A Comprehensive Review on Positive Effects of Games

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Outline

• Old story
  – Positive effects of games in general
  – Positive effects of educational games

• 2002
  – America’s Army & Serious Game Initiative

• Serious Games
  – Games for learning, health, and social change

• Future
  – Design recommendations
Old Story: Previous studies on CG in General

• See next Table

• Till 2002 or so

<table>
<thead>
<tr>
<th>Content</th>
<th>Negative</th>
<th>Positive</th>
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<tr>
<td>Violence</td>
<td>Affect (hostility, anxiety)</td>
<td>Catharsis</td>
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<td>Aggressive behaviors</td>
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<td>Arousal</td>
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<td>Empathy toward others</td>
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<td>Physiological responses (heart rate, blood pressure, hormone)</td>
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<td>Priming of aggressive thoughts</td>
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<td>Pro-social behaviors</td>
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<td>School performance</td>
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<td>Education (Training)</td>
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<td>Motivation</td>
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<td>Retention memory</td>
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<td>Science learning</td>
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<td>Spatial visualization</td>
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<td>Utility for special groups (attention-deficit children, patients)</td>
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<td>Non-content specific</td>
<td>Addiction</td>
<td>Cognitive ability</td>
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<td>Delinquent behaviors</td>
<td>Elderly adults’ well-being</td>
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<td>Mental disorder</td>
<td>Memory enhancement for elderly people</td>
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<td>Obsessive-compulsiveness</td>
<td>Reaction time</td>
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<td>School performance</td>
<td>Safe experience of dangers and conflicts</td>
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<td>Sex-role stereotyping</td>
<td>Self-efficacy</td>
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<td>Vision and other physical health</td>
<td>Sociability</td>
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<td>Utility for people in institutions (hospitals)</td>
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Positive Effects of Entertainment Games in General - 1

• Training
  – the Marine Corps Modeling and Simulation Management Office modified and used the game “Doom”

• Spatial Skills
  – For children (5th, 7th, 9th grades) (McClurg & Chaille, 1987)
  – College students (Pepin & Dorval, 1986)
  – Mixed results for the old (Gagnon, 1985; Pepin & Dorval, 1986)
Positive Effects of Entertainment Games in General - 2

• Cognitive Abilities
  – Better cognitive skills for science (Greenfield et al., 1994); flexible thinking (Doolittle, 1995); inductive reasoning (Camaioni, et al., 1990); complex thinking skills related to problem solving (Keller, 1992); strategic planning (Jenkins, 2002; Keller, 1992); self-regulated learning (Rieber, 1996; Zimmerman, 1990).

• Academic Performance
  – Mixed
  – Durkin and Barber (2002): moderate play is better than non-play in terms of GPA
Positive Effects of Entertainment Games in General - 3

• Sociability
  – Consistent findings show that VT and Columbine cases are outliers
  – Either null or usually positive relationship
    • Shimai et al., 1990; Colwell et al., 1995; Philips et al., 1995; Durkin and Barber, 2002

• Therapy
  – anxiety reduction (Naveteur & Ray, 1990); trigger motivation to exercise during wheelchair use (O’Connor et al., 2001); divert attention from pain (Redd et al., 1987), speech difficulties (Horn, et al., 1991), rehabilitate cognitive problems and memory loss (Larose et al., 1989; Drew & Waters, 1986; Dustman et al., 1992; Goldstein et al., 1997)
Positive Effects of Educational Games - 1

• Learning (mixed findings)
  – Randel, Morris, & Wetzel (1992) – effectiveness of simulations or games
    • 56% no difference, 32% favoring games, 5% favoring conventional instruction, 7% favoring games yet with problematic experimental design
  • Difference in subject matter
    – Math: most effective in comparison to social sciences, logic, physics, and biology
Positive Effects of Educational Games - 2

- Educational games beneficial in the area of
  - teaching strategic management (Hsu, 1989; Wolfe, 1997) and statistical concepts (Lane & Tang, 2000)
  - scientific discovery learning (de Jong & van Joolingen, 1998)
  - language learning (Jordan, 1992; Hubbard, 1991; Kovalik & Kovalik, 2002),
  - skill-based learning (Gopher, Weil, & Bareket, 1994),
  - health education (Dorman, 1997); safe sex education (Cahill, 1994; Kashibuchi & Sakamoto, 2000); juvenile diabetes self-care (Brown et al., 1997); and medical education (Boreham, Foster, & Mawer, 1989).
Positive Effects of Educational Games - 3

• **Improve motivation (consistent results)**

• **Improved retention memory (consistent results)**

• **Utility for special groups**
  – For kids with learning disability (Pope & Bogart, 1996)
  – For cognitively impaired elderly (Farris et al., 1994; Goldstein et al., 1997)
Along came Serious Games…

• After 2002
• Hot during the last couple of years

**What are Serious Games?**
- Results from CA by ASCGames

Working definition from Ute et al., 2007 Annenberg Serious Game Workshop

<table>
<thead>
<tr>
<th>perspective</th>
<th>Desired effects</th>
<th>Undesired effects</th>
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<tbody>
<tr>
<td>producer</td>
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<tr>
<td>Intentional learning/</td>
<td>Serious games</td>
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<td>development/change</td>
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**society**
What are Serious Games?:
CA Results

• Compilation of 612 serious games through
  – Online survey (serious games list)
  – Web sites (e.g., serious games, pervasive games, games for health, social impact games, Wikipedia)

• Platform: almost all serious games are PC based (12 easy play, 9 game platform, 7 handheld)
What are Serious Games?

• Target age group

Cf. Average age of commercial video game player: 33 yrs. (ESA, 2005)
What are Serious Games?

• Genres (kappa = .62)

Cf. 30% of commercial games are classified action, 27% strategy (ESA, 2005)
What are Serious Games?

• Content areas

![Pie chart showing content areas of Serious Games]

<table>
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<tr>
<th>General Category</th>
<th>Percentage</th>
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<tr>
<td>Academic Education</td>
<td>63.39%</td>
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<tr>
<td>Occupation related</td>
<td>14.16%</td>
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<tr>
<td>Health</td>
<td>8.64%</td>
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<tr>
<td>Social Change</td>
<td>8.12%</td>
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<tr>
<td>Military</td>
<td>5.35%</td>
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<tr>
<td>Consumer Behavior</td>
<td>0.35%</td>
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</table>

Figs show percents
Seriousness of serious games

• Currently, $20 million market only… Yet
  – Global education and training market
    • $2 trillion as of 2003
  – By 2008, 40 percent of U.S. companies will adopt serious games in their training efforts (Michael & Chen, 2006).
    • E.g., Seriosity
  – Serious games can be applied to even broader areas such as military, government, campaign, ngo movements, and healthcare.
Virtual Worlds, Real Leaders:
Online games put the future of business leadership on display

A Global Innovation Outlook 2.0 Report
Effects of Serious Games

- Games for Learning
- Games for Health
- Games for Social Change
Games for Learning

• Diverse subjects
  – economics (Lengwiler, 2004), business and management (Chua, 2005), language (Kovalik & Kovalik, 2002), mathematics (van Eck & Dempsey, 2002), biology (Clark & Smith, 2004), geography (Mayer, et al., 2002), medical education (Mann et al., 2002), and military training (Coleman, 2001).

• Meta Results
  – games and interactive simulations have advantages over traditional teaching methods for cognitive gain outcomes (Vogel et al., 2006).
Games for Health

• For disease or risk prevention
  – promoting healthy nutrition (Peng, in press), safe sexual behavior (Thomas, Cahill, & Santilli, 1997), anti-smoking (Lieberman, 2001), injury prevention (Goodman, Bradley, Paras, Williamson, & Bizzochi, 2006), and early treatments for heart attack (Silverman et al., 2001).

• To improve self-management skills for coping with certain chronic diseases
  – asthma (Homer et al., 2000; Lieberman, 2001), diabetes (Brown et al., 1997; Lieberman, 2001), cancer (Cole et al., 2006).
Games for Social Change

- Energy Czar
  - an energy crisis simulation game
- Howard Dean for Iowa
  - to educate various grassroots outreach programs.
- PeachMaker
  - the Israeli Prime Minister vs. the Palestinian President
- Darfur is dying
  - social issue awareness game
- No empirical study yet
Why Serious Games Work? (and for the same reason why it might not work)

• Meaningful Context
  – Situated Learning and problem solving
  – Experiential Learning
• Fun and motivation
• Adjustment and scaffolding
  – Optimal difficulty for maximum flow
• Learner control
  • Perceived control (e.g., more choices, diverse level of difficulty) is important for motivation
Why Serious Games Work? (and for the same reason why it might not work)

• Immediate feedback
  • Unlike classroom settings, immediate and personalized feedback is possible

• Safe test-bed and infinite practices
  – Especially for health related games

• Immersion/Presence
What constraints will need to be considered as we create a new class of serious games especially for children? - 1

- **Scaffolding**
  - Right amount of challenge;
- **Broad appeal**
  - Consider gender, minority, ethnicity issues.
- **Curriculum**
  - Need to be aligned with school curriculum
- **Transfer**
  - From motivation to actual performance
What constraints will need to be considered as we create a new class of serious games especially for children? - 2

– Curiosity
  • For deep learning, games should make learners experience cognitive disequilibrium; Can apply findings from evolutionary psychology to increase curiosity among learners

– Narrative experience
  • Narrative sells, but how can we weave good story into serious games for serious subjects (e.g., math, science)?

– Assessment
  • Should be able to track student’s learning activities
  • Stealth and unobtrusive in order not to block flow
  • Improve student learning directly (e.g., system feedback) or indirectly (e.g., subtle modification of game environments)
Moving Beyond from Here

• Korea can take an initiative in serious games
• Serious games have a bigger market than online games
• Serious games need serious science
  – Need for multi-disciplinary, multi-year, and large-scale projects on serious games.
  – Need to build Learning Science comprised of scholars from
    • Brain Science; Physiology; Psychology; Media Studies; Sociology; Etc…