On Gamification for Higher Education

Dr. Alexandru Iosup, Otto Visser, Dr. Ana Lucia Varbanescu, Tim Hegeman, and Jesse Donkervliet
The “Leaking Faucet”

- Major technical university in the Netherlands

- “P-in-een” of an important BSc track
- Completion “in time” of the BSc
- (What do students think about it?)

<40%

<50%

Exercise: The Blame Game

- Team work, first 2 minutes
  1. Form team of 2-3 persons
  2. Think about own experience
  3. Convince your team before proposing an answer

- Open discussion, next 2 minutes
  - Tell everyone the answer

Q: Who is responsible for the current yield of higher education?

Voting on best answer
We’re In This Together (My Answer)

• New generation of students

• New types of students, especially multi-culti

• It’s not you, it’s me

• New ambition of our faculty, but cannot select students

https://quotablequoteunquote.files.wordpress.com/2008/08/walkingcomputergeek.jpg
We’re In This Together (My Answer)

- New generation of students

- New types of students

The main challenges for the future?

Every student counts!
Every student is different!

- New ambition of our faculty, but cannot select students

https://quotablequoteunquote.files.wordpress.com/2008/08/walkingcomputergeek.jpg
Let’s Extrapolate to Europe: The Workforce Gap in ICT

Source: e-Skills for Jobs in Europe, 2014
Let’s Extrapolate to Europe: The Workforce Gap in ICT

The main challenges for the future?

Every student counts!
Every student is different!

Source: e-Skills for Jobs in Europe, 2014
Let’s Extrapolate to Europe: The Workforce Gap in ICT

The main challenges for the future?

Every student counts!
Every student is different!

Rhetorical Q: Which teaching technique can help?

Source: e-Skills for Jobs in Europe, 2014
Agenda for Today or Gamification. Because Every Student Counts!

1. Introduction, with high-level goal and low-level objectives
2. An intuition behind gamification
3. A practical framework for gamification in higher education (getting your courses gamified)
4. Wrap-up

Time Units
1
1
5½
1/2

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.
What is Gamification?
A: Game Thinking + Techniques

Q: What is gamification?
A: The use of thinking and techniques designed for gaming in non-gaming settings, e.g., in education.

http://goo.gl/V97zSW

What is the intuition behind gamification?
How can gamification be used?

http://goo.gl/ILSNeb
Do You Know This Person?

By Eunice Szpillman, via Wikimedia Commons
Designing a course is like creating a complex puzzle.
I in the Box
I in the Box
I in the Box
I in the Box
I in the Box
I in the Box
### Agenda for Today or Gamification. Because Every Student Counts!

<table>
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<tr>
<th>Time Units</th>
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<td>3.</td>
<td>A practical framework for gamification in higher education</td>
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<td>(getting your courses gamified)</td>
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<td>4.</td>
<td>Wrap-up</td>
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</tbody>
</table>

**1 Time Unit (TU) ~ 7 minutes.**
**Total time 8 TUs ~ 55 minutes.**
Content Unlocked!

2 x L I Z

---

TUD Lectures on Education
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content*.  
   * You already have this
2. Describe the perfect student.
3. Design the gamified experience**.  
   ** Mechanics, Dynamics, Aesthetics
4. Playtest your design and check for fun!
5. Operate your gamified course.

Problem statement: 1 = Understand;  2 = Analyze + Define goal(s);  
Your Approach: 3 = Ideate + Select;  4 = Implement + Validate;  5 = Deploy + Evaluate

(Assuming you want to gamify a traditional course.)
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.
2. Describe the perfect student.
3. Design the gamified experience.
4. Playtest your design and check for fun!
5. Operate your gamified course.
What’s Wrong With the Perfect Student?

The perfect student does NOT exist.
(And yet we are all here.)

- Achieves all course objectives
- Explores new directions
- Socializes with students around
- Excels in all tests, early

https://quotablequoteunquote.files.wordpress.com/2008/08/walkingcomputergeek.jpg
Richard Bartle’s “Players who suit MUDs”, Myers-Briggs, etc.
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- **Acting**
  - Achievers
    - more/more difficult challenges
  - Explorers
    - open/creative challenges

- **Players**
  - Socializers
    - team/discussion-based challenges

- **World**
  - Interacting
  - Challenges:
    - More/more difficult
    - Open/creative
Acting

Winners
competitive/single-winner challenges

Achievers
more/more difficult challenges

Players

Explorers
open/creative challenges

Socializers
team/discussion-based challenges

Interacting

World

• Richard Bartle’s “Players who suit MUDs”, Myers-Briggs, etc.
Exercise: The “Who Are You?” Game

Q: Which best describes you?

Players

Winners
competitive/single-winner challenges

Achievers
more/more difficult challenges

Socializers
team/discussion-based challenges

Explorers
open/creative challenges

Acting

Interacting

World

Richard Bartle’s “Players who suit MUDs”, Myers-Briggs, etc.
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.

2. Describe the perfect student.

3. Design the gamified experience.

4. Playtest your design and check for fun!

5. Operate your gamified course.
Gamification Is NOT Only:

- Playing a game in the classroom

Points
Badges
Leaderboards

PBL = The BLT sandwich
Q: What’s in a game?
A: Over 250,000,000 active players

Social Gaming = 100,000k+ players who benefit from social engagement

1. Mechanics
   Explore, do, learn, socialize, compete +

2. Dynamics
   Player progress and interaction, ...
   +

3. Game Content*
   puzzles, challenges, extra-projects, culture

* Art class pending.
Gamification Mechanics & Dynamics in Our Courses

• Too many to list here
  • Scoring system is but one element
  • Badges? Only for B.Sc., some “random”*
    * Manga cum laude

• Onboarding (mechanics)
  • Entry quiz
  • Story every lecture

• Social Learning (dynamics)
  • In-class teams, competing casually
  • Self-study as team effort, competing
  • Involve Winners and Achievers in class
  • Involve Winners and Explorers in self-study

• Different player types → different Mechanics, Dynamics, Aesthetics
  • Ladders, ranking, end-lecture quiz: mostly for Winners
  • Content unlocking (dynamics): Explorers and Achievers

# Mechanics (mostly)

Possible Games for Teaching Facts, Concepts, Procedures, and Systems

<table>
<thead>
<tr>
<th>What?</th>
<th>How? Common teaching elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facts</td>
<td>Story w terms, acronyms, and jargon</td>
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<tr>
<td></td>
<td>Taxonomies and Venn diagrams</td>
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<td></td>
<td>Games of repetition, recognition, matching</td>
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<tr>
<td>Concepts</td>
<td>Story w metaphors</td>
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<td>Boundary examples (what is/is not)</td>
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<td>Games to experience, classify, compare, sort</td>
</tr>
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<td>Procedures</td>
<td>Top-to-bottom view, story w Why? What?</td>
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<tr>
<td>(Rules)</td>
<td>Role-playing (Mechanics + feedback)</td>
</tr>
<tr>
<td>Systems</td>
<td>Simulations to experience</td>
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<tr>
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<td>(Tutorials to experience under guidance)</td>
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</tbody>
</table>
Exercise: The Onboarding Game

• Team work, first 2 minutes
  1. Form team of 2-3 persons
  2. Think about own experience
  3. Convince your team before proposing an answer

• Open discussion, next 2 minutes
  • Tell everyone the answer

Q: How do you onboard the current generation?
Voting on best answer
Onboarding: Challenging and Diverse Content to Activate Diverse Students

Learning Objectives

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<tr>
<th>BSc-CO, 6EC (168h)</th>
<th>MSc-CC, 5EC (140h)</th>
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<tbody>
<tr>
<td>Digital Logic and Data Representation</td>
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<td>Scheduling and Resource Management</td>
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<td>Interfacing and I/O Strategies</td>
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<td>Memory Architecture</td>
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<td>Functional Organization</td>
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<td>Multiprocessing</td>
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<td>Performance Enhancements</td>
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<td>Directions in Computing</td>
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</tbody>
</table>

Q: How did I try to onboard you, in this presentation?

Industry state-of-the-art

Topics touch today’s research

Social relevance

Photos: (left) courtesy Google Inc. (middle) http://www.flickr.com/photos/dimitrisotiropoulos/4204766418/ (right) personal library of A. Iosup.
Designing a course is like creating a complex puzzle
The Learning Graph

Q: How to build the learning graph for your course?
Q: How to build the learning graph for your course?

A: From the Course Schedule

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Lecture (Hoorcollege)  Tutorial (Instructie)  Lab (Practicum)  Exam
From the Course Schedule

1. Extract activities from the Course Schedule

Q: How to build the learning graph for your course?
Q: How to build the learning graph for your course?

From the Course Schedule

2. Add dependencies between activities

→ Assessment
Q: How to build the learning graph for your course?

From the Course Schedule

2. Add dependencies between activities (continued)

→ Assessment
Q: How to build the **learning graph** for your course?

From the Course Schedule

3. Add important states, such as **Winning**

→ Assessment
Q: How to build the learning graph for your course?

From the Course Schedule

1. Extract activities from the Course Schedule
2. Add dependencies between activities
3. Add important states, such as Winning
4. Annotate edges (points, etc.)
5. Identify paths of advancement on the resulting graph

(Iterate, finer granularity)
Q: How to build the *learning graph* for *your course*?

From the Course Schedule

Q: How to add to this *learning graph* self-study (homework) activities?

Q: How to add to this *learning graph* an entry quiz?

→ Assessment
Does gamification work?
(Meta-)Research on the Use of Game Elements in Education

<table>
<thead>
<tr>
<th>Study</th>
<th>Meta-study of ... studies</th>
<th>Findings</th>
</tr>
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<tbody>
<tr>
<td>Randel et al. (1992)</td>
<td>&gt;60</td>
<td>&gt;50% no difference if using games. &gt;30% significant improvement when using games.</td>
</tr>
<tr>
<td>Hays (2005)</td>
<td>&gt;100</td>
<td>Game <strong>design must match learning objectives.</strong></td>
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<tr>
<td>Vogel et al. (2006)</td>
<td>&gt;30</td>
<td>Games <strong>can help</strong> improve cognitive skills vs. traditional.</td>
</tr>
<tr>
<td>Sitzman (2011)</td>
<td>&gt;60</td>
<td>Playing <strong>improves confidence.</strong> Vs. traditional, better retention, declarative and procedural knowledge</td>
</tr>
</tbody>
</table>
Gamification works!

Extra work due to gamification, relative to traditional [% all students]

Gamified, BSc 2014
Gamified, BSc 2013
Gamified, BSc 2012
Gamified, BSc 2011
Traditional, BSc 2010

Bonus: Every year, we make the course more difficult.
What Happens When A Student Does Not Like the Course Topic?

I want to thank you for showing that even though I'm not that good at written exams, I still can excel at other points in my study. I'd love to have a copy of my badge, as physical reminder of a course that made me eager to learn about things. Even when some of those things will never really have my interest.

This course, and the way it was given, learned me a few things about what motivates me, and only for that reason it was totally worth getting up for every lecture.
Agenda for Today or Gamification. Because Every Student Counts!

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2. An intuition behind gamification
3. A practical framework for gamification in higher education (getting your courses gamified)
4. Wrap-up

Time Units
1
1
5½
½

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.
Q: What did you learn today?
Designing a course is like creating a complex puzzle
Gamification framework:
concept & intuition, mechanics & dynamics, ...

Gamification works!
The Gamification Masterclass (a future BKO course?)

• “By taking this course, you will be able to”

1. Identify student types and sketch their paths of advancement.

2. Identify and explain the mechanics and dynamics that are most likely to motivate students.

3. Select assessment methods that are most likely to challenge students yet avoid common pitfalls.

4. Construct, playtest, and operate a gamified course.

5. Demonstrate your gamification skills, by gamifying your course.
Thanks from our team.

Alexandru Iosup
Gamification Researcher & Professor

Otto Visser
Gamification Engineer & Professor

Ana Lucia Varbanescu
Gamification Professor

Tim Hegeman
Gamification SA

Jesse Donkervliet
Gamification SA

Marc de Kool
Gamification Supporter & Part-Time Actor

www.pds.ewi.tudelft.nl
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.

2. Describe the perfect student.

3. Design the gamified experience*.

4. Playtest your design and check for fun!

5. Operate your gamified course.

* Mechanics, Dynamics, Aesthetics
Course Design, In 5 Easy Steps...

• Team work, first 2 minutes
  1. Form team of 2-3 persons
  2. Think about own experience
  3. Convince your team before proposing an answer

• Open discussion, next 1 minute
  • Tell everyone the answer

Q: How do you design a course in higher education? (What do you show to your Director of Education?)

Voting on best answer
Decide on Learning Objectives etc.
(or, the basics of education)

1. Goals
   • High-level descriptions, e.g., “EDU601 Modern Education Techniques”

2. Outcomes
   • Low-level descriptions
   • Measurable verb + Limitations + Performance

3. Teaching method(s)
   • Teaching facts, concepts, procedures, systems
   • Lectures [, flipped classroom?], Lab, etc.
   • [Learning learning? Teaching teachers?]

4. Assessment method(s)
   • Of students. Of the course itself.
   • [Of the teaching methods?]

5. Operation of the course
   • Team, including SAs, co-teacher, etc.
Have You Read These?

- Learning how to learn
- Significant learning
- Group work
- Assessment
- Planning, team
- Grading
- From the trenches...
Q: But, Alexandru, surely not every course can use **gamification**!? I mean, there is no technique for my concept / activity / entire course...
A: Wonderful Advances in Gaming, Last 10 Years: diverse *individual* challenges
A: Wonderful Advances in Gaming, Last 10 Years: diverse social challenges
Exercise: The “Who Are You?” Game

Q: How would you use other taxonomies of student types?

- Richard Bartle’s “Players who suit MUDs”, Myers-Briggs, etc.
Gamification Mechanics & Dynamics

- Mechanics = how the system turns inputs into outputs
  Mechanics are applied directly, by the system (course staff), without further interaction from students.

- Points
- Badges
- Leaderboards

- Game states, such as winning, losing, cheating, etc.
- Challenges for each player type

- Rules, tutorials, guidelines, helpers, checklists
- Feedback
- Unlocked content

- ... so many more

Gamification Mechanics & Dynamics

- **Dynamics** = how the players and the system interact
  - **Progress / Learning graph**, with challenges as **nodes**, tested progress as **edges**, points etc. as **properties of edges**

- **Individual dynamics** (so, regardless of what others do)
  - Students can spend their points for some reward
  - Students get access to more advanced content

- **Group dynamics** (so, regardless of what students outside the group do)
  - Peer-reviews are discussed with the group, can result in bonuses/exclusions

- **Cohort dynamics**
  - Top-20% participate in extra lectures
  - Best group wins cookies
  - Bonus for best student/group of the day

A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.

2. Describe the perfect student.

3. Design the gamified experience.
   - Focus on Mechanics and Dynamics
   - Focus on Assessment

4. Playtest your design and check for fun!

5. Operate your gamified course.
Assessment That Motivates!

10,000 points for a 10
+50 for good activity
+1,000 for most challenging activity

Badges, unlocked content
# Our Diverse Scoring System

<table>
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</thead>
<tbody>
<tr>
<td><strong>10,000 for straight 10</strong></td>
<td></td>
<td><strong>I will bake brownies for you!</strong> (but not force you to eat them)</td>
</tr>
<tr>
<td>+1,000 <strong>team</strong> self-study</td>
<td><strong>Start with 1</strong></td>
<td></td>
</tr>
<tr>
<td>+1,000 lab bonus #2</td>
<td><strong>Bonus Lab assignments</strong></td>
<td></td>
</tr>
<tr>
<td>+500 lab bonus #1</td>
<td><strong>Advanced topics</strong> (GPUs, clouds)</td>
<td></td>
</tr>
<tr>
<td>+300 correct exam Q</td>
<td>Discuss w Lecturer</td>
<td></td>
</tr>
<tr>
<td>+50 activity in Lab/Lecture/Tutorial</td>
<td>Propose Exam Qs</td>
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<tr>
<td>+25 correct end-lecture quiz</td>
<td><strong>Rec. letter</strong></td>
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<tr>
<td>+500 entry quiz</td>
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</table>
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.
2. Describe the perfect student.
3. Design the gamified experience.
4. Playtest your design and check for fun!
5. Operate your gamified course.
Playtesting Your Own Course!

(Get others to role-play being your students)

1. Fine-tune fun

2. Are you increasing student motivation?

3. Balance the different paths of advancement
1. What Leads to Fun?

- Surprise
- Recognition
- Belonging
- Fantasising
- Just playing
- ...

A Theory of Fun for Game Design
Raph Koster
2. What Leads To Motivation?

- **Extrinsic Motivation**
  - Fun!
  - Rewards, achievements, badges
  - Passing the course
  - Top of the ranking
  - ...

- **Intrinsic Motivation**
  - Fun!
  - **Mastery** of subject, your way
  - Be you! **Access** and, later, **Autonomy**
  - Higher purpose, your way
  - (also **Maslow’s Hierarchy of Needs**)

- But ... one trigger may be extrinsic for some, and intrinsic for others
3. Balance Leads to Flow

- Flow = mind state of being focused exclusively on one activity (“being in the zone”, “the flow channel”)

- Balance between challenge increase and skill growth
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>10+ Operational Years Since 2007

- **B.Sc. Courses**
  - TI140x Computer Organization (5+ years)

- **M.Sc. Courses**
  - IN4392 Cloud Computing (3 years, co-teaching)
  - IN4391 Distributed Computing Systems (2 years)

- **Main lesson: manage course dynamics**
- **We are building a Living Lab, we are here to help you!**
Experience Operating Our Courses

• Overview, overview, overview!

• Learning graph overview

• Public overview (student’s view)
  • Updates often & complete

• Private overview (your & your team’s view)
  • Statistics: how many and which students are lagging behind?
It’s The People

• You
  • Time management

• Co-teacher
  • Verify and reflect on your ideas and adaptations

• Student assistants
  • What are they going to do? How many? How to co-involve in design?

• Students
  • How many? Is this cohort the same as last year?
  • Have they seen a gamified course before?
Tools: Missing?

- BlackBoard?
  - Contract ends end of 2015; tender for replacement is started
  - We are involved in testing possible candidates

- Excel?

- FeedbackFruits?
  - Promises basic gamification support for 2015/2016

- Dropbox? $\rightarrow$ SurfDrive!
There’s No Free Lunch!

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

- Gamification takes personal effort
  - A new system has to conquer inertia
  - A new system has to conquer doubt

- You are not alone, we are here to help!
A Framework for Gamification in Higher Education

1. Decide on Learning Objectives and related content.

2. Describe the perfect student.

3. Design the gamified experience.
   • Focus on the Mechanics-Dynamics-Aesthetics Framework
   • Focus on Mechanics and Dynamics
   • Focus on Assessment

4. Playtest your design and check for fun!

5. Operate your gamified course.
Agenda for Today or Gamification. Because Every Student Counts!

1. Introduction, with high-level goal and low-level objectives
2. An intuition behind gamification
3. A practical framework for gamification in higher education (getting your courses gamified)
   1. Learning Objectives to content (refresher on higher-education basics)
   2. Understanding student types
   3. Designing the gamified experience, focus on MDA* framework
   4. Designing the gamified experience, focus on dynamics and mechanics
   5. Designing the gamified experience, focus on assessment
   6. Playtesting for fun and motivation, and against common pitfalls
   7. Operating a gamified course
4. Wrap-up

* Mechanics, Dynamics, Aesthetics

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.
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4. Wrap-up

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Time Units
1
1
5½
½
1
1
½
1
1
½
1
½

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.
References (Shortlist, brief info)