Towards Effective Serious Games

Keynote Talk – VS-Games 2017

Prof. dr. Olga De Troyer
WISE research group
Vrije Universiteit Brussel
BELGIUM
http://we.vub.ac.be/nl/olga-de-troyer

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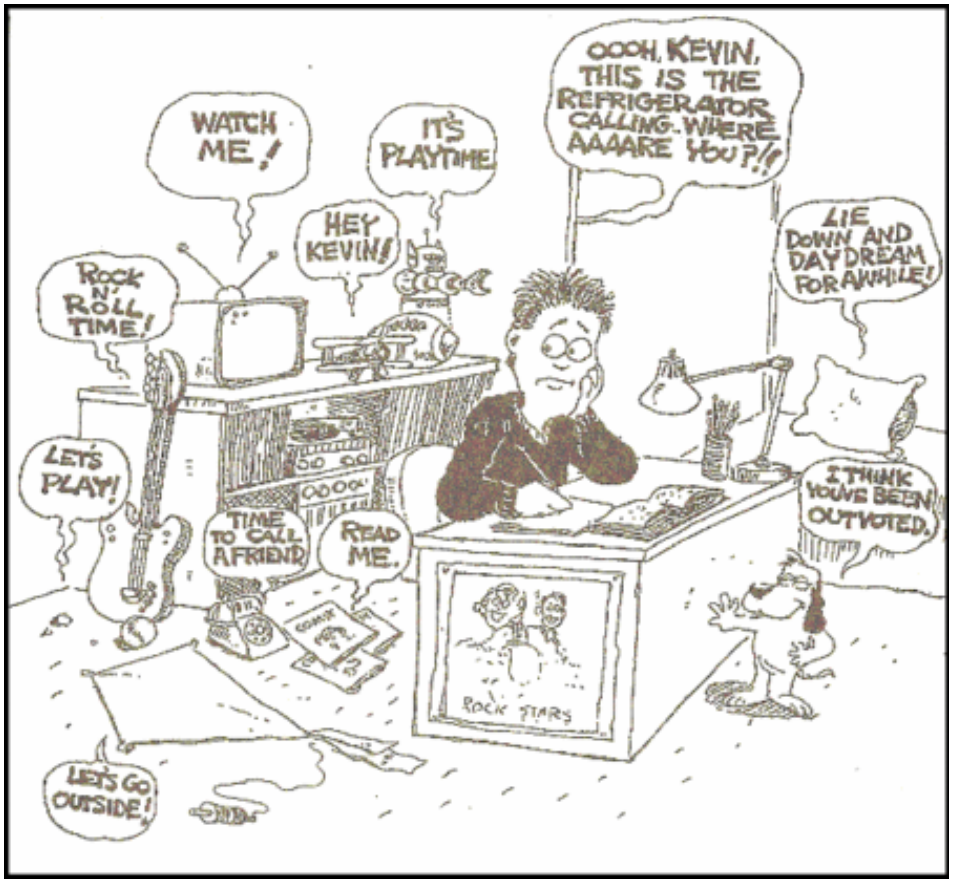
WEB & INFORMATION SYSTEMS ENGINEERING

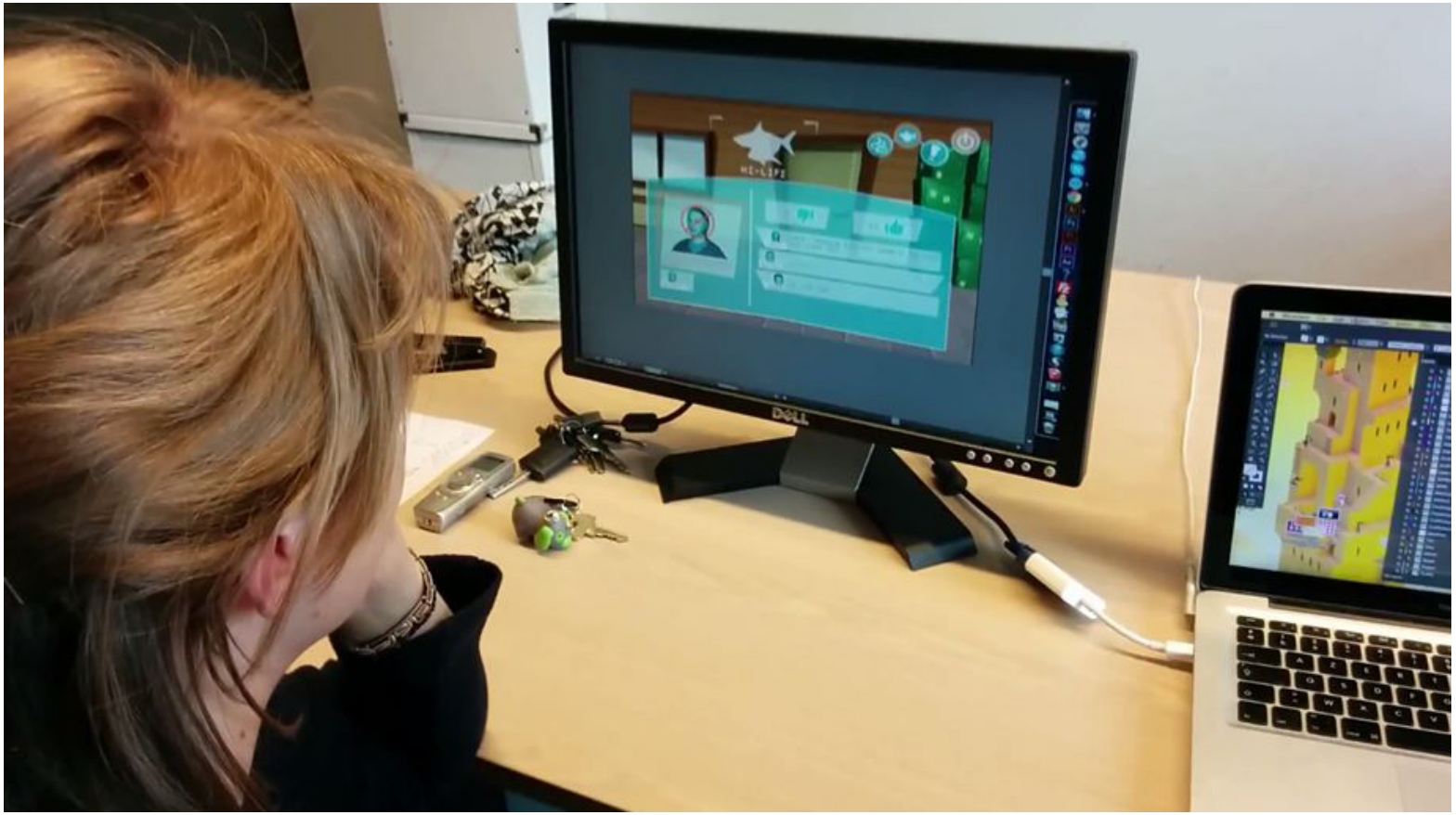
Why do we need “serious games”?

Traditional methods for learning and performing tasks are losing in effectiveness



Source: www.psychologytoday.com

Are Serious Games the Silver Bullet?



When could a serious games be successful and effective?

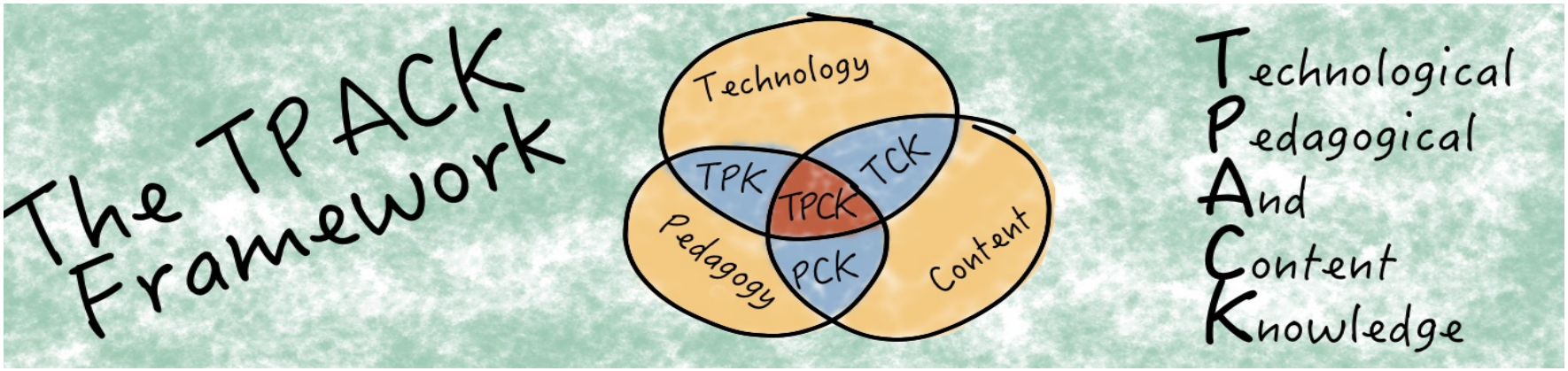
- **Provide fun**
- **Achieve its purpose**

How do we ensure this?

- Requirements for the development process
- Requirements for the SGs themselves

The process of Developing Serious Games

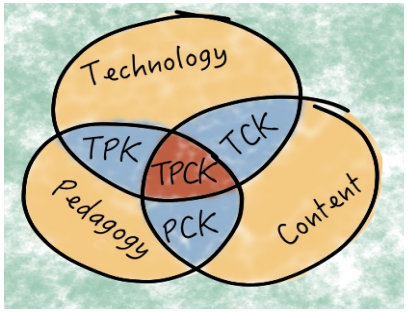
Developing technology-enhanced education

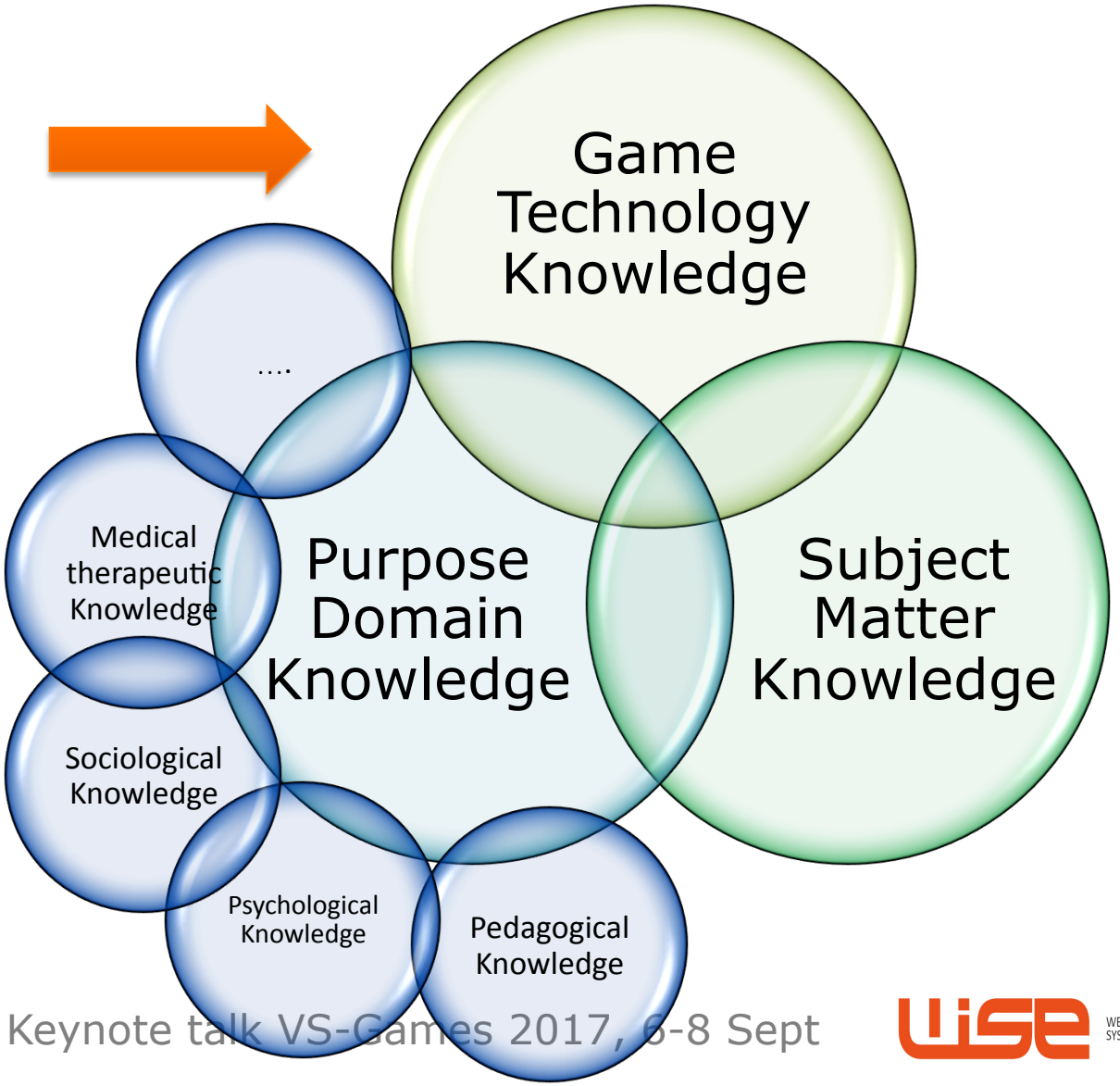


Source: www.tpack.org

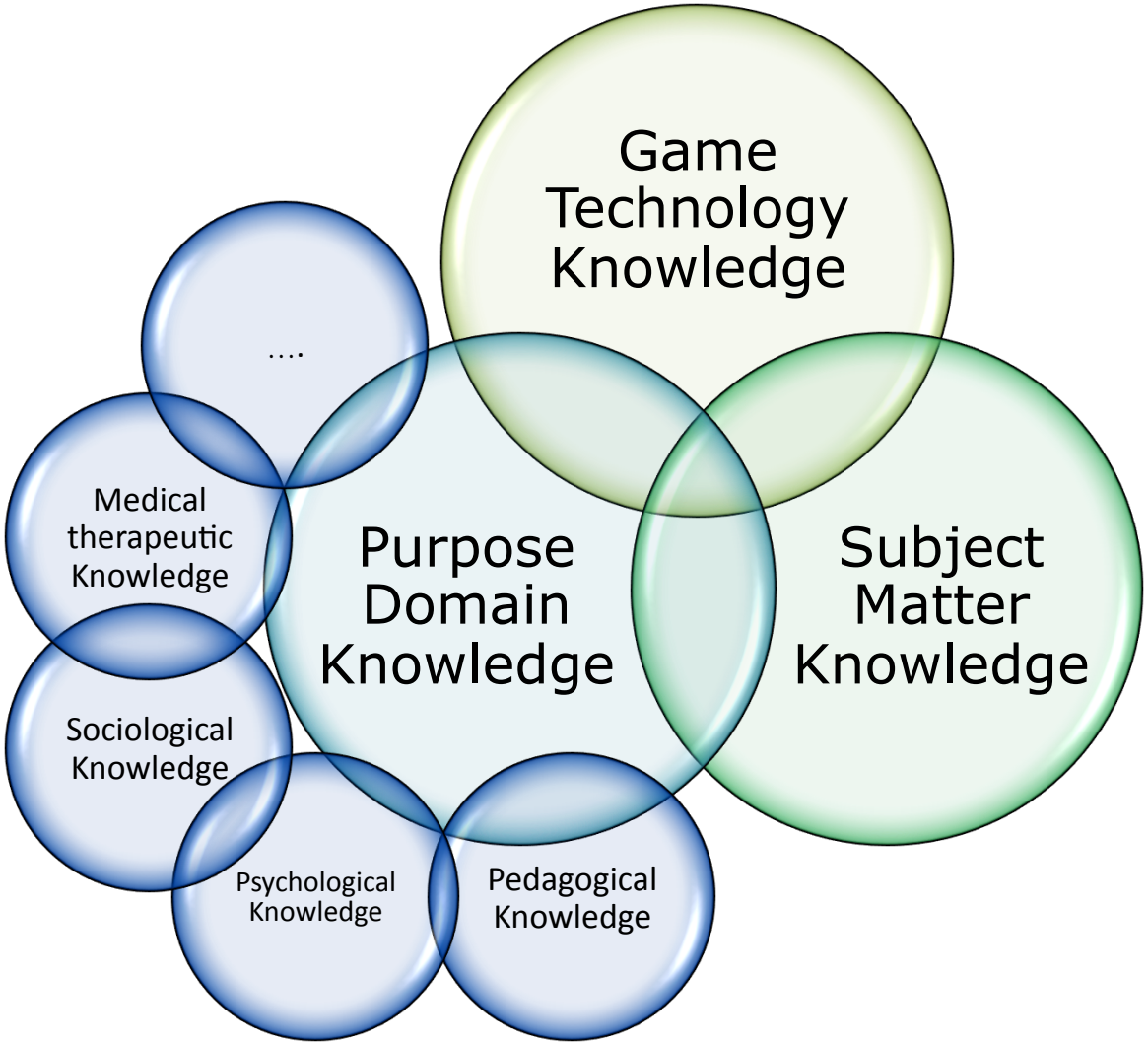
Developing Effective Serious Games

Applying TPACK for developing serious games





Developing Effective Serious Games



This calls for multidisciplinary development teams

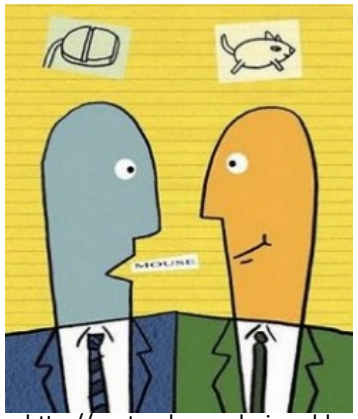
Multidisciplinary Development Teams

- Different backgrounds
- Different terminologies
- Different concerns

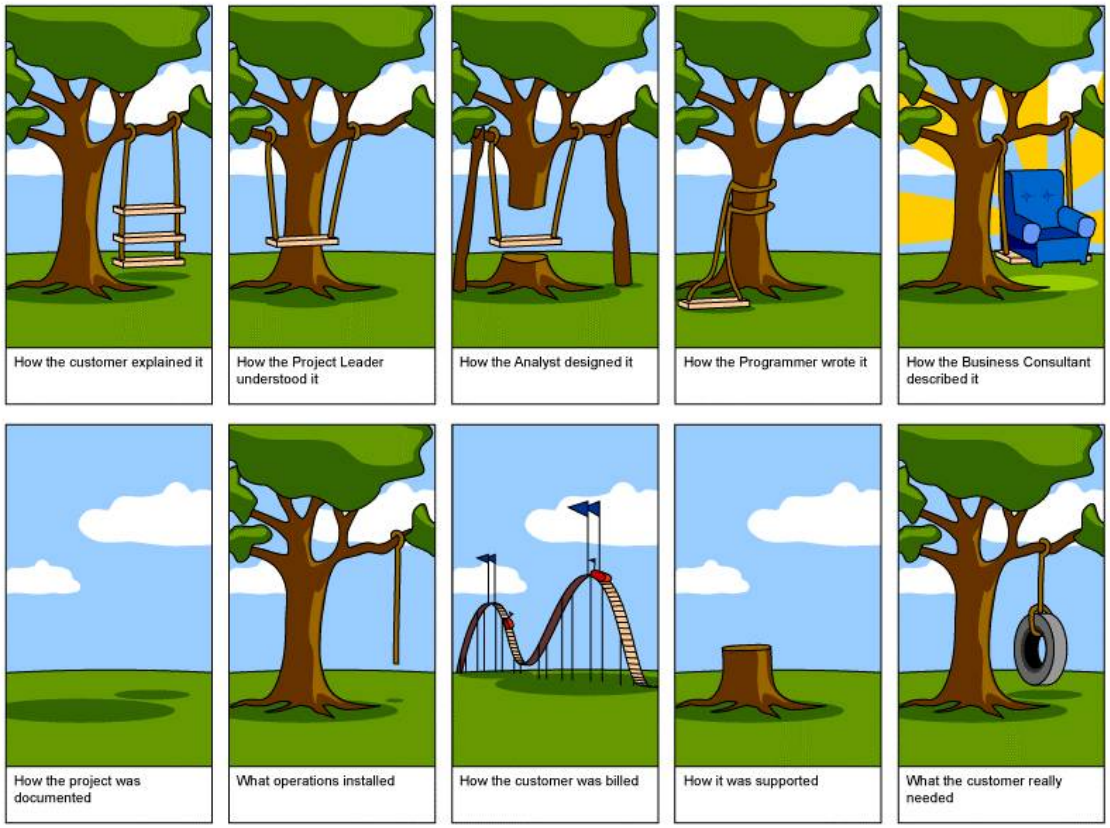
https://n415son17.wordpress.com/category/uncategorized/

Multidisciplinary Teams

- How to avoid communication problems?

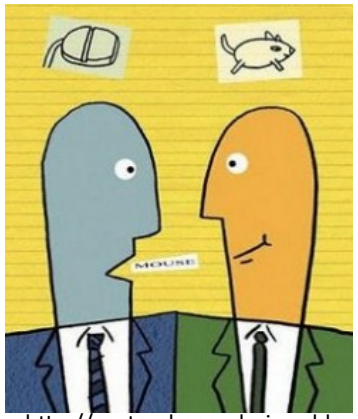


http://pastoralmeanderings.blogspot.be/



Multidisciplinary Tool Support

- How to avoid communication problems?



http://pastoralmeanderings.blogspot.be/

https://www.linkedin.com/pulse/how-succeed-group-assessmentfina6900u-iol-jiawei-jenny-song

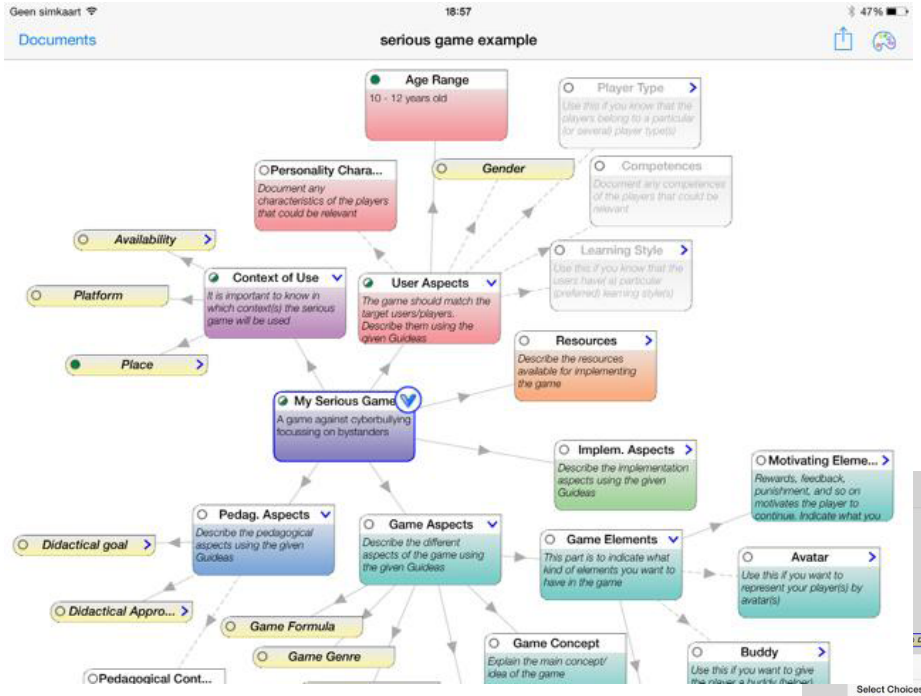
- Actively involve all experts

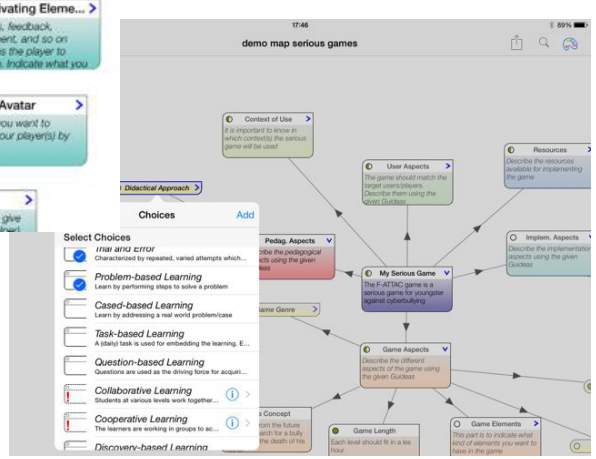
  But how?

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



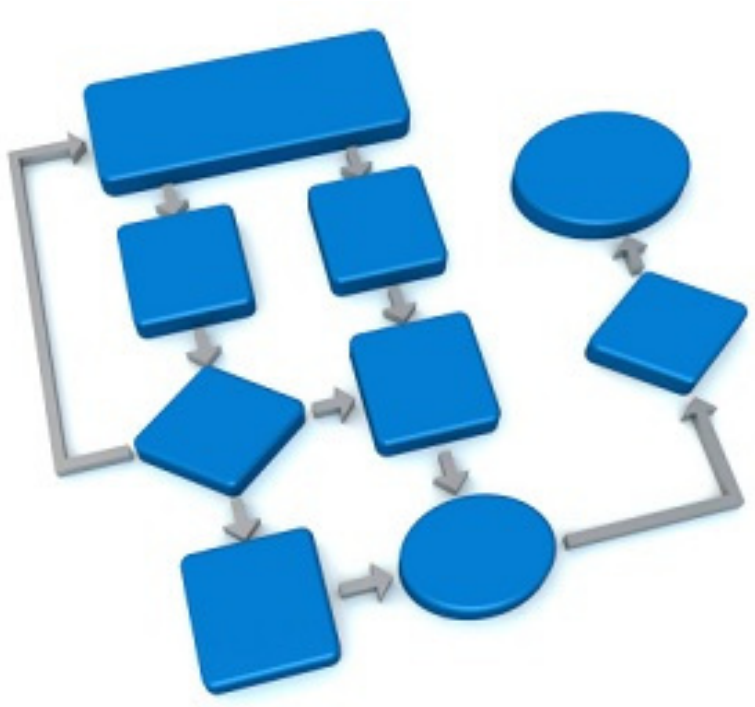


But!

Tools on their own
do not guarantee success

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

Methods

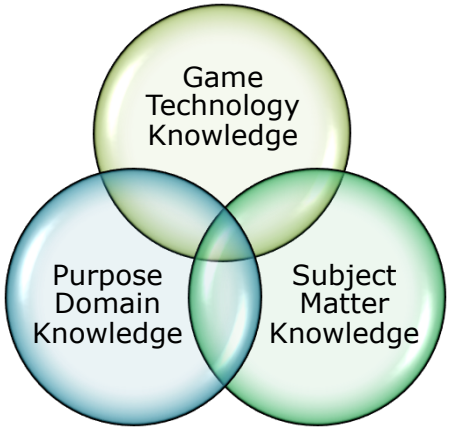


Source: Microsoft Dynamics 365

"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"

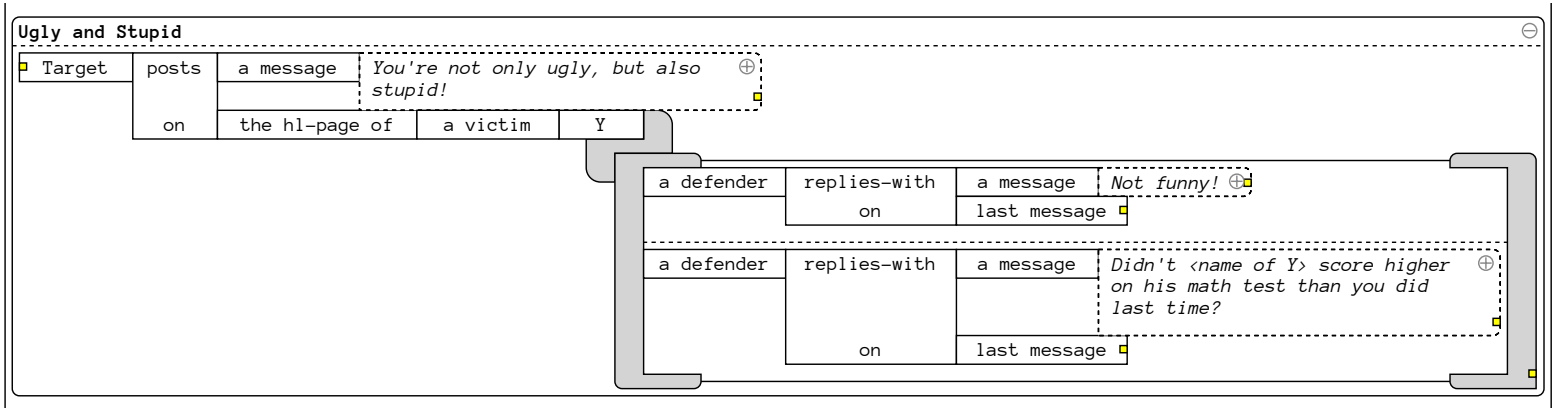
www.businessdictionary.com

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



Integrating PD Knowledge
Example: ATTAC-L

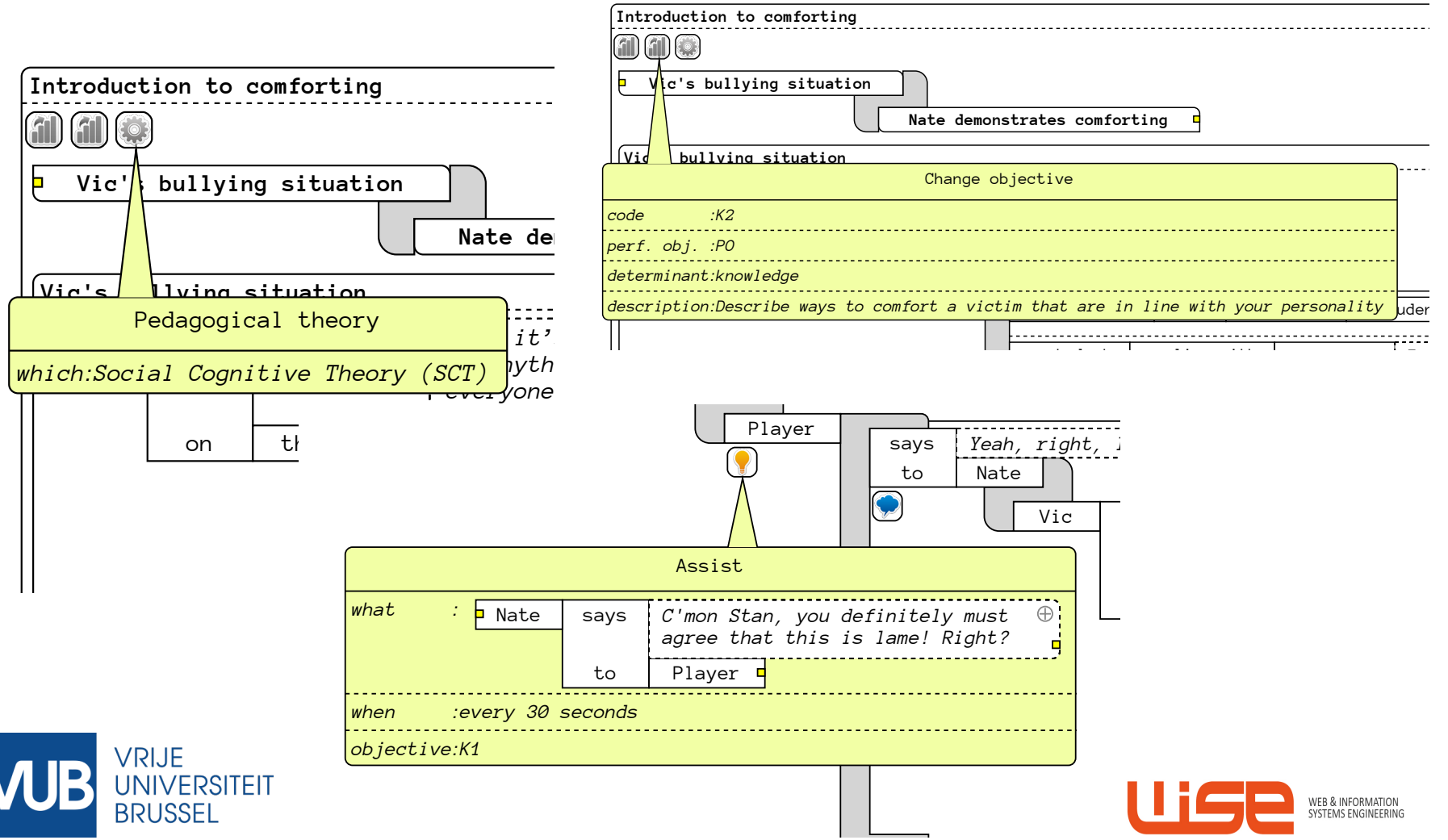
Domain-specific modeling language for narrative-based serious games



Integration of purpose domains through annotations

Integrating PD Knowledge
Example: ATTAC-L

Annotations



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Requirements for the development process:

Dedicated, multidisciplinary Tools & Methods

Source: http://www.activollubericants.com/light/

How do better ensure the success and effectiveness of SG?

- Requirements for the development process
- Requirements for the SGs themselves

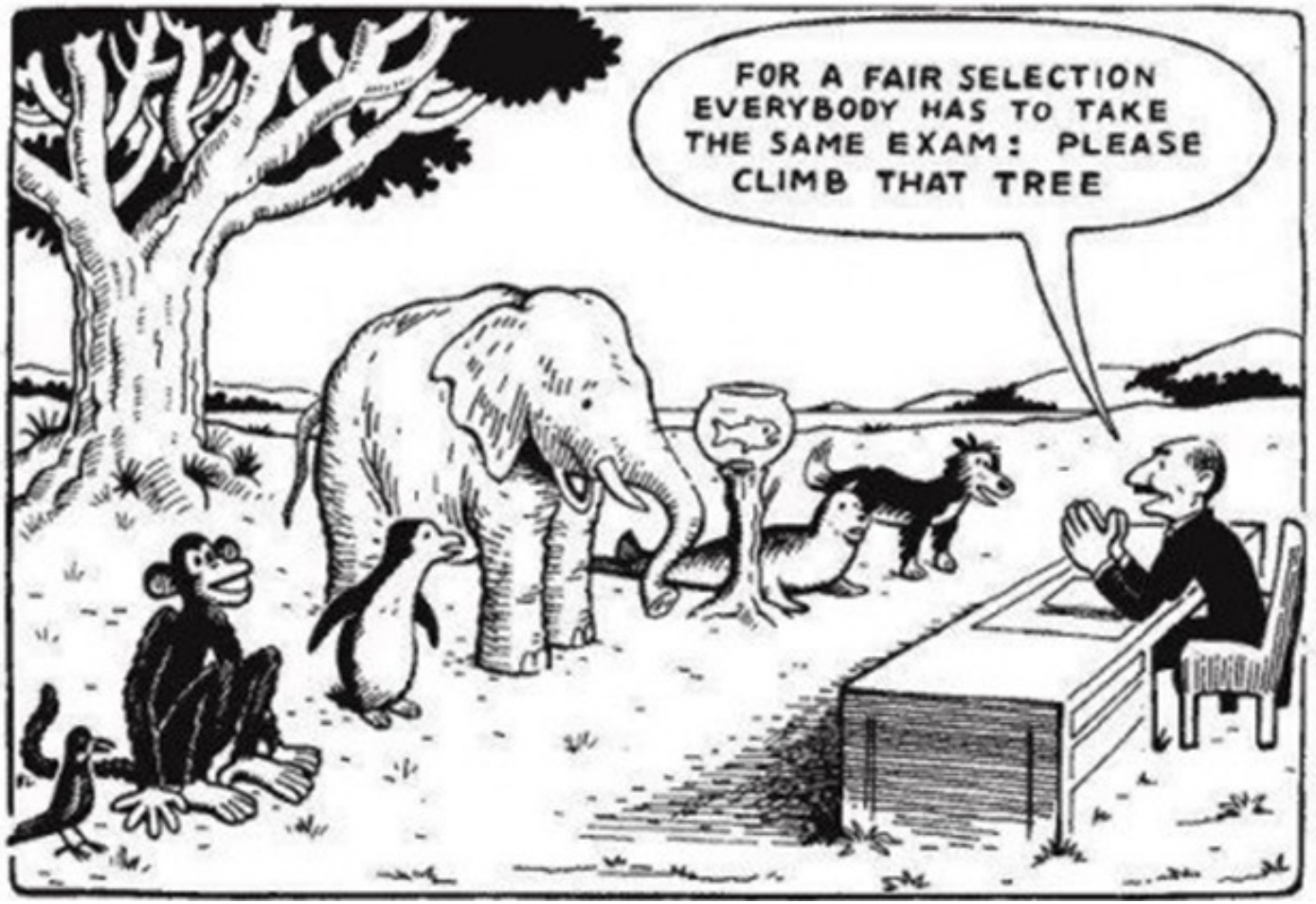

SWEET
SPICY
HOW DO YOU
LIKE YOUR FOOD?
www.theenglishstudent.com
SALTY
BITTER

Everyone is Different

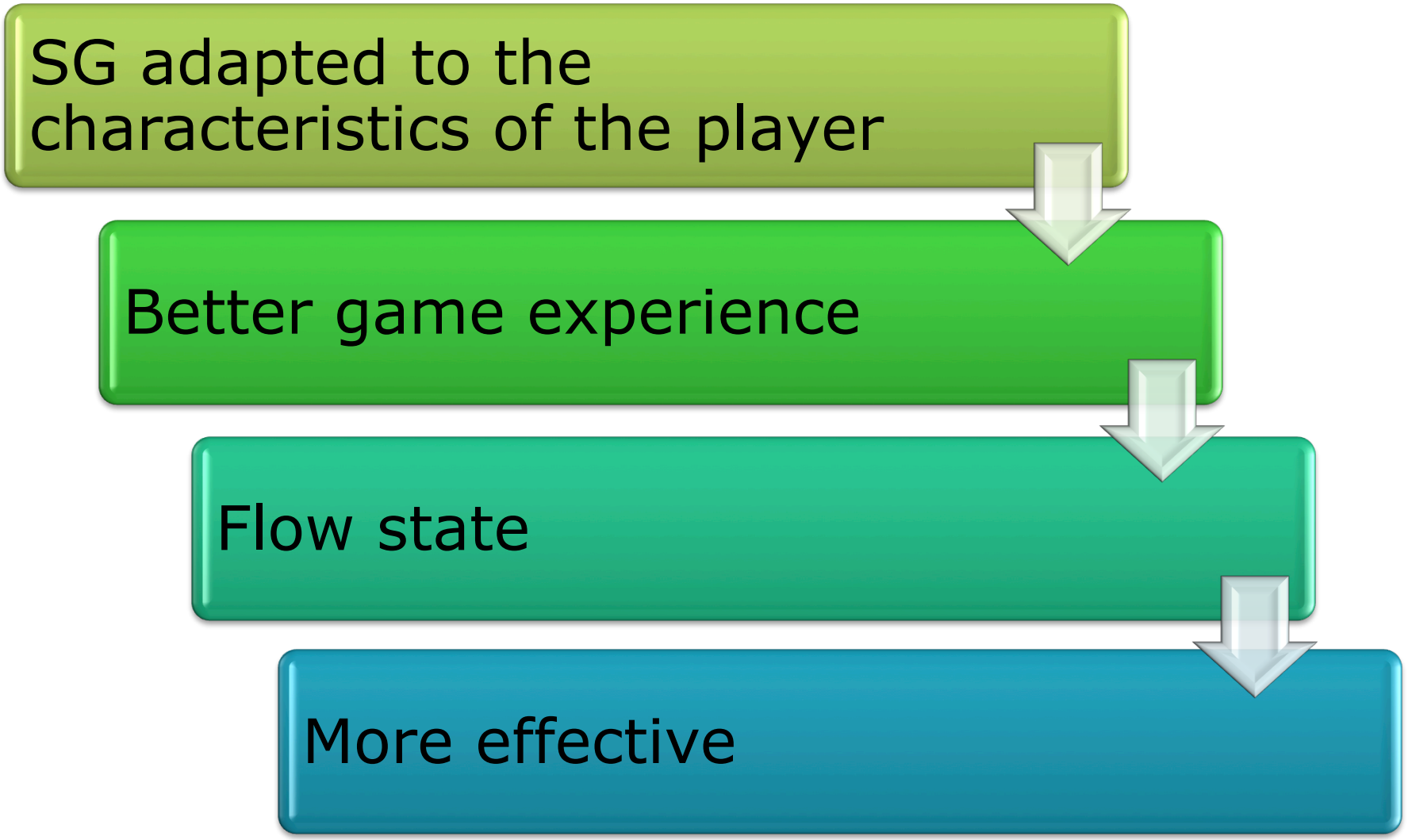
Source: http://vjic.lv/jauniesu-alternativas-izglitibas-iespejas/

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

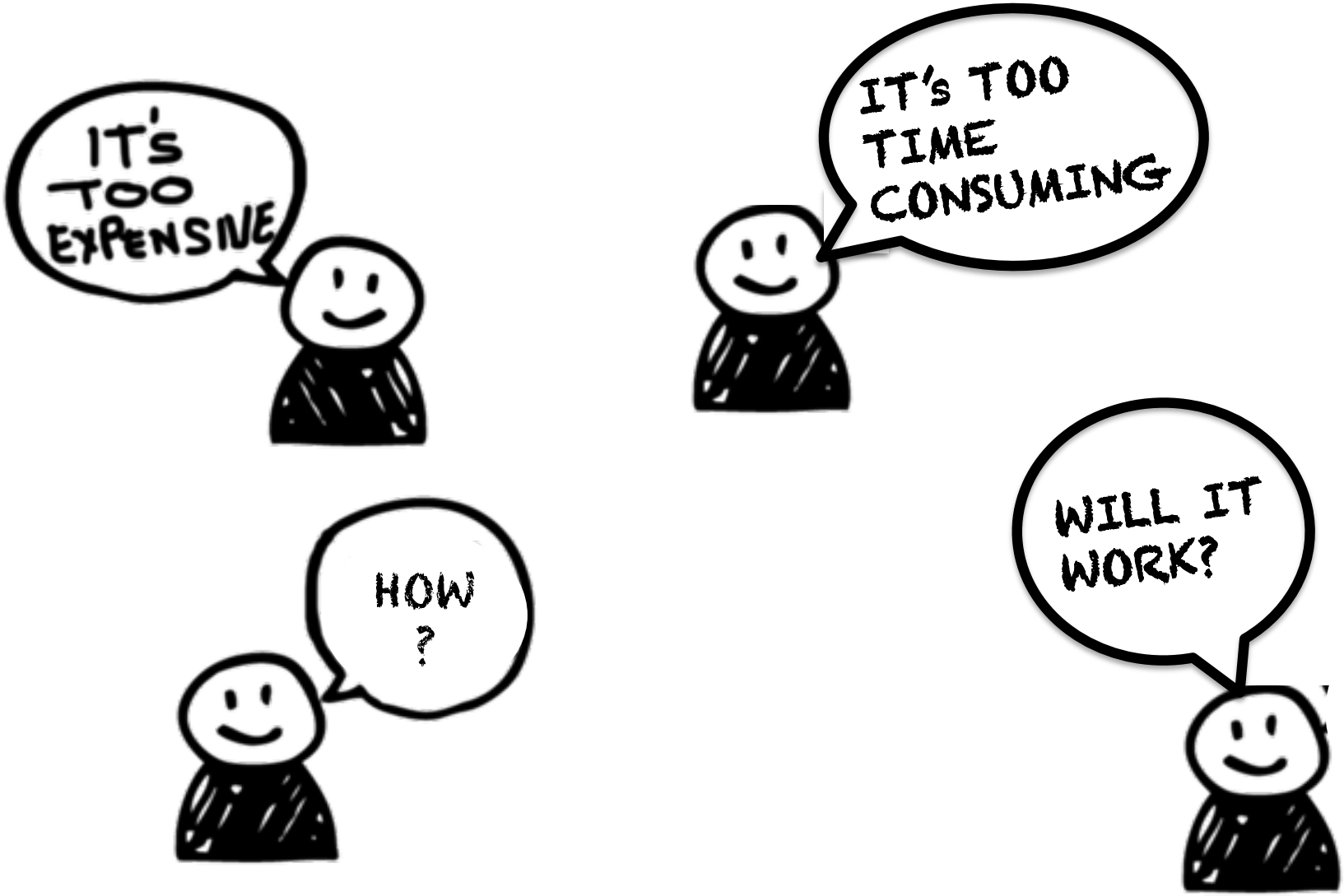
One size fits nobody!



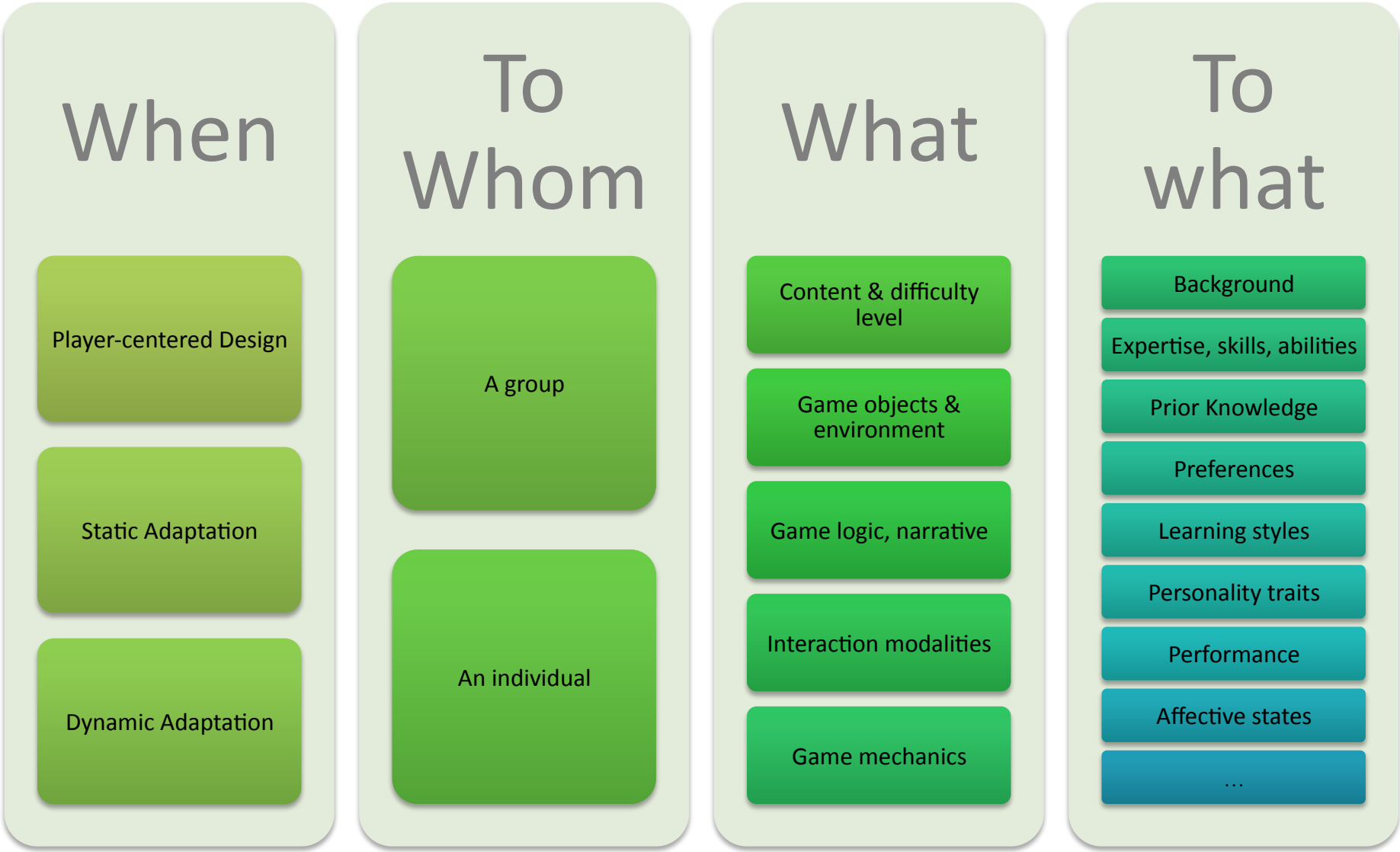
Adapting Serious Games to the Player



Personalization: Why not (yet)?



Personalization: Different Flavors



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

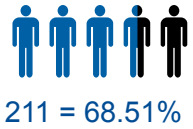
Positive impact on

- game experience?
- learning outcome?

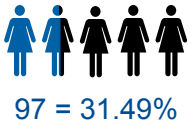
Survey study

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

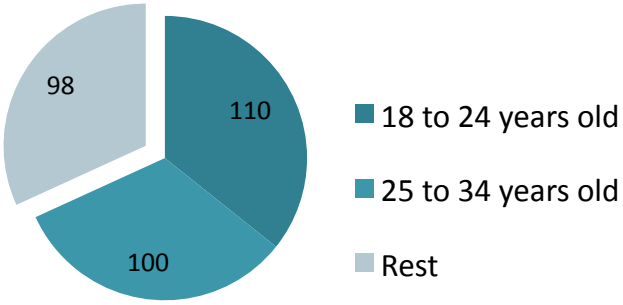
308 participants



211 = 68.51%



97 = 31.49%



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?

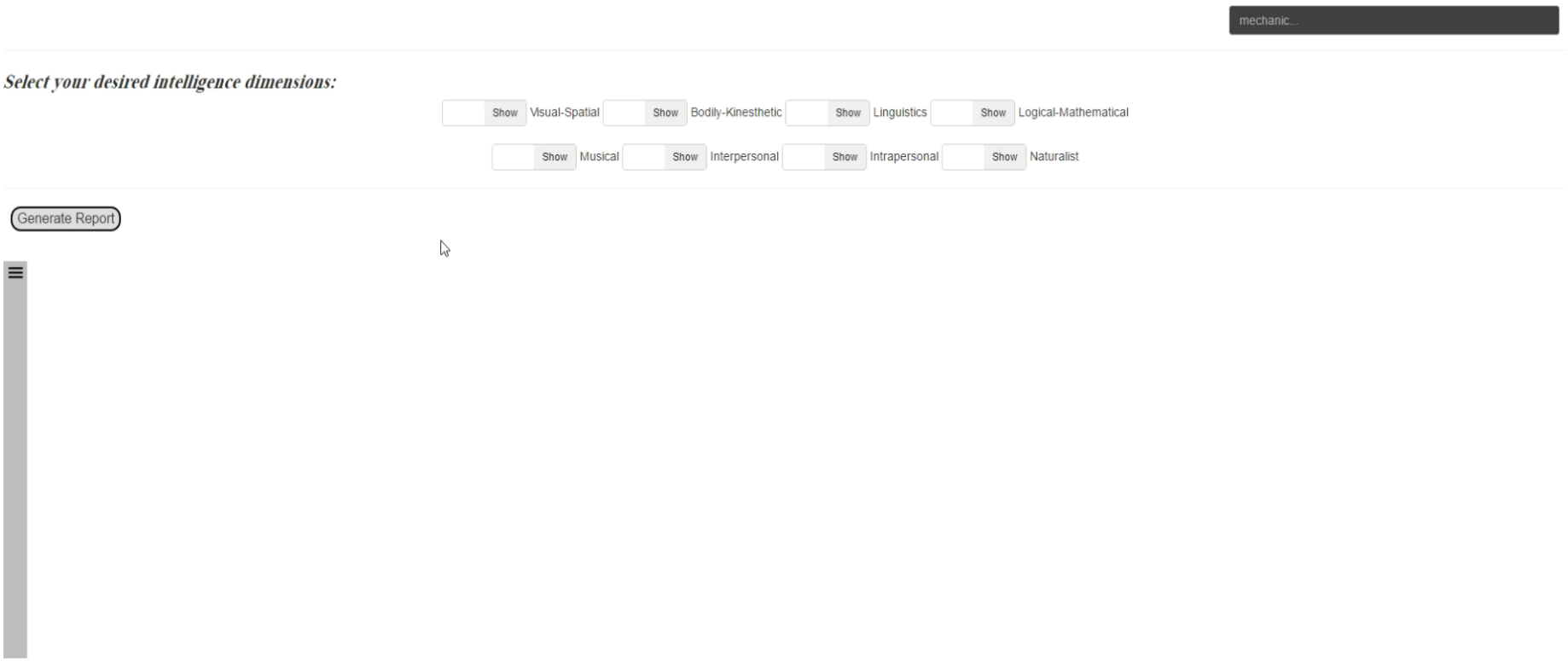
MI and Preference for Game Mechanics

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

Logical-mathematical dimension	
Achievements	Dubious
Bonuses	Positive
Discovery	Positive
Infinite Gameplay	Negative
Epic Meaning	Dubious
Levels	Positive
Loss aversion	Positive
Points	Dubious
Reward Schedules	Positive
...	

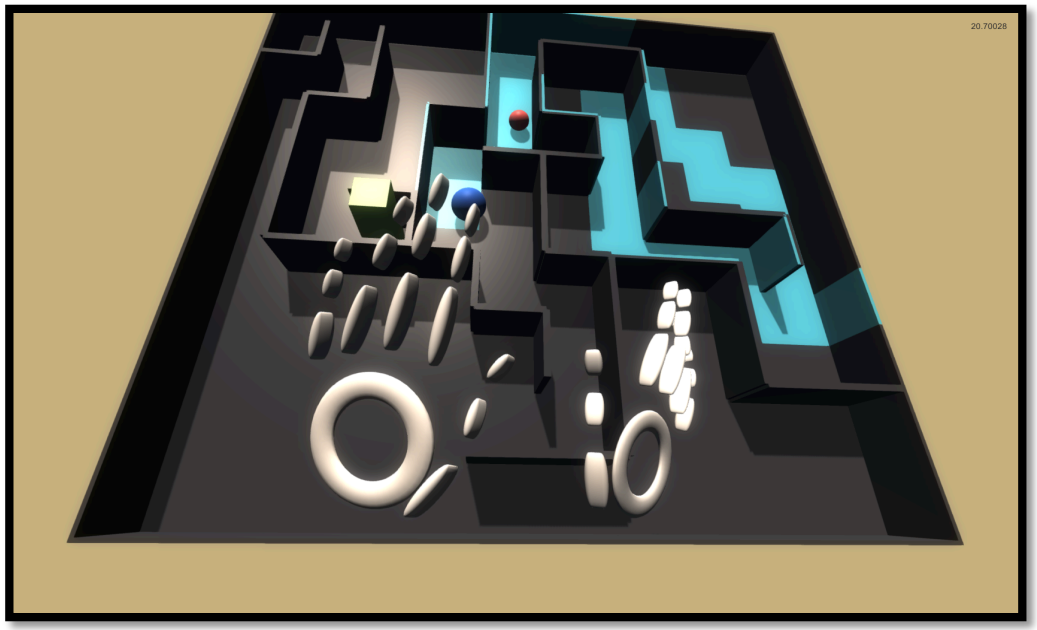
Decision	
Positive	**Recommend**
Dubious	**Use with caution**
Negative	**Not recommend**

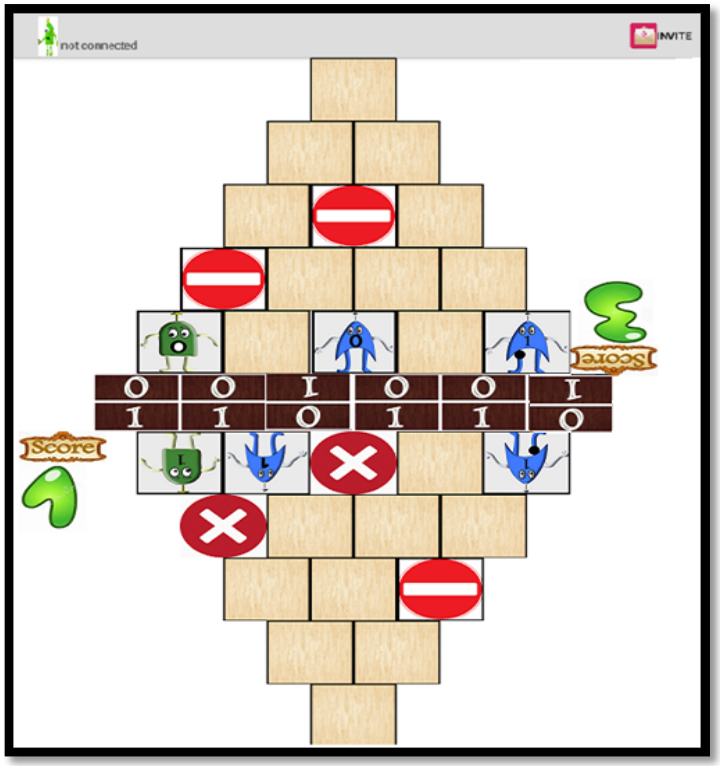
Tool Support: wise.vub.ac.be/dpl



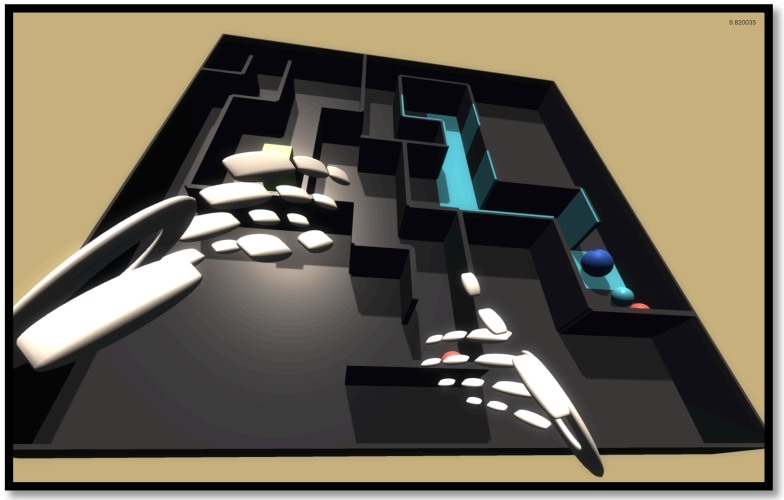
Does this work?

2 case studies





LeapBalancer: for bodily-kinesthetic players



Mechanic	*Bodily-kinesthetic dimension*
Motion Core	✓ Positive
Timing	✓ Positive
Pavlovian interaction	✓ Positive
Tutorial / first run scenarios	✓ Dubious
Gravity	✓ Dubious
Directed exploration	-
Controlling Core	-

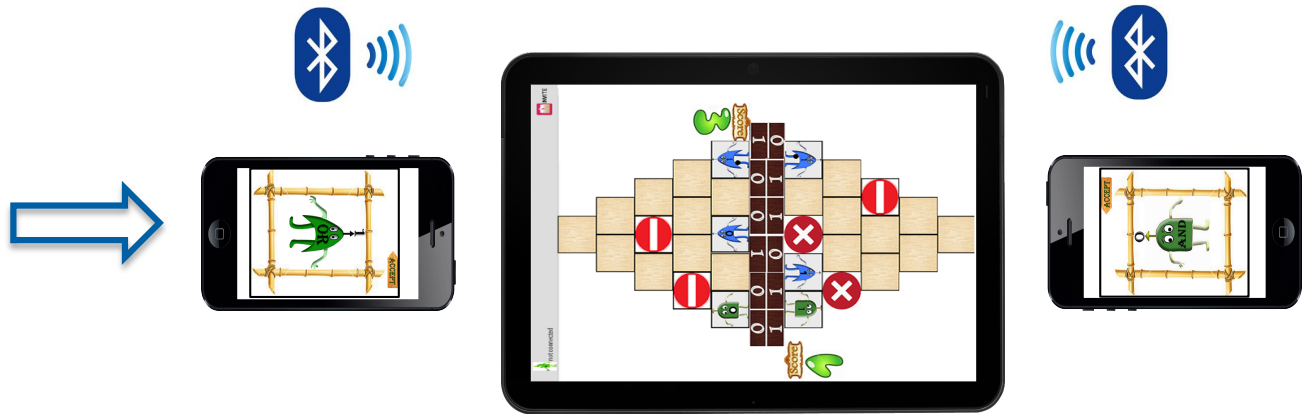
Experiment

- Hypothesis: bodily-kinesthetic players intelligence will have a better game experience compare to non-bodily-kinesthetic players
- Result: Bodily-kinesthetically players experienced significantly more competence, less negative affect, more immersion, and less tension

TrueBiters: for logical-mathematical players

P	Q	$\neg P$	$P \wedge Q$	$P \vee Q$	$P \Rightarrow Q$	$P \Leftrightarrow Q$
False	*False*	*True*	*False*	*False*	*True*	*True*
False	*True*	*True*	*False*	*True*	*True*	*False*
True	*False*	*False*	*False*	*True*	*False*	*False*
True	*True*	*False*	*True*	*True*	*True*	*True*

bOOleO



TrueBiters

Mechanic	*Logical-mathematical Intelligence*
Motion	-
Repeat Pattern	✓ dubious
Memorizing Core	-
Submitting	-
Points Core	✓ positive
Quick feedback	✓ positive
Modifier	✓ positive
Disincentives	✓ negative
Companion gaming	✓ positive
Tutorial/first run scenarios	✓ positive
Logical thinking Core	✓ positive
Strategizing Core	✓ positive
Browsing	✓ negative
Choosing	✓ negative

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.activolubricants.com/light/

How to ensure transfer to reality?

- Reflection on the in-game performance

  E.g., by a debriefing phase

http://cape.stanford.edu/programs/for-healthcare-instructors/advanced-debriefing.html

Debriefing

With human facilitator

- expensive,
- time consuming,
- not always possible

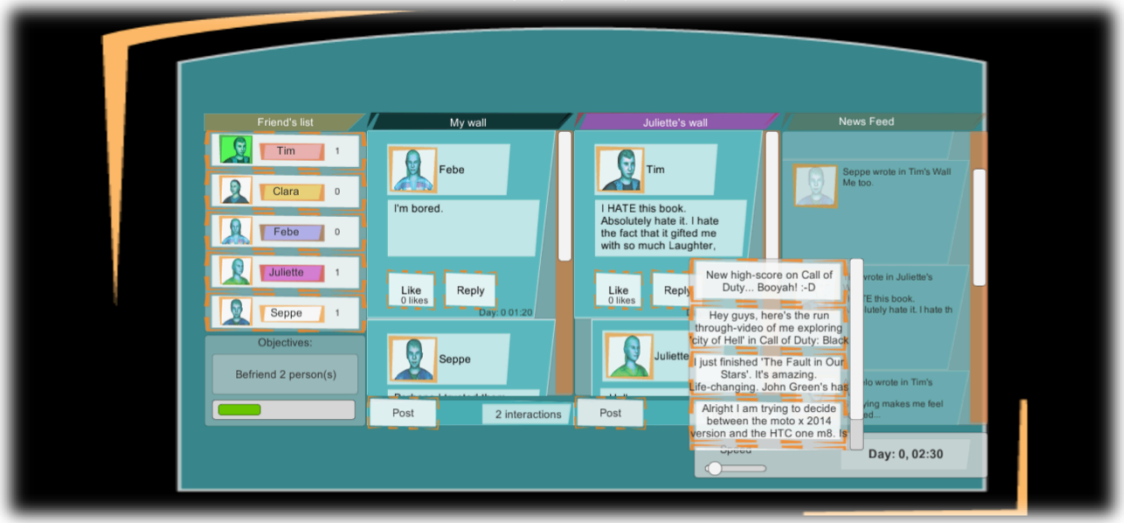
Need for automatic debriefing facility!

But How?

Different types of games may require different approach

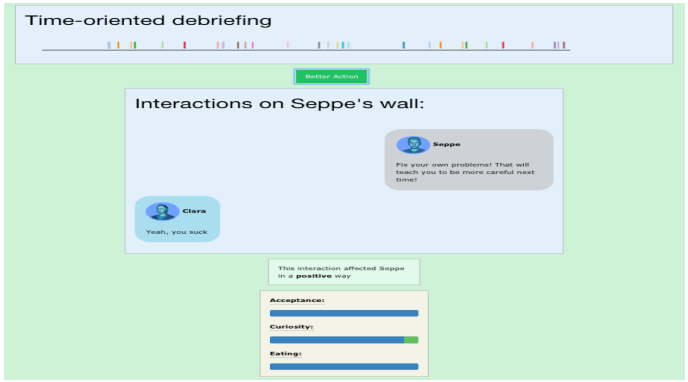
Debriefing Approach
Example: The BullyBook case

- A form of simulation;
- NPCs show realistic, non-predictable behaviors;
- Multiple possible paths to a solution

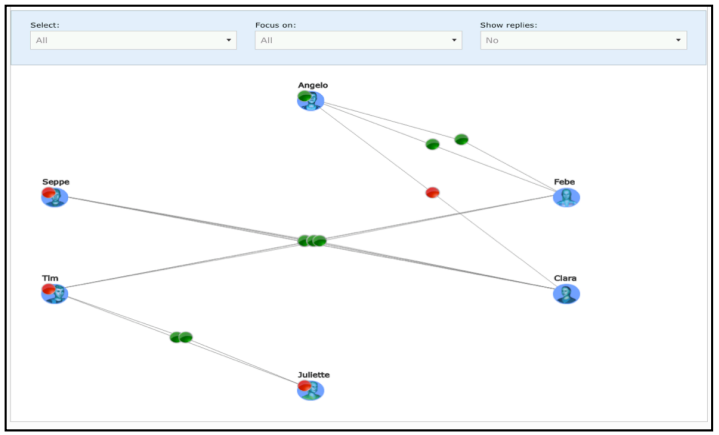


The BullyBook case
Visual approach to debriefing

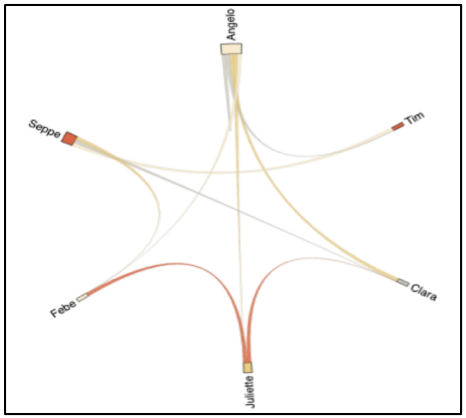
Time-Oriented Visualization

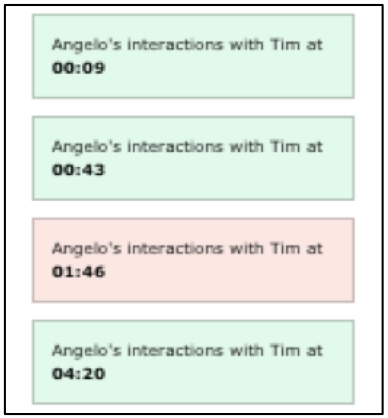


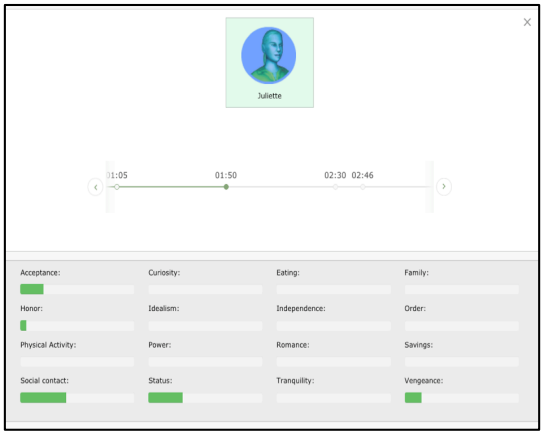
Interaction-Oriented Visualization



Character-Oriented Visualization







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

For more info:

ATTAC-L

F. Van Broeckhoven and O. De Troyer, "ATTAC-L: A modeling language for educational virtual scenarios in the context of preventing cyber bullying," in *SeGAH 2013 - IEEE 2nd Intl Conf on Serious Games and Applications for Health*, 2013.

F. Van Broeckhoven and O. De Troyer, "Specifying the pedagogical aspects of narrative-based digital learning games using annotation," in *Proc of the 9th Intl Conf on the Foundations of Digital Games. Society for the Advancement of the Science of Digital Games*, 2014.

F. Van Broeckhoven, J. Vlieghe, and O. De Troyer, "Mapping between Pedagogical Design Strategies and Serious Game Narratives," in *Games and Virtual Worlds for Serious Applications (VS-Games),* pp. 123–130.

O. De Troyer, F. Van Broeckhoven, and J. Vlieghe, "Linking serious game narratives with pedagogical theories and pedagogical design strategies," *J. Comput. High. Educ.*, pp. 1–25, 2017.

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Personalization

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P. Sajjadi, J. Vlieghe, and O. De Troyer, "Evidence-based mapping between the theory of multiple intelligences and game mechanics for the purpose of player-centered serious game design," in *Games and Virtual Worlds for Serious Applications (VS-Games)*, 2016, pp. 1–8.

P. Sajjadi, E. El Sayed, and O. De Troyer, "On the Impact of the Dominant Intelligences of Players on Learning Outcome and Game Experience in Educational Games: The TrueBiters Case.," in *Games and Learning Alliance Alliance (GALA 2016) , LNCS 10056*, 2016, pp. 221–231.

P. Sajjadi, A. Lo-A-Njoe, J. Vlieghe, and O. De Troyer, "Exploring the Relation Between Game Experience and Game Mechanics for Bodily-Kinesthetic Players", in *Games and Learning Alliance (GALA 2016) , LNCS 10056*, 2016, pp. 354–364.

P. Sajjadi, "Individualizing Learning Games: Incorporating the Theory of Multiple Intelligences in Player-Centered Game Design," PhD thesis, Vrije Universiteit Brussel, 2017.

Debriefing

O. De Troyer, A. Helalouch, and C. Debruyne, "Towards Computer-Supported Self-debriefing of a Serious Game Against Cyber Bullying," in *Games and Learning Alliance (GALA), LNCS 10056*, 2016, pp. 374–384.