instructional designers
  - Support one-on-one development akin to online learning
  - Find technology integration specialists in college of education
- Technical support
  - Faculty during development and implementation
  - Students during implementation
  - Means training help desk and providing documentation to them

Support

- Financial support
  - Assistance with licensing
    - Set up volume licenses and limited use with companies
    - Negotiate better pricing and pass on to students
  - Development time
    - Provide incentives to faculty to do it right way
    - Similar model to much online course development

Infrastructure

- ✓ Appropriately configured labs
  - ✓ Not locked down*
    - ✓ Video resolutions
    - ✓ Installation of proprietary drivers & game patches
    - ✓ Ability to save and retrieve games
  - ✓ Equipment
    - ✓ Headphones/speakers; sound cards
    - ✓ Video cards
  - ✓ Access for out of class play (homework)

* Or dedicated technician support

Research & Development

- Find those doing research in games and learning
  - Instructional design, education, cognitive psychology
- Collect and disseminate research and examples
  - Database of examples, guidance for application to additional domains
- Encourage rigorous studies and game design
  - Artificial intelligence, intelligent tutoring systems, pedagogical agents

Additional Resources & Readings

- Aldrich, C. (2004). Simulations and the future of learning: An innovative (and perhaps revolutionary) approach to e-learning. San Francisco: Pfeiffer.
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