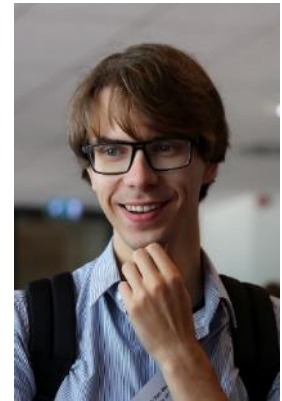


Serious gaming, natural resources management and learning

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[Project info](#)



From games to action: When and how can serious games stimulate learning and support decision making for natural resource management?



Outline – Two interlinked topics

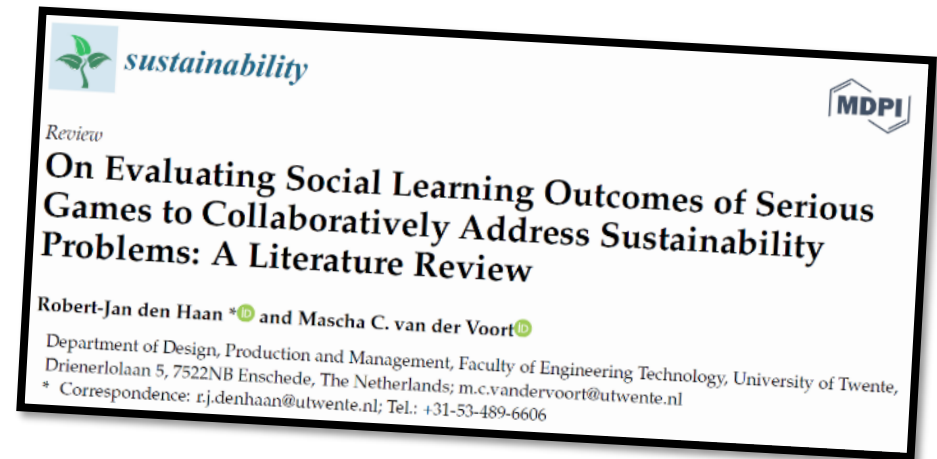
1. How to design 'collaborative' serious games for learning

- Based on experience designing the Virtual River serious game



2. How to evaluate learning from 'collaborative' serious games?

- Following systematic literature review

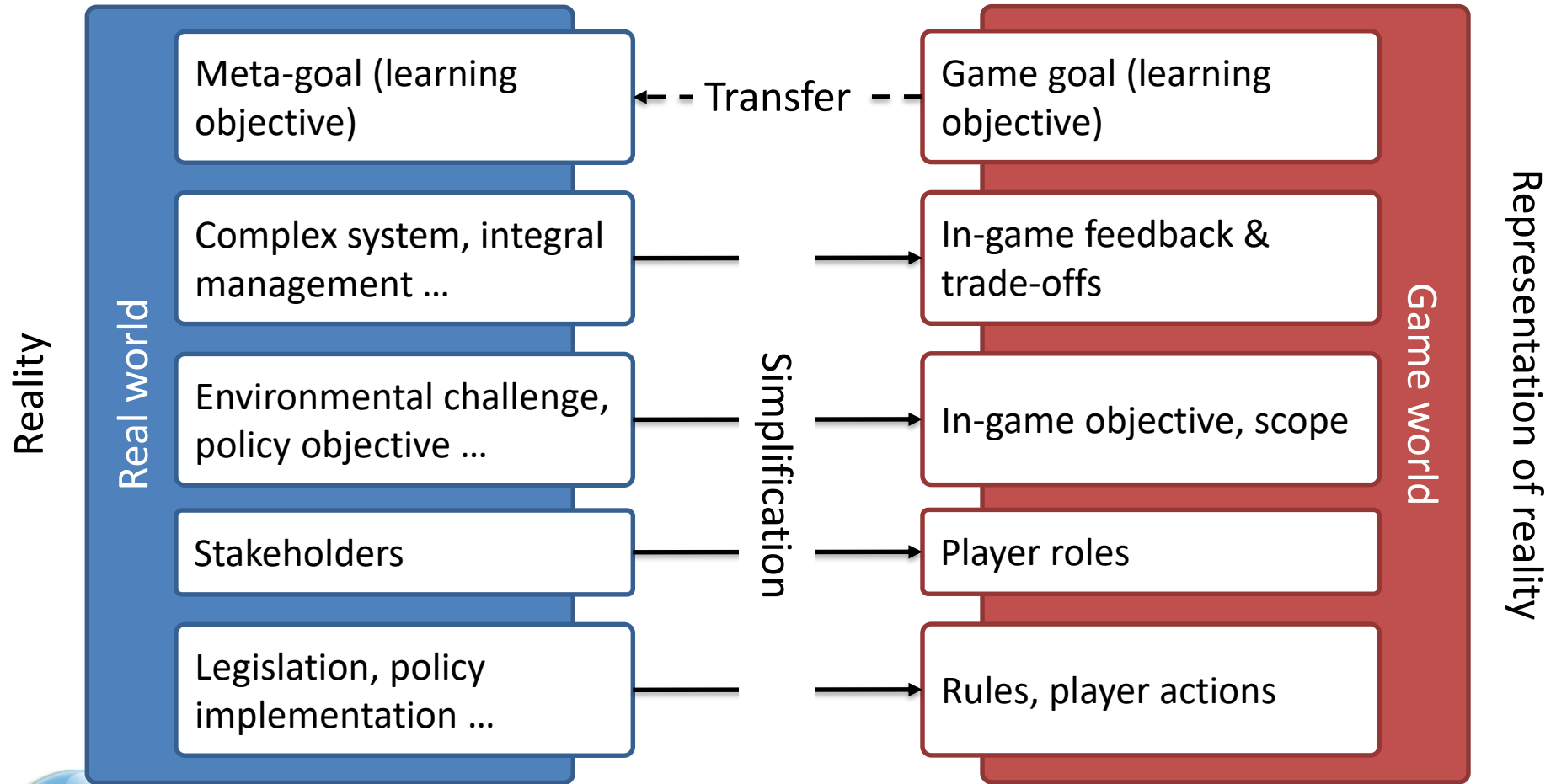


Serious games – What are we talking about?

- High level definition:
 - Games that have a primary purpose other than entertainment, such as educating, training or informing players
- Narrower definition (Mayer, 2009, p. 825):
 - “experi(m)ent(i)al, rule-based, interactive environments, where players learn by taking actions and by experiencing their effects through feedback mechanisms that are deliberately built into and around the game”



Serious game design



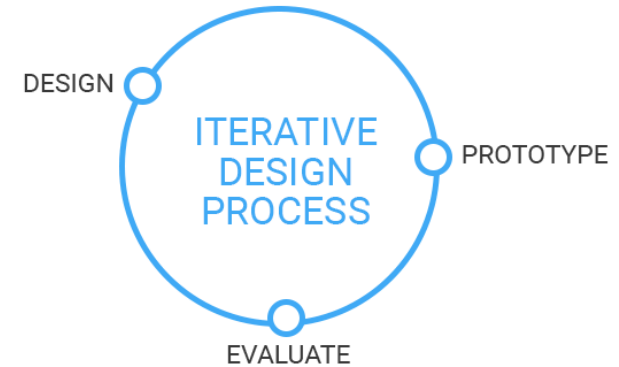
Virtual River serious game

- A serious game to explore the management of a Dutch river area
 - Goal: increase both flood safety and ecological value
- Hybrid game, combining a physical game board with digital models



Prototyping & playtesting

- Designing serious games = designing in iterations
- Previous Virtual River 'paper prototype'
 - Test elements and rules to see if and how these worked
 - Evaluate players' perceived complexity on these



Prototyping & playtesting

- Learning objectives were not (fully) reached as:
 - Players from a **water background** questioned the **game's realism** and saw the game as so **simplified** that it was an optimization exercise that could be mathematically solved
 - Players from a **non-water background** perceived the game's feedback as a **black box** and the overall game as **highly complex**



Prototyping & playtesting

- What we designed for: Balancing Meaning-Reality-Play (Harteveld, 2011)
- What we should have also focused on: Game as a boundary object (Cash, 2003)

Credibility	whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy
Saliency	the relevance of information for an actor's decision choices, or for the choices that affect a given stakeholder.
Legitimacy	whether an actor perceives the process in a system as unbiased and meeting standards of political and procedural fairness



Harteveld, Casper. Triadic game design: Balancing reality, meaning and play. Springer Science & Business Media, 2011.

Cash, David, et al. Saliency, credibility, legitimacy and boundaries: linking research, assessment and decision making. 2002.

Prototyping & playtesting

- What we designed for: Balancing Meaning-Reality-Play (Harteveld, 2011)
- What we should have also focused on: Game as a boundary object (Cash, 2003)

Questions of realism

Credibility

whether an actor perceives information as meeting standards of scientific plausibility and technical adequacy

Saliency

the relevance of information for an actor's decision choices, or for the choices that affect a given stakeholder.

Legitimacy

whether an actor perceives the process in a system as unbiased and meeting standards of political and procedural fairness

High complexity & black box vs optimization exercise perception

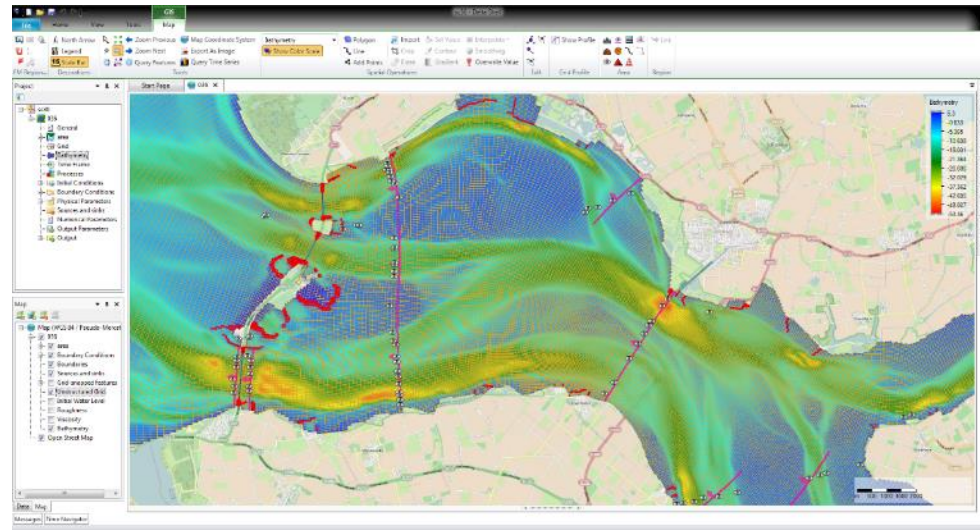
Harteveld, Casper. Triadic game design: Balancing reality, meaning and play. Springer Science & Business Media, 2011.

Cash, David, et al. Saliency, credibility, legitimacy and boundaries: linking research, assessment and decision making. 2002.



New design iteration

- Solution: Include a real water (hydrodynamic) model in the game and add an interface for players to interact with it
- Rationale: hydrodynamic models perceived as black box in reality
- New learning objective!



Hydrodynamic model interface

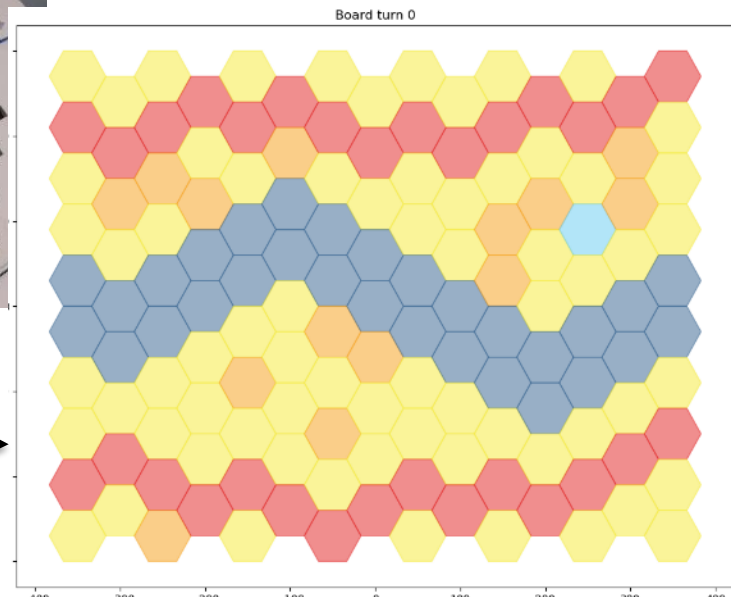


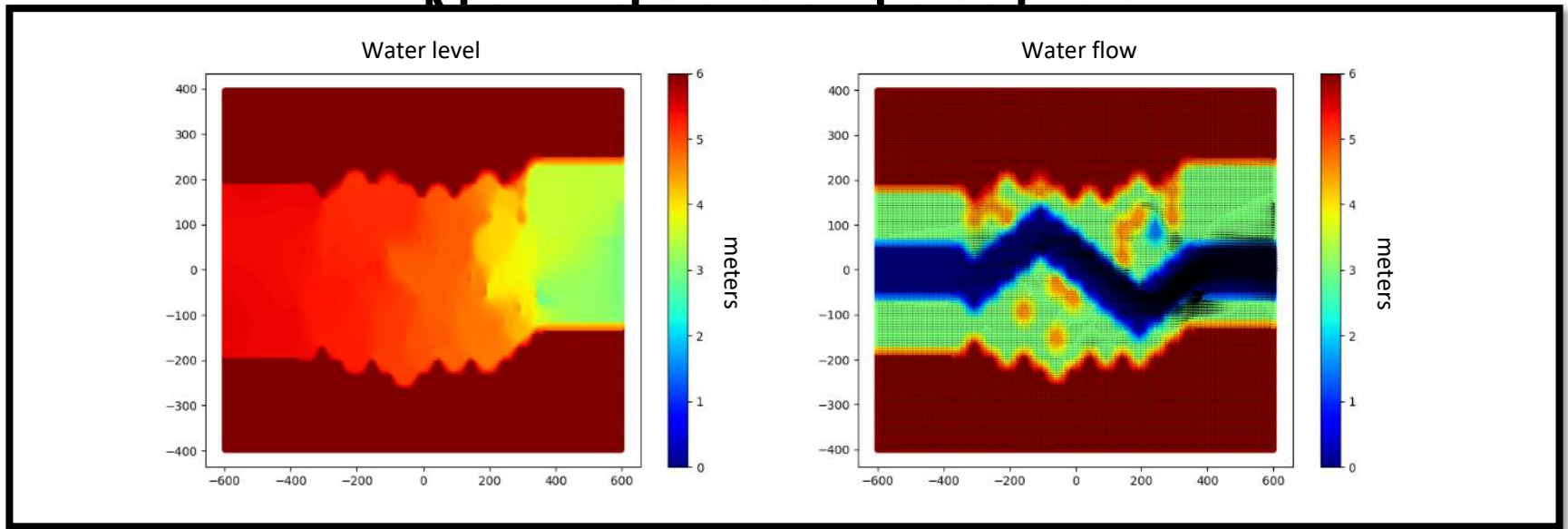
New design iteration

- Tangible interaction: linking physical forms to digital information (Ishii, 2008)

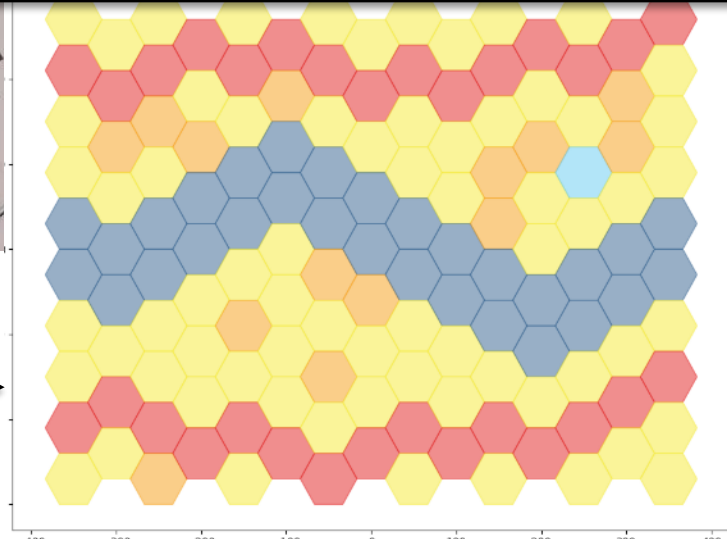


Automatically
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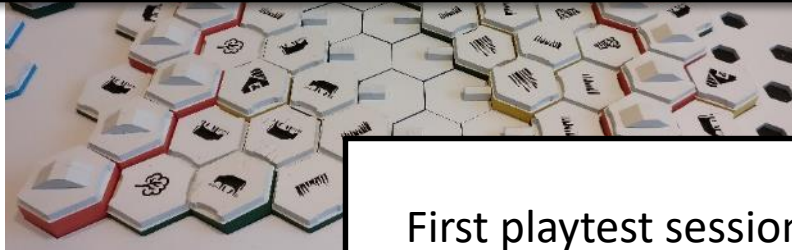
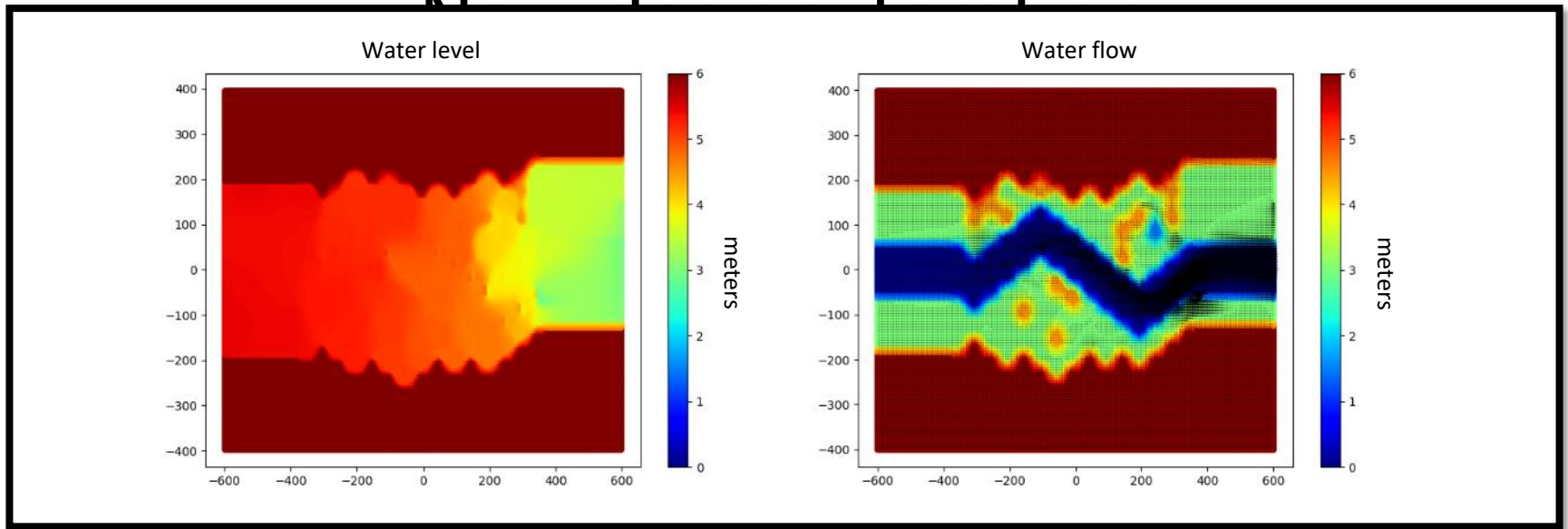


Input for
model



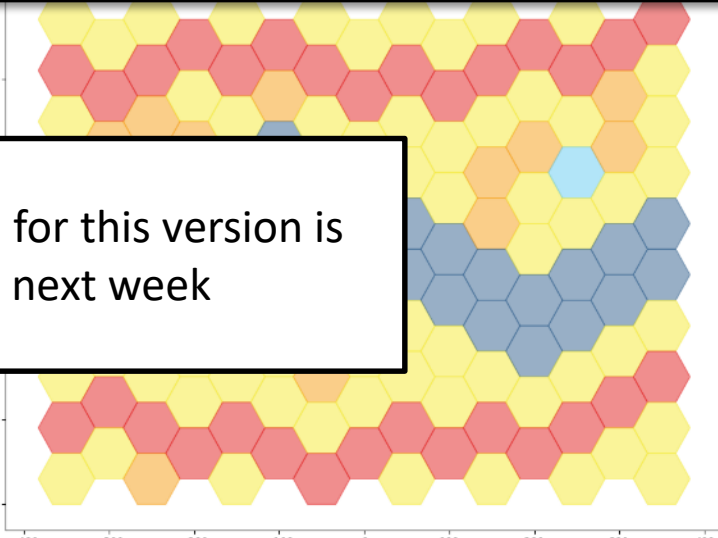
Ishii, H. Tangible bits: beyond pixels. in Proceedings of the 2nd international conference on Tangible and embedded interaction. 2008. ACM.

UNIVERSITY OF TWENTE.



First playtest session for this version is
scheduled for next week

Automatically
made digital



Input for
model



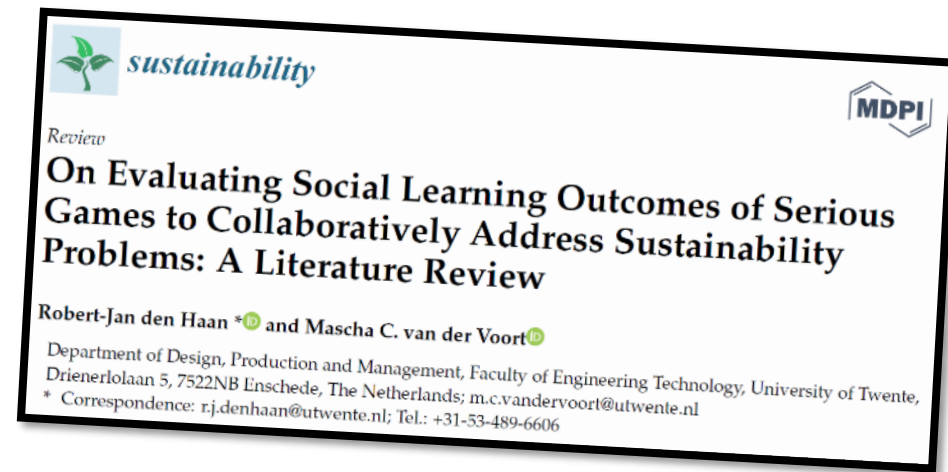
Take home message

- Interested in developing and applying serious games?
 - Start and keep it simple
 - Playtest, playtest, playtest
- Serious game is a boundary object, its design should balance **reality-meaning-play** in such a way that all stakeholders find the game **credible**, **salient** and **legitimate**
- Learning objectives will not be reached without these being fulfilled



Serious games & Learning

- Systematic literature review on the evaluation of collaborative serious games learning outcomes
- Rationale:
 - Increasingly serious games + natural resources management + social learning literature
- Gap:
 - Lack of common methodology to evaluate serious games in general (see Mayer et al., 2014)
 - Lack of common methodology to evaluate social learning from collaborative serious games specifically (see Madini et al., 2017)



Research questions

- Main research question:
 - What is the current state of the art of the different methods and procedures used to assess social learning outcomes of collaborative serious games?
- Review research questions:
 1. How is learning through collaborative serious games conceptualized?
 2. When is data collected in the evaluation of learning through collaborative serious games?
 3. What methods are used in the evaluation of learning through collaborative serious games?
 4. Do evaluations of learning through collaborative serious games use quantitative, qualitative or a combination between quantitative and qualitative data?
 5. What are the learning effects of collaborative serious games according to their evaluations in relation to social learning?



Type	Definition/Indicators of Learning Effects	Measures of Indicators
Cognitive learning	Acquisition of new knowledge; restructuring of existing knowledge	Test scores; change in centrality and specificity of knowledge presented in concept maps
Normative learning	Changes in norms; change in values; change in paradigms; convergence of group opinion	Change in, and convergence around, environmental beliefs; participant reflections; meeting proceedings
Relational learning	Improved understanding of mind sets of others; building of relationships; enhanced trust and cooperation	Change in social network structure; participant reflections

- Review research questions:
 1. How is learning through collaborative serious games conceptualized?
 2. **When is data collected in the evaluation of learning through collaborative serious games?**
 3. **What methods are used in the evaluation of learning through collaborative serious games?**
 4. **Do evaluations of learning through collaborative serious games use quantitative, qualitative or a combination between quantitative and qualitative data?**
 5. What are the learning effects of collaborative serious games according to their evaluations in relation to social learning?



Synthesized results

Type	Assessment Approach	Data Collection	Methods
Cognitive learning	Self-reflective questions	Post-game	Questionnaires (open or closed questions); interviews; debriefings
	Knowledge measurements	Pre- and post-game	Questionnaires (open or closed questions); interviews; concept maps
	Observed knowledge acquisition	In-game	Observations (structured or unstructured, in-situ or from recordings); Analysing data logged during gameplay
Normative learning	Self-reflective questions	Post- and post-post game	Interviews
	Shifts in opinion measurements	Pre- and post-game	Questionnaires (closed questions); perspective mapping
Relational learning	Self-reflective questions	Post- and post-post game	Questionnaires (open or closed question); interviews; debriefings
	Group dynamics analysis	In-game	Questionnaires (closed questions) & interaction analysis and social network analysis



Post-game self reporting:

- Questionnaires/interviews/debriefings
- Mostly qualitative

Type	Assessment Approach	Data Collection	Methods
Cognitive learning	● <u>Self-reflective questions</u>	<u>Post-game</u>	Questionnaires (open or closed questions); interviews; debriefings
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Pre/post measurements:

- Questionnaires/interviews/concept maps (cognitive)/perspective mapping (normative)
- Qualitative and quantitative

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In-game observed learning:

- Observations (in-situ/recorded), Game data logging & analysis, interaction/social network analysis
- Qualitative and quantitative

Type	Assessment Approach	Data Collection	Methods
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Synthesized results

Type	Assessment Approach	Data Collection	Methods
	Self-reflective questions	Post-game	Questionnaires (open or closed questions); interviews; debriefings
Co	<div> <ul style="list-style-type: none"> Overall: <ul style="list-style-type: none"> Lack of common evaluation methodology Wide range of quality (and documentation) of evaluation approaches Very few studies evaluate the learning or the impact of learning some time after applying serious games </div>		
No			
Relational learning	Self-reflective questions	Post- and post-post game	question); interviews; debriefings
	Group dynamics analysis	In-game	Questionnaires (closed questions) & interaction analysis and social network analysis



What should we do?

- We lack a common evaluation methodology—should we develop one?
 - Evaluation of serious games is going to differentiate heavily between games, their scope, their players, where a game is applied, in what setting it is applied...
- What should we certainly do?
 - **Make the evaluation of learning a design question**—thinking upfront on how to evaluate learning from playing your game may improve its design, its evaluation and save you time in the long run
 - **Apply mixed-method evaluations**—e.g. combine pre/post measurements of cognitive learning through questionnaires with in-game observations to match reported learning with observed learning. Serious games are very suitable to mixed-method evaluations
 - **Look for ways to assess the impact of learning well after game sessions**—i.e. we assume that learning in the game is transferred to ‘the real world’, is it?



What should we do?

- - Discussion:
 - What (other) methods to evaluate learning come to mind that may be very suitable to use with games?
- What should we certainly do?
 - **Make the evaluation of learning a design question**—thinking upfront on how to evaluate learning from playing your game may improve its design, its evaluation and save you time in the long run
 - **Apply mixed-method evaluations**—e.g. combine pre/post measurements of cognitive learning through questionnaires with in-game observations to match reported learning with observed learning. Serious games are very suitable to mixed-method evaluations
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