Towards Effective Serious Games

Keynote Talk – VS-Games 2017

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Why do we need “serious games”?
Traditional methods for learning and performing tasks are losing in effectiveness

Source: www.psychologytoday.com

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Are Serious Games the Silver Bullet?
When could a serious games be successful and effective?

- Provide fun
- Achieve its purpose

How do we ensure this?

- Requirements for the development process
- Requirements for the SGs themselves
The process of Developing Serious Games

Developing technology-enhanced education

The TPACK Framework

Source: www.tpack.org
Developing Effective Serious Games

Applying TPACK for developing serious games

- Technology Knowledge
- Pedagogical Knowledge
- Psychological Knowledge
- Sociological Knowledge
- Medical therapeutic Knowledge

Purpose Domain Knowledge

Subject Matter Knowledge

Game Technology Knowledge
Developing Effective Serious Games

This calls for **multidisciplinary development teams**

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Multidisciplinary Development Teams

• Different backgrounds
• Different terminologies
• Different concerns

https://n415son17.wordpress.com/category/uncategorized/
Multidisciplinary Teams

- How to avoid communication problems?

http://pastoralmeanderings.blogspot.be/
Multidisciplinary Tool Support

• How to avoid communication problems?

• Actively involve all experts

But how?

Need for multidisciplinary tools to assist the development of serious games
Multidisciplinary Tool Support
Example Tool: **GuideaMaps**

Tablet app to support the requirement elicitation phase
But!

Tools on their own do not guarantee success

Source: https://www.pickthebrain.com/blog/9-traits-successful-people
Methods

“An established, habitual, logical, or prescribed practice or systematic process of achieving certain ends with accuracy and efficiency, usually in an ordered sequence of fixed steps”
www.businessdictionary.com

Methods that integrate methods or principles from the purpose domain are scarce

Source: Microsoft Dynamics 365

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Integrating PD Knowledge
Example: ATTAC-L

Domain-specific modeling language for narrative-based serious games

Integration of purpose domains through annotations
Integrating PD Knowledge

Example: ATTAC-L

Annotations

Introduction to comforting

Vic’s bullying situation

Pedagogical theory

which: Social Cognitive Theory (SCT)

Vic’s bullying situation

Nate demonstrates comforting

Vic’s bullying situation

Change objective

code: K2
perf. obj.: PO
determinant knowledge

description: Describe ways to comfort a victim that are in line with your personality.

Player says to Nate

Yeah, right, I agree that this is lame! Right?

Assist

what: Nate says C’mon Stan, you definitely must agree that this is lame! Right?
to: Player

when: every 30 seconds

objective: K1
Requirements for the development process:
Dedicated, multidisciplinary Tools & Methods

Source: http://www.activolubricants.com/light
How do better ensure the success and effectiveness of SG?

- Requirements for the development process
- Requirements for the SGs themselves
How do you like your food?

www.theenglishstudent.com
Everyone is Different

- Different preferences
- Different abilities
- Different performance motivations
- Different personality treats

Source: http://vjc.lv/jauniesu-alternativas-izglitibas-iespejas/
One size fits nobody!
Adapting Serious Games to the Player

- SG adapted to the characteristics of the player
- Better game experience
- Flow state
- More effective

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Personalization: Why not (yet)?

- It's too expensive
- It's too time consuming
- How?
- Will it work?
Personalization: Different Flavors

When
- Player-centered Design
- Static Adaptation
- Dynamic Adaptation

To Whom
- A group
- An individual

What
- Content & difficulty level
- Game objects & environment
- Game logic, narrative
- Interaction modalities
- Game mechanics

To what
- Background
- Expertise, skills, abilities
- Prior Knowledge
- Preferences
- Learning styles
- Personality traits
- Performance
- Affective states
- ...

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Adaptation to the Player
Example: Theory of Multiple Intelligence (MI)

― An intelligence is the ability to solve problems, or to create products, that are valued within one or more cultural settings”
~Howard Gardner~

• 8 dimensions of intelligence
• Everyone possesses every intelligence but to different degrees
• All dimensions work together in an orchestrated way
Adaptation based on MI

Positive impact on
• game experience?
• learning outcome?

Survey study

**Hypothesis:** there exist correlations between players’ strong MI intelligence dimensions and their preferences for games

308 participants

<table>
<thead>
<tr>
<th>MI Dimension</th>
<th>Gender</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical</td>
<td>Men</td>
<td>100</td>
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<tr>
<td>Naturalistic</td>
<td>Men</td>
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<tr>
<td>Visual-Spatial</td>
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<td>211</td>
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<tr>
<td>Kinesthetic</td>
<td>Women</td>
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<tr>
<td>Bodily-Motor</td>
<td>Women</td>
<td>170</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>Women</td>
<td>170</td>
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</tbody>
</table>

18 to 24 years old: 104
25 to 34 years old: 107
Rest: 120

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Personalization based on MI

47 game titles

5 games for each dimension
7 games more than one dimension

Result: Each MI dimension is correlated (negatively or positively) to one or more preferences for game titles

Why? Game genre?
MI and Preference for Game Mechanics

- Further analysis of the 42 games based on 236 game mechanics

<table>
<thead>
<tr>
<th>Logical-mathematical dimension</th>
<th>Decision</th>
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<tbody>
<tr>
<td>Achievements</td>
<td>Dubious</td>
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<td>Bonuses</td>
<td>Positive</td>
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<td>Discovery</td>
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<td>Infinite Gameplay</td>
<td>Negative</td>
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<td>Epic Meaning</td>
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<td>Points</td>
<td>Dubious</td>
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<td>Reward Schedules</td>
<td>Positive</td>
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...
Tool Support: wise.vub.ac.be/dpl
Does this work?

2 case studies
LeapBalancer: for bodily-kinesthetic players

<table>
<thead>
<tr>
<th>Mechanic</th>
<th>Bodily-kinesthetic dimension</th>
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<tbody>
<tr>
<td>Motion</td>
<td>✓ Positive</td>
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<tr>
<td>Timing</td>
<td>✓ Positive</td>
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<tr>
<td>Pavlovian interaction</td>
<td>✓ Positive</td>
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<tr>
<td>Tutorial / first run scenarios</td>
<td>✓ Dubious</td>
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<tr>
<td>Gravity</td>
<td>✓ Dubious</td>
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<td>Directed exploration</td>
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<td>Controlling</td>
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Experiment

- **Hypothesis:** bodily-kinesthetic players intelligence will have a better game experience compared to non-bodily-kinesthetic players

- **Result:** Bodily-kinesthetically players experienced significantly more competence, less negative affect, more immersion, and less tension

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TrueBiters: for logical-mathematical players

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### Hypothesis 1:
The logically-mathematically players will have a higher learning outcome compared to the rest.

### Hypothesis 2:
The logically-mathematically players will have a better game experience to the rest.
TrueBiters: 2 Pilot Experiments

Experiment 1:
• Pre-test;
• Self-training; game sessions;
• Post-test

Result: Logically-mathematically exhibit higher learning outcome compared to the rest

Experiment 2:
• Self-training; 2 game sessions
• Game Experience Questionnaire (GEQ)

Result: Logically-mathematically experienced significantly more immersion compared to the rest
Requirements for the SG themselves:

• Adaptation

Something else?

Source: http://www.acvollubricants.com/light/
How to ensure **transfer to reality?**

- Reflection on the in-game performance
  - E.g., by a **debriefing phase**

Debriefing

With human facilitator
• expensive,
• time consuming,
• not always possible

Need for automatic debriefing facility!
But How?
Different types of games may require different approach
Debriefing Approach
Example: The BullyBook case

- A form of simulation;
- NPCs show realistic, non-predictable behaviors;
- Multiple possible paths to a solution
The BullyBook case
Visual approach to debriefing

Time-Oriented Visualization

Interaction-Oriented Visualization

Character-Oriented Visualization

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The BullyBook case
Evaluation

Pilot Study
Aspects evaluated:
• Post-game and post-debriefing understanding
• Visualizations & overall usability

Results:
• Better understanding after debriefing
• Good scores for all visualizations; best score for the interaction-oriented debriefing
• Good overall usability
Conclusions

Serious Games: How to better ensure their effectiveness?

1. Development process:
   - **Knowledge** about
     - The subject matter,
     - Game development
     - The **purpose domain** (pedagogy, psychology, sociology, medicine...)
   - **Multidisciplinary** teams
   - **Multidisciplinary** tools
   - **Dedicated** methods

2. For the serious game itself:
   - Some form of **personalization or adaptation** to the target audience
   - An **explicit debriefing phase**
ATTAC-L

GuideaMaps:

Personalization

Debriefing