Gamification: Playful Teaching for Generation-X/-Y/-Z/…

Alexandru Iosup
Parallel and Distributed Systems Group

Thanks from the PDS Group at TU Delft.
Questions? I have one…

Q: May I help you gamify your course?

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Alexandru Iosup

Grids/Clouds
P2P systems
Big Data
Online gaming

Dick Epema

Grids/Clouds
P2P systems
Video-on-demand
e-Science

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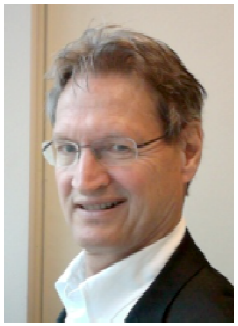
Ana Lucia Varbanescu

HPC systems
Multi-cores
Big Data
e-Science



Henk Sips

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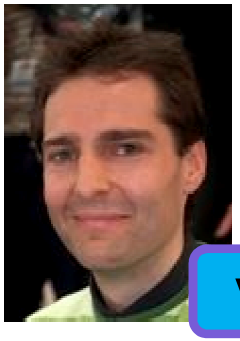

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Home page

- www.pds.ewi.tudelft.nl

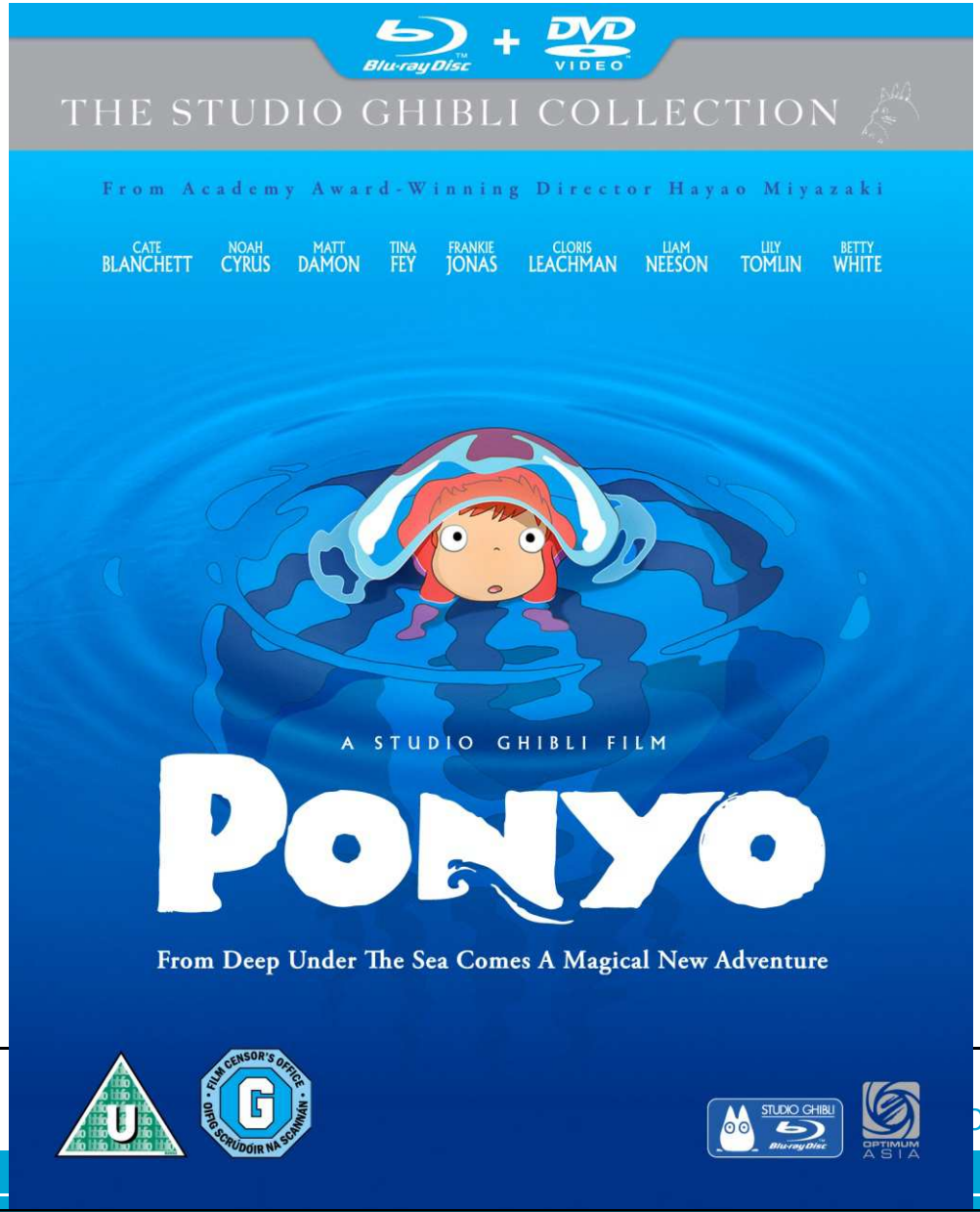
Publications

- see PDS publication database at publications.st.ewi.tudelft.nl

What Is This Talk About?
A Games-Based Teaching Technique

Q: What would you learn about Van Gogh from a Museum poster?

What is This Talk Also About? My Personal Curiosity*



* "A Magical New Adventure"

Take-Home Message

Gamification* in Higher Education = Rich Challenge

*** Making courses similar to game universes**

Gaming used to be about youths, now all generations

Gaming is challenge and reward, tension and catharsis

Game universes populated with all levels of skill

Game universes populated with all personalities

Agenda = A play in 7 acts, 3 set pieces, and 75 minutes

1. What is this talks about?
2. **Why fix it if it ain't broken?**
3. What is Gamification? Any other definition? Any related technique?
4. How can Gamification help?
5. Reality check: how to use Gamification in practice? Is it worth it?
6. What's next (to study) in Gamification?
7. Conclusion

Why Fix It If It Ain't Broken?

- Well, it's broken bad (at least grammar)

- New generation of students
  - Attention span
  - Is higher education needed?
  - A technical education?!
- New wave of students
  - International means multi-cultural
  - Gaming may be the unifying factor for the student nation
- It's not you, it's me
- New ambition of TU Delft
  - "slagingspercentage" too low, but cannot select students…
  - … find ways to motivate them!

Exercise 1
(10 minutes, open discussion)

- Think about own experience
- Convince your partner before proposing an answer
- Tell everyone the answer

Q: What are the major issues of current higher education?

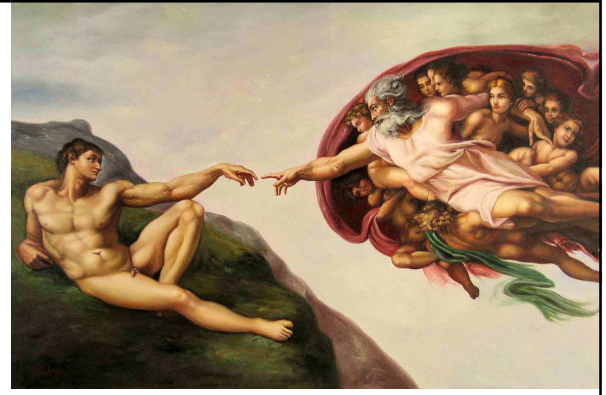
The New Generation

Munch, The Scream

- Attention span
  - Macro: competition with Internet, TV, …, other work (14+ hours common)
  - Micro: skills and rewards acquired from Internet, TV, …
- Is studying for higher education needed?
  - Inflation of diplomas: MOOCs, diploma-in-21-days, spec courses
  - Inflation of requirements: a nurse may need credentials for writing
  - General image of higher education has been declining (Diederik Stapel)
- A technical education?
  - "Cultuur van zesjes" (Zijlstra), <1/3 of students finish in +25% time
  - Pre-university level decreased significantly over past decade (Dijsselbloem)
  - "Women earn just 12% of computer science degrees" (37% in 1984) *
- Availability of expert mentorship (see Lex Borghans about NL)

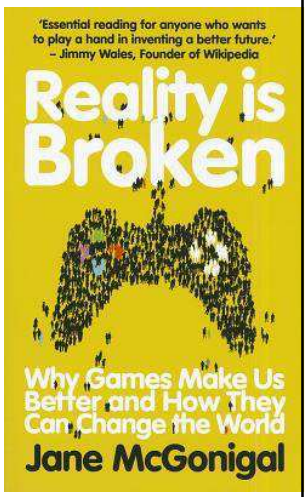
* Claire Cain Miller, NYTimes.com http://dealbook.nytimes.com/2013/04/02/opening-a-gateway-for-girls-to-enter-the-computer-field/?hp

New Wave of Students



Michelangelo during Renaissance

- International means multi-cultural
  - Failing course may be literally a matter of life and death
  - Competition may be perceived differently
  - Communication may be different
  - Cheating, especially plagiarism, may be seen differently
  - "Exam takers" vs learners



- Job-hopping, trainspotting, …
  - Job satisfaction important
  - The new workplace needs to be fairer, rewarding, offer higher goals

- What is the common denominator?
  - Not the language, culture, desire to learn
  - Perhaps gaming…

It's Not You, It's Me

Rauschenberg, White Noise

- **Most** faculty members consider their teaching **above average** in quality and effectiveness (Blackburg & Lawrence, 1995)(Bok, 2006)(Gillespie, Hilsen, & Wadsworth, 2010)(…)
- Starting educators judged by research, not education
- Education other than of under-graduate students not supported
- Disseminating education material and education given to students in other universities not supported
- In-depth training not available

Agenda

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   Any other definition? Any related technique?
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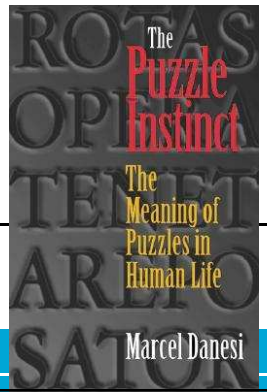
What's in a name?

Gamification = using social gaming elements in non-game environments for higher education

Social Gaming =

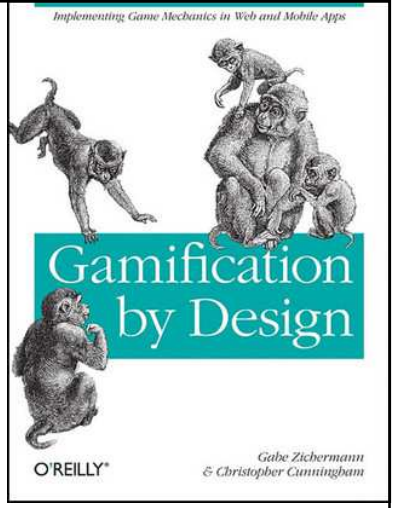
(online) games for which social interaction helps the gaming experience



1. **Mechanics**
   Explore, do, learn, socialize, compete
   +
2. **Dynamics**
   Onboarding, player stats, badges, unlocked content, social engagement, others
   +
3. **Game Content**
   puzzles, challenges, extra-projects, culture

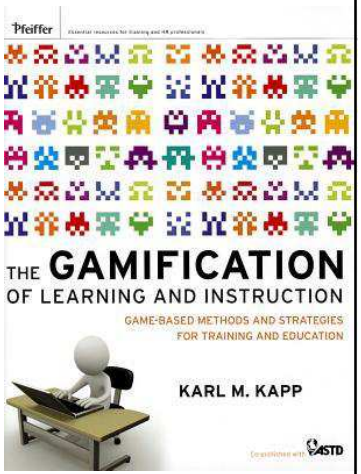
Other Definitions

- Zichermann & Cunningham
  "the use of game thinking and game mechanics to engage users and solve problems"
  Rather broad, but good.



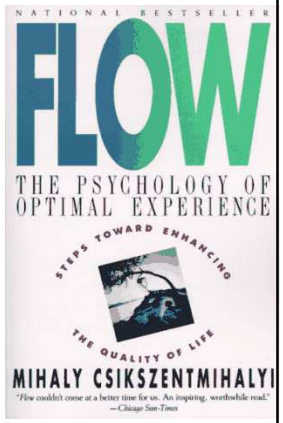
- The Gartner group
  "employing game mechanics to non-game environments such as innovation, marketing, training, employee performance, health and social change"
  I think it's more than mechanics. Dynamics (tie with the current player) and content also play their part.

- Karl Kapp
  "Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems."
  I don't think aesthetics play such an important role.
  Kids play football with a rag ball, in the mud.



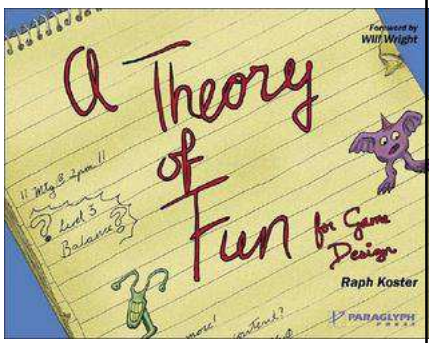
Related Techniques (Too Many to Name)

- The relationship between games and other art forms? (ludology)
  - Games and theatre, opera, miming
  - Games and storytelling
  - Games and painting, music



- Flow = people can enter a state of grace where they work tirelessly and with excellent results

- Social Learning Theory = people learn from each other, through observation



- A Theory of Fun = fun derives from many of the game elements described in this lecture

- Much on (intrinsic) motivation, education, **serious gaming**, …

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Why Gamification?

"***Science and scholarship are much like games***. *Players are drawn into games because of their* ***challenges****, and playing involves* ***creating, testing and revising strategies as well as the skills necessary for progressing*** *in the game."*
Mayra, Game Studies, 2009, p.3

+

Exercise 2
(10 minutes work + 5 minutes talk)

- Groups of 4
- Think about own experience
- Convince your team before writing down an answer
- Discussion (talk) at end

Q: Why would gamification work for your course?

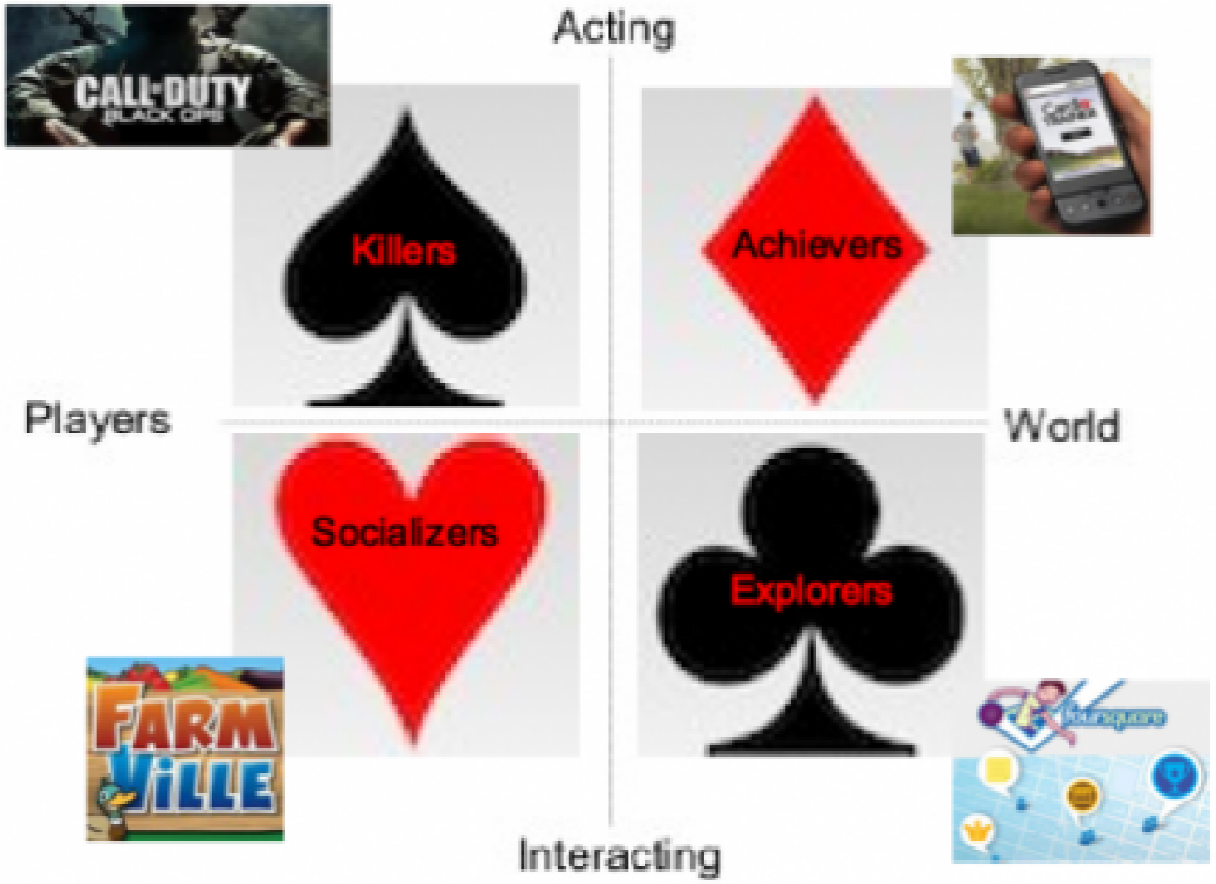
Which activities do you see as game-like?

Why would it work at BSc level vs MSc level?
Why would it work in Large Class vs Small Class?
Why would it work at Lecture- vs Seminar- vs Project-Based?
etc.

Intuition: Games Cater for Different Player Types

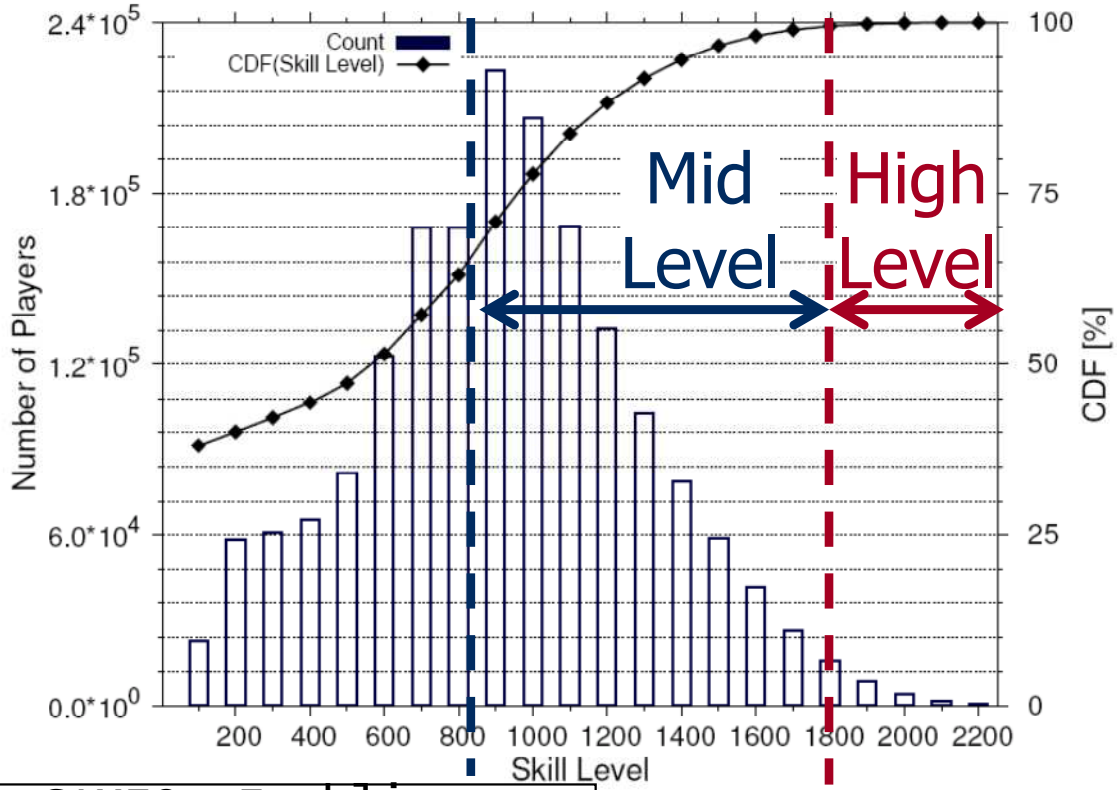
Each type ~25% players

- Richard Bartle's "Players who suit MUDs"
- Achievers
  - Solve the challenge
- Explorers
  - See what's there
- Socializers
  - There for others
- Killers
  - Win against others



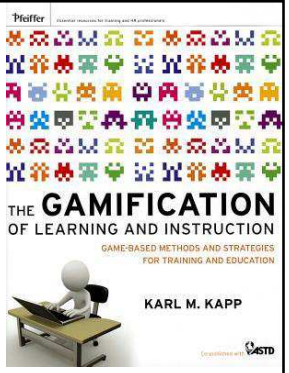
Intuition: Games Cater for Different Player Levels

- **RuneScape**: 135M+ open accounts (world record)
- Dataset: **3M players (largest measurement, to date)**
  - 1.2M players under level 100
  - Max skill 2,280
- **Number of players at each level (low, mid, high) is significant, anytime**



A. Iosup, A. Lascateu, N. Tapus, CAMEO: Enabling Social Networks for Massively Multiplayer Online Games through Continuous Analytics and Cloud Computing, ACM NetGames 2010.

(Meta-)Research on the Use of Game Elements in Education



Study	Meta-study of … studies	Findings
Randel et al. (1992)	>60	>50% no difference if using games. >30% significant improvement when using games.
Hays (2005)	>100	Game design must match learning objectives.
Vogel et al. (2006)	>30	Games can help improve cognitive skills vs traditional.
Sitzman (2011)	>60	Playing improves confidence. Vs traditional, better retention, declarative and procedural knoweldge

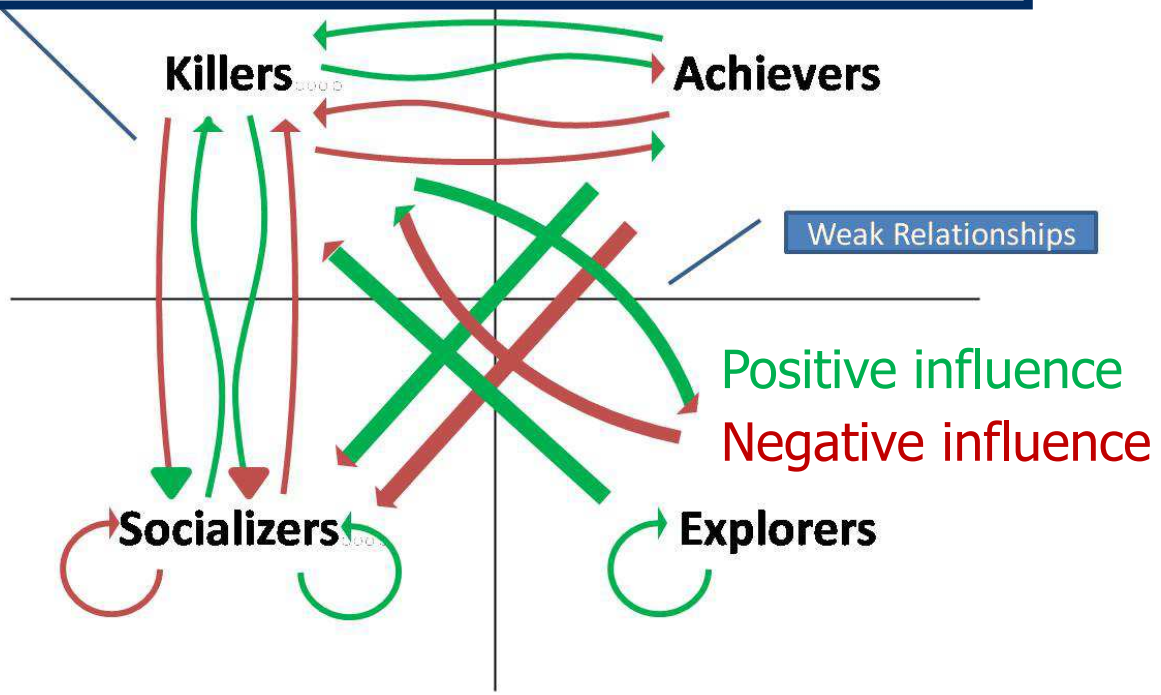
Research on Different Player Types

- Richard Bartle's "Players Who Suit MUDs"
- Achievers
  - Sol
- Explorers
  - See what's there
- Socializers
  - There for others
- Killers
  - Win against others

Need to keep each type in class

Achievers and Socializers cancel each other

Explorers, in particular, need Killers



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5. **Reality check:**
   How to use Gamification in practice? Is it worth it?
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Gamification at TU Delft, since at least 2007

- B.Sc. Courses
  - **TI1400 Computer Organization** (2 years + ongoing) (previously, was consistently rated lower than others, considered tough and boring course)
  - IN3305 Bachelorseminarium (5 years, evolving form)
- M.Sc. Courses
  - IN4392 Cloud Computing (1 year, ongoing, pair teaching)
  - IN4391 Distributed Computing Systems (ongoing)

Q: How to gamify a course?

Q: Is gamification useful?

Start With the Perfect Student

Q: When to explain coarse elements? How about detailed?

- Explain students what is expected to learn and do
- Explain how to get a 10, but not how to get a 6
- Coarse and detailed explanation of expectations
- Coarse and detailed time allocation

Q: What is the problem with this student?

The Scoring System for TI1400

1. Course Points	2. Access Tokens	3. Brownie Points
10,000 for straight 10	Start with 1	
+1,000 t		
+1,000 lab bonus #2	Bonus Lab assignments	I will bake brownies for *you*! (but not force you to eat them)
+500 lab bonus #1		
+300 correct exam Q	**Advanced topics** (GPUs, clouds)	
+50 activity in Lab/Lecture/Tutorial	Discuss w Lecturer	
+25 correct end-lecture quiz	Propose Exam Qs	
+500 entry quiz	Rec. letter	

Q: What is unusual about this scoring system?

The Scoring System for TI1400

Q: Why this complicated system?

A1:

1. Gamification =
more tracks of advancement +
keeps top students involved in the classroom

2. Decoupling grading schemes =
responding to "cultuur van zesjes"

3. Extra (bonus) points for **Lab**, **Lectures**, and **Tutorial**,
through extra assignments, lecture participation and end-lecture quizzes,
and team-/self-study, respectively.

A2:

1. >65% success rate at first exam for 2 years now.

Detailed Time Allocation

	Lecture	Tutorial	Lab	Self-Study
1. Digital Logic	4h	1/2h	-	10h
2. Data Repr./Processing	4h	1/2h	-	10h
3. ISAs/Assembler	6h	2h	16+8h	20h
4. Basic Processing Unit	4h	2h	-	10h
5. I/O + OS Principles	2h	1h	-	10h
6. Memory + Performance	2h	1h	-	10h
7. Pipelining + Perf.	2h	2h	-	10h
8. Programming Principles	2h	-	-	5h
9. Parallelism/Distribution	2h	1h	-	10h
Total	**28h**	**14h**	**16+8h**	**95h**

Other Elements

- Too many to list here
- Onboarding
  - Entry quiz
  - Story every lecture
- Social Learning
  - In-class teams
  - Self-study as team effort
  - Keep Killers in class
  - Involve Killers and Explorers in self-study
- Different player types
  - Ladders, ranking, end-lecture quiz: only for Killers
  - Content unlocking: Explorers and Achievers

Exercise 3
(10 minutes work + 5 minutes talk)

- Groups of 4
- Convince your team before writing down an answer
- Discussion (talk) at end

Q: What game elements could you use in your own course?

1. **Mechanics**
   Explore, do, learn, socialize, compete
   +
2. **Dynamics**
   Onboarding, player stats, badges, unlocked content, social engagement, others
   +
3. **Game Content**
   puzzles, challenges, extra-projects, culture

There's No Free Lunch in Comp.Sci. (My Personal XP)

- Gamification takes time and energy
  - One week to consider gamification elements +
  - One day per lecture for adaptation +
  - Continuous adaptation +
  - End-lecture quiz +
  - Explaining a new system to students +
  - The nitty-gritty details

- Gamification takes moral strength (did I say that?!)
  - A new system has to conquer inertia
  - An untested new system has to conquer doubt
  - Support from TUD at most limited
  - On the positive side, I really enjoyed the open and inquisitive attitude of the Dutch student

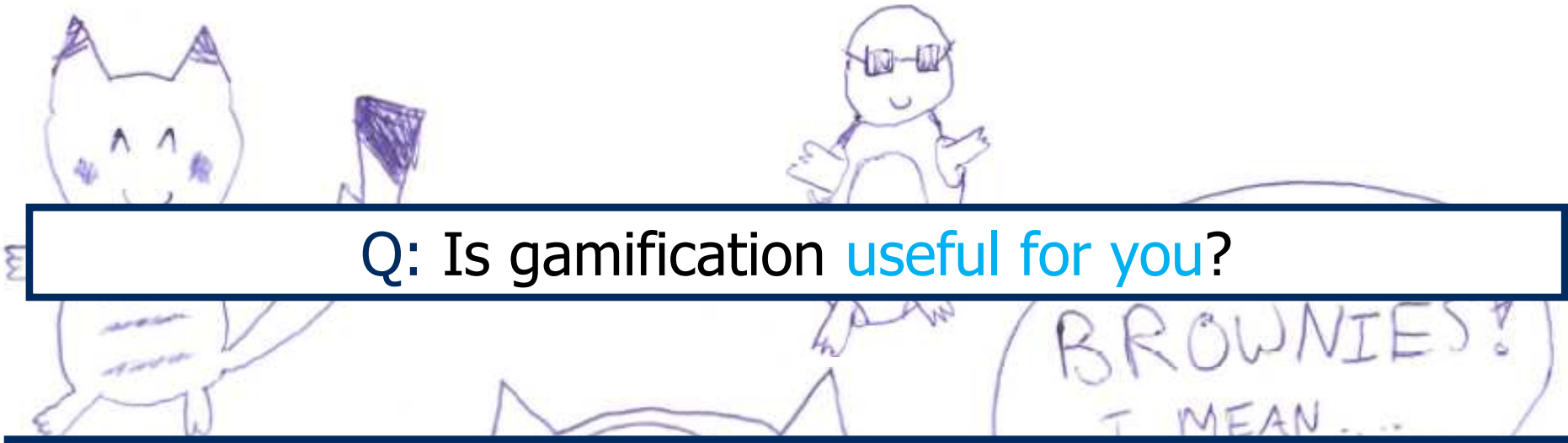
Exit Quiz (started Q3 2012—2013)

- (Yes-No-Don't care questions) (>90% 75-90% 50-75%)
- I understand how this course was gamified
- Gamification made me more motivated
- Gamification **made me think more carefully** about what I like to do (where I can get bonus points)
- I **enjoyed** the interactive part of the lectures
- I **enjoyed** the exercises at the end of the lectures

Testimonials

- "Alex Iosup is teh baws! :) His lectures on Collegerama would be awesome." [Collegerama lectures now available]
- "Lectures were nice, different in a good way from other teachers."
- "I really like the **rewards** [during lectures]"
- "I just would like to say that the **extra lectures** are a great concept to reward the motivated students. Thank you for inviting me, it was a great lecture."
- "Keep it going, keep mihai :D"

Is This Playful (or) Education?



Q: Is gamification useful for you?

Two thirds of our students pass after their first try.

Exam in 2012 more difficult than exam in 2011.
Self-study work in 2012 more extensive than in 2011.
We keep top students in the classroom.
We get requests for Honors Track.
etc.

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What's Next to Study in Gamification?

- Macro
  - Does gamification lead to sustained improvement at TUD?
  - Which gamification element is responsible for the largest improvement at TUD?
  - Which type of learning goal gains most from gamification, at TUD?
  - Which type of student gains most from gamification?
  - Which level of student gains most from gamification?
  - How to measure? Long-term studies, etc.
- Micro
  - Tuning point flows
  - Tuning gamification elements
  - Measure reaction of students

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7. **Conclusion**

~~Conclusion~~ Take-Home Message

Q: What was this talk about?

- **Gamification = use of gaming elements in non-game environments**
- **Gamification can help in higher eduction**
  - Better results with retention, and procedural and declarative knowledge
  - Better results with cognitive skills
  - Better confidence
  - Keeps all types of players involved
  - Keeps all levels of players involved
- **Reality Check:**
  tried at TUD since 2007,
  with good results so far

http://www.flickr.com/photos/dimitrisotiropoulos/4204766418/

Thanks from the PDS Group at TU Delft.
Questions? I have one…

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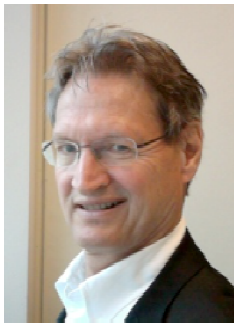

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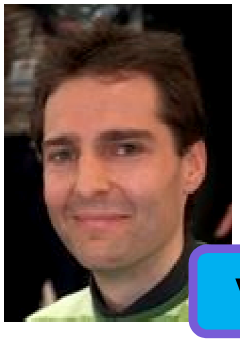

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Johan Pouwelse

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In-Class Questions (Summary of Two Sessions)

1. Why did you not design this as a gamified experience?
   I did design it as a gamified experience, but also to show that you do not need to change your entire course to use gamification. Here, elements of narrative, interactivity, verbal reward for good questions and answers ("Good question!"), work in pairs and teams. Plus… was it fun for you?

2. What is specifically game-related in technique X or element of gamification Y that you have shown?
   Ludologists would perhaps solve this more elegantly, but let me state again: gaming and other performing arts are intertwined. The challenges, the puzzles, the goal-setting and achieving introduced in this workshop are the specifically game-related elements.

In-Class Questions (Summary of Two Sessions)

3. I think there are other issues with higher education, such as funding. How does gamification solve these? (Can gamification solve all my problems?)
   Gamification can only solve a part of the problems, among which many of the problems identified in the agenda point 2. It cannot replace bad teaching skills, funding, etc.

4. I don't think (computer) games are as wide-spread as you claim. Or that they can help with education.
   First, you are fighting a growing body of evidence with personal opinions. Games are spread well enough that our students know them well. This lecture has very little to do with computer games or any specific type of game, but it does mention core rules (mechanics) that appear in many games.

In-Class Questions (Summary of Two Sessions)

5. Is gamification only about rewards? Aren't rewards extrinsic motivation and inherently bad?
   As show in this workshop, gamification includes many different elements, one of which is the reward structure. Rewards can often be thought as both extrinsic and intrinsic (a final grade is an extrinsic goal—to finish—but also an intrinsic goal—to evaluate and later improve.) Designing rewards is an art.

6. I would have liked to get a checklist on how to gamify a course.
   Unfortunately, this is like asking for a checklist in a course on novel writing; I could explain the process, but the details would still solicit the student's skills (knowledge, design, and art). In other words, there is no detailed list, only general guidelines and some detailed examples.

A Student and a Gamer Meet in a Bar…

- ***Civilization arises in and as play, and never leaves it.***
  Huizinga, Homo Ludens, 1938, p.178

- ***Science and scholarship are much like games****. Players are drawn into games because of their* ***challenges****, and playing involves* ***creating, testing and revising strategies as well as the skills necessary for progressing*** *in the game.*
  Mayra, Game Studies, 2009, p.3

Traditional Gaming

Play** is a **voluntary** activity or occupation executed within certain fixed **limits of time and place**, according to **rules** freely accepted but absolutely binding, having its aim in itself and **accompanied by a feeling of tension, joy, and the consciousness that it is "different" from "ordinary life"

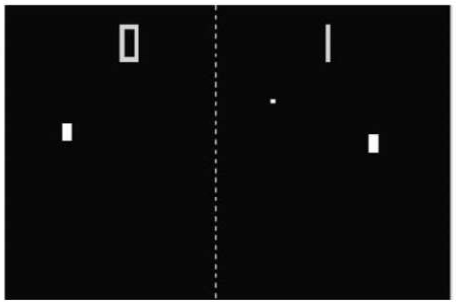
Huizinga, Homo Ludens, 1938, p.28

Chess players, Lucas van Leyden, c.1508

Awari, solved by J. Romein et al., c.2000

A Brief History of Computer Games

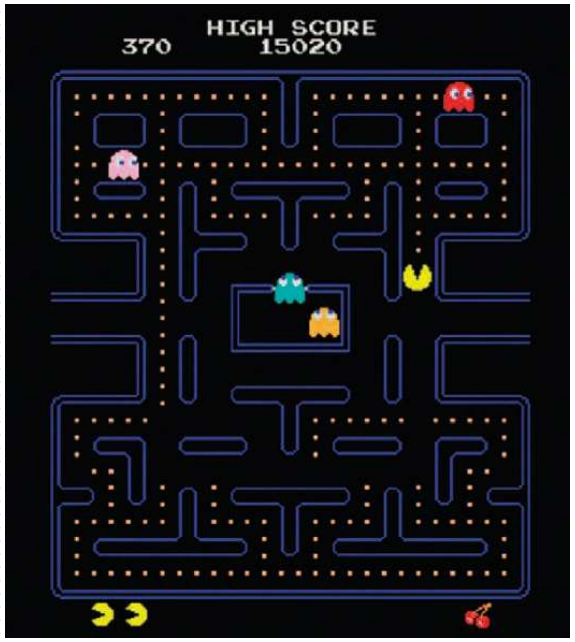
1970s: The Device

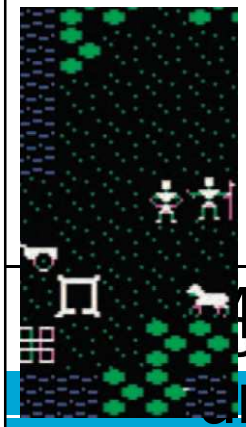


1980s: The Hero Era

1981: Handheld Crash

1983: Videogames Crash





1990s: The Tech & Genre Era

2000s: The Social Gaming Era

Testimonials

Did you learn enough from this project?
Yes: Not only did I learn a lot about workload modeling, I also really improved speaking English. I have learned what a real "research" project looks like. I have learned that I need to be more clear in expressing myself, as subtilities tend to get lost in translation.

Not only did I learn a lot

Were all your expectations in terms of supervision met?
Yes, the huge amounts of red ink were really helpful for me to be able to finish the project. The informal and pleasant meetings really helped to keep me motivated. I would have liked a more planned approach, but I blame this at the rush-start we had in an attempt to make the August 2011 deadline. I would really have liked more freedom in the project.

Really helpful

Would you recommend doing a thesis with your direct supervisor to your friends?
Certainly: I like the informality and openess of our meetings. I like the optimistic approach to the supervision. I like that there are always suggestions to enhance son

Certainly [recommend]

Would you recommend doing a thesis in this group to your friends?
Certainly: There are nice things going on in the group and there are lots of nice research opportunities, for example on a elastic MapReduce system and on the adaption of Skymark for other types of workloads. The Grids 'n Cloud meetings help to keep in touch with the other group members and really

Conclusion

Was the thesis project worth it?
Yes, for me personally it is a huge benefit to have completed a research project.

A huge benefit