Play and Learn: Potentials of Game-Based Learning

by

Maja Pivec
Play and Learn: Potentials of Game-Based Learning

Presented by
Dr Maja Pivec

MODSIM, September 12th 2007
Game-Based Learning

- Games and learning - how does this work?
- Game about designing a game & results
- Transferability - GBL in Medicine
- Games for Treatment
Games Characteristics

Game elements

- Fantasy – Imaginary or fantasy context, themes, or characters.
- Rules/Goals – Clear rules, goals, and feedback on progress towards the goals.
- Sensory Stimuli – Dramatic or novel visual and auditory stimuli.
- Challenge – Optimal level of activity and uncertain goal attainment.
- Mystery – Optimal level of informational complexity.
- Control – Active learner control.

Games - Motivation and Learning

Games enhance motivation and increase students interest in subject matter

... yet the extent to which this translates into more effective learning is less clear

[Druckman (1995) ]
Games - Theory of "Flow"

- Tasks that can be completed.
- The ability to concentrate on the task.
- Where concentration is possible because the task has clearly identified goals.
- Where concentration is possible because the task provides immediate feedback.
- The ability to exercise a sense of control over one's actions.
- An immersion that removes awareness of the frustrations of everyday life.
- The concern for one's self disappears but emerges stronger afterwards.
- The sense of the duration of time is altered.

[Csikszentmihalyi, M. (1990)]
Games - Immersion

Causes a "persistent re-engagement" of the Player.

Games - Identifying Immersion

Eye Tracking to Identify Player Immersion
Games - Eye Tracking

Quake II
Games - Eye Tracking

Tomb Raider

MODSIM 2007

Dr Maja Pivec
NeverWinter Nights
How to design effective learning opportunities?

- learners are encouraged to combine knowledge from different areas to choose a solution or to make a decision at a certain point,
- learners can test how the outcome of the game changes based on their decisions and actions,
- learners are encouraged to contact other team members and discuss and negotiate subsequent steps,
- thus improving their social skills.
Game-Based Learning

Learning is the acquisition of knowledge or skills through experience, practice, or study.

Learning outcomes are the knowledge, skills, and abilities that the student will possess following the learning experience.
Player’s Learning Outcomes

- Skill-based learning outcomes
  performance of technical or motor skills

- Cognitive learning outcomes
  declarative knowledge
  procedural knowledge
  strategic knowledge

- Affective learning outcomes
  beliefs or attitudes regarding an object or activity
In-Game Cycle

Concrete Experience

Active Experimentation

Reflective Observation

Abstract Conceptualisation


MODSIM 2007

Dr Maja Pivec
In-Game Cycle

System feedback

Judgements

Player Behaviour


MODSIM 2007

Dr Maja Pivec
Player's Reflection

- Reflection-in-Action

*If play is broken up with reflection, learning is reduced. If reflection is dispersed within the game, learning is increased.*
Player's Abilities

- The Player must be able to enter the game at the appropriate level
- The cognitive challenge must be appropriate for the player's ability
- As the player's skill level is incremented, the challenge must increase
Player's Abilities

"Persistent Re-engagement comes from Player Immersion"

"Player Immersion is the result of Scaffolded Challenge"

So how does this occur....

Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural, Strategic Knowledge)

Player Abilities

Instructional Design

Game Characteristics

Zones of Proximal Development

Level 1
Level Completed
(Abilities incremented)

Level 99

System feedback
Judgements

Behaviour

Debriefing
Reflection-on-Action
Learning Outcomes

Social Environment
(Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

Dr Maja Pivec

MODSIM 2007
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural, Strategic Knowledge)

Player Abilities

Instructional Design

Game Characteristics

Zones of Proximal Development

Level 1

Level Completed (Abilities incremented)

Level 99

System feedback

Judgements

Behaviour

Debriefing Reflection-on-Action
Learning Outcomes

Social Environment (Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

MODSIM 2007

Dr Maja Pinec
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural,
Strategic Knowledge)

Player Abilities

Instructional Design

Game Characteristics

Level Completed
(Abilities incremented)

Level 1

Level 99

Zones of Proximal Development

System feedback

Judgements

Behaviour

Debriefing
Reflection-on-Action

Learning Outcomes

Social Environment
(Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

SYSTEM FEEDBACK

Behaviour

Judgements

Dr Maja Pivec
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural, Strategic Knowledge)

Player Abilities

System feedback
Judgements
Behaviour

Instructional Design

Zones of Proximal Development

Game Characteristics

Level Completed (Abilities incremented)

Level 1

Level 99

Debriefing
Reflection-on-Action
Learning Outcomes

Social Environment (Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

M O D S I M  2 0 0 7

Dr Maja Pivec
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural,
Strategic Knowledge)

Persistent Re-Engagement

Player Abilities

Instructional Design

Game Characteristics

Zones of Proximal Development

Level 1
Level Completed
(Abilities incremented)

Level 99

System feedback
Judgements
Behaviour

Debriefing
Reflection-on-Action

Learning Outcomes

Social Environment
(Affective Learning)

System feedback
Judgements
Behaviour

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

MODSIM 2007

Dr Maja Pivec
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural, Strategic Knowledge)

Player Abilities

Instructional Design

Game Characteristics

Zones of Proximal Development

Level 1

Level Completed (Abilities incremented)

Level 99

System feedback

Judgements

Behaviour

Debriefing
Reflection-on-Action

Learning Outcomes

Social Environment (Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

Dr Maja Pivec
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural, Strategic Knowledge)

Player Abilities

Instructional Design

Game Characteristics

Zones of Proximal Development

Level 1
Level 2
Level 3
Level 4
Level 99

Level Completed (Abilities incremented)

System feedback
Judgements

Behaviour

Debriefing
Reflection-on-Action

Learning Outcomes

Social Environment
(Affective Learning)

Micro Game Cycle
(Skill based Learning, Cognitive Abilities)

Dr Maja Pivec
Model of Game-Based Learning

Game-Based Learning occurs in a recursive loop and as such, as skills are acquired or incremented, the player moves to the next level of the game.

Recurring loops of GBL
Game-Based Learning is the "vehicle" that fosters the acquisition of learning outcomes.

Recurring loops of GBL
GBL - Learning Outcomes

- Learning Objective: Memory/ Repetition/ Retention
- Definition: Factual Knowledge
- Appropriate Games/ Typology:
  
  Drill and Practice
  Quiz games
  Puzzle games
GBL - Learning Outcomes

- Appropriate Games/ Typology:
  
  **Drill and Practice**
  
  **Quiz games**
  
  **Puzzle games**

- Examples:
  
  **Roadquiz**
  
  **Virtual Cell**
GBL - Learning Outcomes

- Learning Objective: Dexterity/ Spread, Precision/ Motoric
- Definition: Sensorial/ dexterous knowledge
- Appropriate Games/ Typology:
  - Combat/ fighting games
  - Driving games
  - Simulation games
GBL - Learning Outcomes

- Appropriate Games/ Typology:
  
  Combat/ fighting games
  Driving games
  Simulation games

- Examples:
  
  Doom
  Flight Simulator
GBL - Learning Outcomes

- Learning Objective: Applying Concepts/ Rules
- Definition: Translate knowledge into new context: use information, use methods, concepts, theories in new situations
- Appropriate Games/ Typology:
  - Sport games
  - Action games
  - Driving games, Drill & Practice
GBL - Learning Outcomes

- Appropriate Games/ Typology:
  
  Sport games  
  Action games  
  Driving games, Drill & Practice

- Examples:

  FIFA  
  Driver

MODSIM 2007

Dr Maja Pivec
GBL - Learning Outcomes

- Learning Objective: Decision-making (strategy & problem solving)

- Definition: Analysis of knowledge based on problem solving, prediction, drawing conclusions, choice making, reasoned argument

- Appropriate Games/ Typology:
  - Strategic games
  - Adventure games
  - Role Play games
  - Simulation games
GBL - Learning Outcomes

- Appropriate Games/ Typology:
  
  Strategic games
  Adventure games
  Role Play games
  Simulation games

- Examples:

  SimCity
  Monkey island
GBL - Learning Outcomes

- Learning Objective: Ability to learn/ Self-assessment
- Definition: Evaluation
- Appropriate Games/ Typology:
  - Role play games
  - Simulation games
GBL - Learning Outcomes

- Appropriate Games/Typology:
  
  * Role play games
  * Simulation games

- Examples:
  
  The Sims
  GeoGame
Educational game design

- Constructivist learning theory
- Exploratory approach to learning
  - interaction, coping with problems, understanding of the whole
  - learners are active participants in knowledge acquisition
  - learners are engaged in restructuring, manipulating, re-inventing, and experimenting with knowledge
Educational game design

Pedagogical goals:

1. to provide an experience with the knowledge-construction process,

2. to provide experiences encouraging appreciation of multiple perspectives,

3. to embed learning in realistic and relevant contexts,

4. to encourage ownership in the learning process,
Educational game design

Pedagogical goals:

5. to embed learning in social experience,

6. to encourage the use of multiple modes of representation,

7. and to encourage self-awareness of the knowledge construction process
Class on GBL

Game about designing a Game

- Team work — one team, one company
  - role within a team — role in a company
  - game producer, game developer, programmer

- Goal — concept of an educational game
Golden Pineapple Award

"Anaphylactic" from Dudary Entertainment

"Keep Me Alive" from Stardust Enterprises
Anaphylactic

The Medical Game

Bayer Thomas, Gumpf Bernhard, Hollinger Michael, Lengauer Patrick
IND04 - Game Based Learning
Paul Kearny | Maja Pivec

MODSIM 2007

Dr Maja Pivec
Anaphylactic
Anaphylactic

.the challenge
Anaphylactic
Anaphylactic

.the interface
Anaphylactic

.the marketing

MODSIM 2007

Dr Maja Pivec
Keep Me Alive

Do you know your body?

Play Instructions
Keep Me Alive
Keep Me Alive

Do you know your body?

Skeleton

Organs

Character

How to heal

The illnessattle

info

Lung

Your lungs are complex organs, but what they do is take a gas that your body needs to get rid of (carbon dioxide) and exchange it for a gas that your body can use (oxygen).

Diseases:

- Asthma
- COPD (including emphysema and chronic bronchitis)
- Infectious lung diseases
- Lung cancer
- Sleep apnea

More Information

Drag the organs to their right position

Finished!
Keep Me Alive
Keep Me Alive
Keep Me Alive

Do you know your body?

Charly
0% 100%

Bill
0% 100%

Skeleton
Character
How to heal
The illness battle

Charly has a horrible tummy-ache.
Please choose the right medicine.
Potentials of GBL

- Formal and informal learning
- Educational game for interdisciplinary learning
- Context based environment
- Off the shelf game
Contagion

- role-playing adventure game
- fostering interdisciplinary learning
- targeted at children aged 10 – 15
- based on active exploration

[de Castell, 2006]

Information about diseases, such as Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Avian Flu, and Acquired Immune Deficiency Syndrome (AIDS)

Career preparation environment, community health officer, physician, or a medical researcher
George ... a virtual patient

- curricular topics blurred with narrative elements thus creating a realistic context
- condition gets more complicated as they progress in their studies

http://www.eemec.med.ed.ac.uk/visitors/

Students are role playing "to be a doctor", until the end of their education when they become doctors

[Begg et al 2006]
• situation (plus) various choices

• repeated interaction with “what if” reflections

• College of Medicine and Veterinary Medicine’s Learning Technology Section at the University of Edinburgh

http://www.eemec.med.ed.ac.uk/visitors/

Role-play focused on decision-making scenarios

[Begg et al 2006]
Video games as teaching tool for improvement of laparoscopic skills

- fewer errors,
- better performance
- faster completion

"Video games may help thin the technical interface between surgeons and screen-mediated applications"

[Rosser et al 2007]
e-Inclusion by means of Game-Based Learning

[Pivec et al., 2005]

- Socialization
- Creating experience
- Therapeutic application of game environments
Socialization

- personal development and improvement of self esteem of the learner
- establishing the dialogue and breaking social and cultural boundaries

"makes me feel like a real person"

[Kearney, 2005]
Creating experience

Terraformers - 3D adventure game for sighted and blind.

- provides a standard graphics mode
- also has a high contrast mode for gamers with low vision
- can be played with no graphics for the blind

http://www.terraformers.nu/eng/features.php
Therapeutic application of game environments

- force feedback joystick for the therapy of cerebral palsy
- 40% in movement precision and movement speed using this technique

[Geerdink et al., 2003]
Therapeutic application of game environments

- VR and Sony's Eye-toy
- Snowboarding, Volleyball, Soccer.

"perceived physical changes and increased social acceptance from peers and family"

[Miller & Reid, 2003]
Therapeutic application of game environments

- RoboMemo
- improvement of working memory capacity

complementary treatment for people with Attention Deficit Hyperactivity Disorder (ADHD)

**Therapeutic application of game environments**

- PI - 3D game for adolescent psychotherapy
- depression, anxiety and social skills problems, and engage more easily with therapists
- play therapy, therapeutic storytelling, interactive narrative systems

Media Lab Europe and Trinity College Dublin
[Coyle et al., 2005]
Conclusions

The success of any game is dependant on the games ability to maintain immersion by staying within the upper zone of the player’s ability.
Conclusions

Opportunity to get the experiences and to learn in a “safe virtual world”
Thank You

Contact Details

Professor DI Dr. Maja Pivec
Information Design
FH JOANNEUM
University of Applied Sciences
Alte Poststrasse 152
8020 Graz Austria

Email: maja.pivec@fh-joanneum.at
Website: www.majapivec.com
Discussion

Why don't we use games more often in classrooms?

- Low tolerance of the environment for the games
- Perceived as unserious activity
- Fear not to reach learning objectives
- Lack of technical resources
- Quality of games as learning resources
II. Learning Theory Session

How Learning Theory Supports Using Modeling, Simulation, and Game-Based Learning to Teach Science, Technology, Engineering, and Mathematics