

Gamification: An Interactive Session


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@AIosup

TUD Lectures on Education 1

The “Leaking Faucet”



- Major technical university in the Netherlands
- “P-in-een” of an important BSc track **<40%**
- Completion “in time” of the BSc **<50%**
- (What do students think about it?) **ELSEVIER**


* THE-QS world rankings, 2013 and 2014. TUD Lectures on Education 2

Exercise: The Blame Game


- Team work, first 2 minutes
 - Form team of 2-3 persons
 - Think about own experience
 - 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

TUD Lectures on Education 3

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

TUD Lectures on Education 4


We’re In This Together (My Answer)

- New generation of students
- New types of students

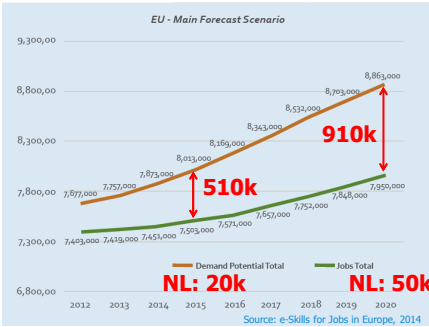
The main challenges for the future?


**Every student counts!
Every student is different!**

- New ambition of our faculty, but cannot select students

* THE-QS world rankings, 2013. TUD Lectures on Education 5

Let’s Extrapolate to Europe: The Workforce Gap in ICT



TUD Lectures on Education 6

Let's Extrapolate to Europe:
The Workforce Gap in ICT

EU - Main Forecast Scenario

9,300,00

The main challenges for the future?

Every student counts!
Every student is different!

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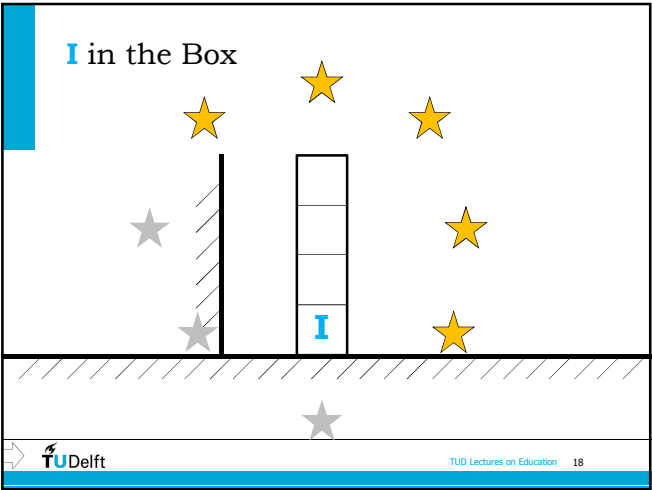
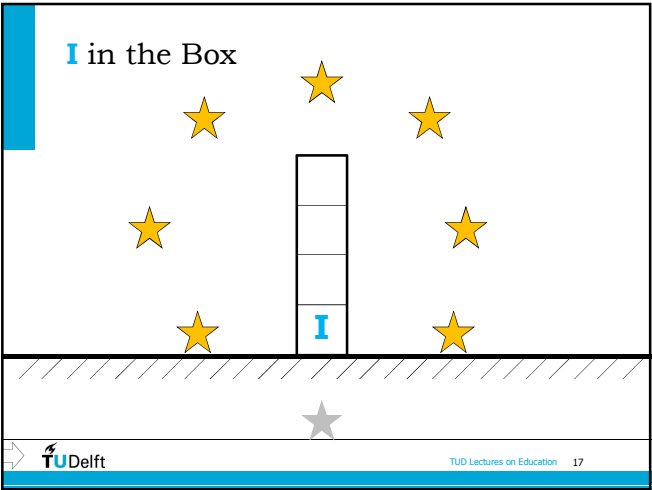
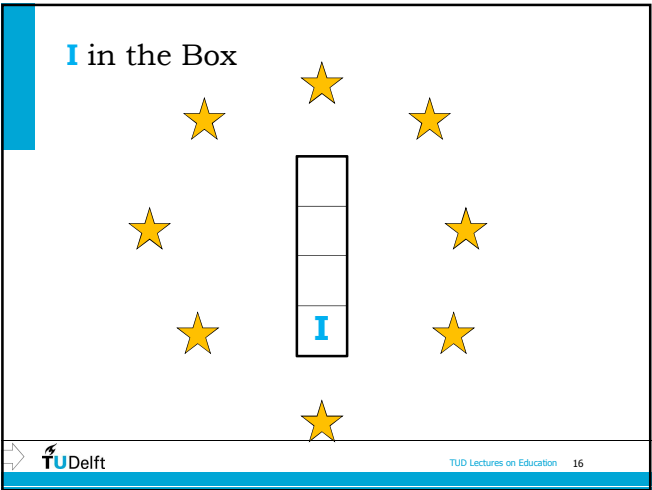
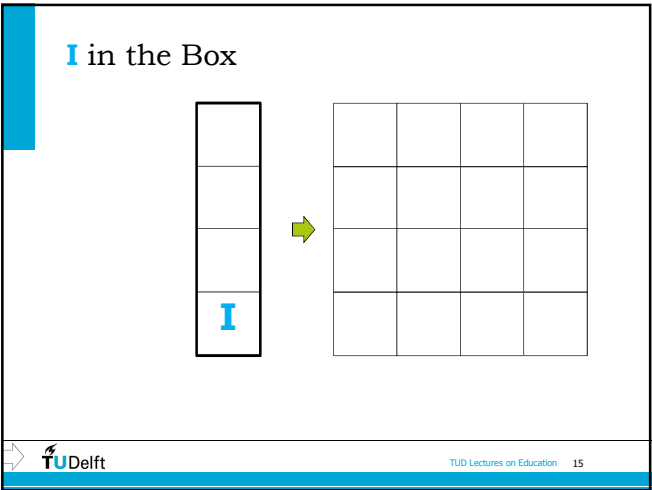
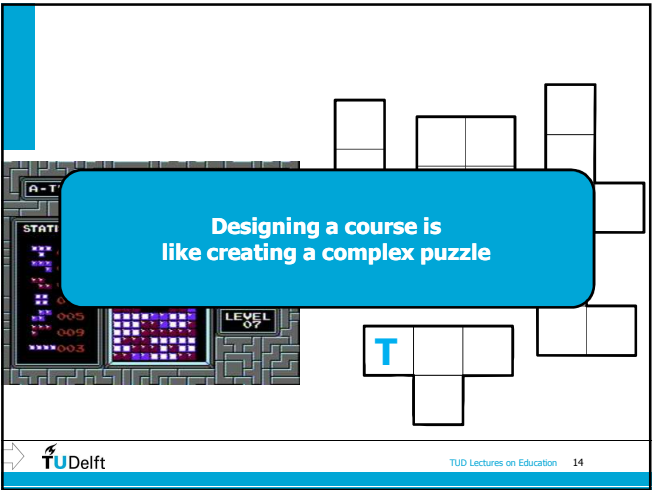
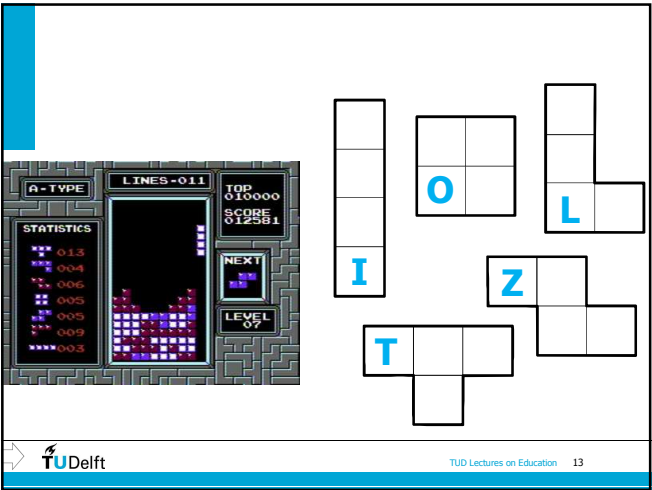
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I in the Box

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I in the Box

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Content Unlocked!

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Agenda for Today or Gamification.
Because Every Student Counts!

	Time Units
1. Introduction, with high-level goal and low-level objectives	1
2. An intuition behind gamification	1
⇒ 3. A practical framework for gamification in higher education (getting your courses gamified)	5½
⇒ 1. Learning Objectives to content (refresher on higher-education basics)	½
⇒ 2. Understanding student types	1
⇒ 3. Designing the gamified experience, focus on MDA* framework	½
⇒ 4. Designing the gamified experience, focus on dynamics and mechanics	½
⇒ 5. Designing the gamified experience, focus on assessment	1
⇒ 6. Playtesting for fun and motivation, and against common pitfalls	1
⇒ 7. Operating a gamified course	1
⇒ 4. Wrap-up	½

* Mechanics, Dynamics, Aesthetics

TUDelft

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.


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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


 (Assuming you want to gamify a traditional course.)

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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




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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?)

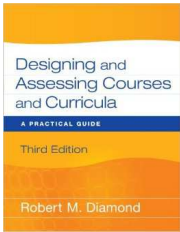
Voting on best answer




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

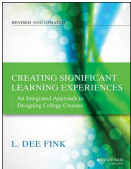
1. **Goals**
 - High-level descriptions, e.g., "EDU601 Modern Education Techniques"
2. **Outcomes**
 - Low-level descriptions
 - Measurable verb + Limitations + Performance
3. **Teaching method(s)**
 - Teaching facts, concepts, procedures, systems
 - Lectures [, flipped classroom?], Lab, etc.
 - [Learning 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.



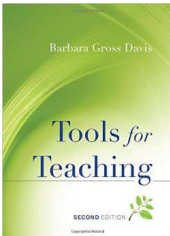


TUD Lectures on Education 28

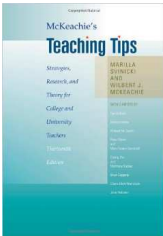
Have You Read These?




Learning how to learn
Significant learning




Group work
Assessment



Planning, team
Grading




From the
trenches...



TUD Lectures on Education 29

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.



TUD Lectures on Education 30


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

A cartoon illustration of a student in a green uniform and glasses, carrying a large backpack. A computer monitor is attached to the backpack, and the student is holding a laptop and a mouse. A thought bubble above the student's head contains a book cover titled 'Reality is Broken' by Jane McGonigal. The book cover features a green, pixelated character and the text 'Why Games Make Us Better and How We Can Change the World'. The cartoon is signed 'ROBERT HANSEN' at the bottom.

<https://quotablequoteunquote.files.wordpress.com/2008/08/walkingcomputergeek.jpg>

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TU Delft Lectures on Education

31

Acting

Players ————— World

Interacting

• Richard Bartle's "Players who suit MUDs", Myers-Briggs, etc.

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TU Delft Lectures on Education 32

Acting

Interacting

Players

World

Achievers

Acting

Players

World

Interacting

Achievers
more/more difficult challenges

Acting

World

Interacting

Achievers
more/more difficult
challenges

Explorers
open/creative
challenges

Players

Acting

World

Players

Achievers
more/more difficult challenges

Explorers
open/creative challenges

Socializers
team/discussion-based challenges

Interacting

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Richard Bartle's "Players who suit MUDs", Myers-Briggs, etc.

TUD Lectures on Education

36

Acting

Winners
competitive/single-winner challenges

Achievers
more/more difficult challenges

World

Interacting

Socializers
team/discussion-based challenges

Explorers
open/creative challenges

Players

TU Delft • Richard Bartle's "Players who suit MUDs", Myers-Briggs, etc. TUD Lectures on Education 37

Acting

Winners
competitive/single-winner challenges

Achievers
more/more difficult challenges

World

Interacting

Socializers
team/discussion-based challenges

Explorers
open/creative challenges

Players

Q: Which best describes **you**?

TU Delft • Richard Bartle's "Players who suit MUDs", Myers-Briggs, etc. TUD Lectures on Education 38

Acting

Winners
competitive/single-winner challenges

Achievers
more/more difficult challenges

World

Interacting

Socializers
team/discussion-based challenges

Explorers
open/creative challenges

Players

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

TU Delft • Richard Bartle's "Players who suit MUDs", Myers-Briggs, etc. TUD Lectures on Education 39

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.

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Gamification Is NOT Only:


Playing a game in the classroom



Points

Badges

Leaderboards



PBL = The BLT sandwich

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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.

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Q: What's in a game?
A: **Over 250,000,000 active players**

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



Gamification scales in practice

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

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

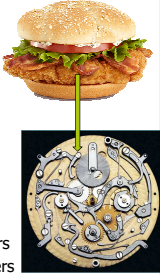
3. **Game Content***
puzzles, challenges, extra-projects, culture


* Art class pending.

 [http://nimga.com/press/default/files/articles/images/03img/ghenaPicsP4%20\(13%20of%2017\)_0.jpg](http://nimga.com/press/default/files/articles/images/03img/ghenaPicsP4%20(13%20of%2017)_0.jpg) TUD Lectures on Education 43

Gamification Mechanics & Dynamics
in Our Courses

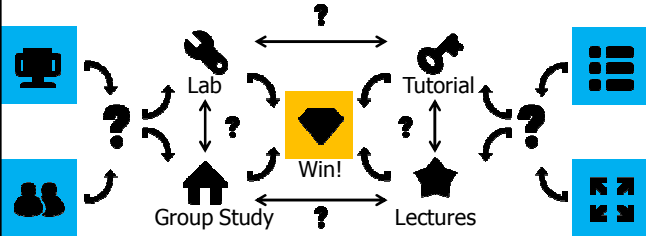
- Too many to list here
 - Scoring system is but one element
 - Badges? Only for B.Sc., some "random" * [Manga cum laude](#)
- Onboarding (mechanics)
 - Entry quiz
 - Story every lecture
- Social Learning (dynamics)
 - In-class teams, competing casually
 - Self-study as team effort, competing
 - Involve Winners and Achievers in class
 - Involve Winners and Explorers in self-study
- Different player types → different MDA
 - Ladders, ranking, end-lecture quiz: mostly for Winners
 - Content unlocking (dynamics): Explorers and Achievers




 A. Iosup and D. Epema, An Experience Report on Using Gamification in Technical Higher Education, ACM SIGCSE'14. <http://goo.gl/v97zSw>

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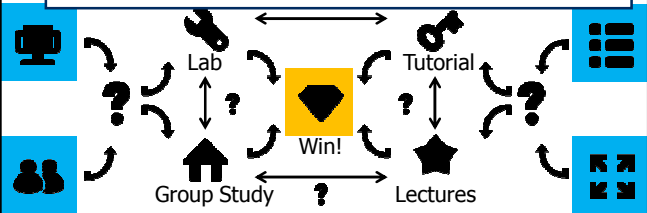
Designing a course is like creating a complex puzzle




 TUD Lectures on Education 45

The Learning Graph

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




 TUD Lectures on Education 46

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

A: From the Course Schedule

weeknr.	36	37	38	39	40	41	42	43	44	45
weektype	C	C	C	C	CT	C	C	CW	CWT	T
onderwijsweek	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10
maandag	Open. acad.jr	9	16	23	30	7	14	21	28	4
dinsdag	3	10	17	24	1	8	15	22	29	5
woensdag	4	11	18	25	2	9	16	23	30	6
donderdag	5	12	19	26	3	10	17	24	31	7
vrijdag	6	13	20	27	4	11	18	25	1	8
zaterdag	7/09	14/09	21/09	28/09	5/10	12/10	19/10	26/10	2/11	9/11
zondag	8/09	15/09	22/09	29/09	6/10	13/10	20/10	27/10	3/11	10/11


 Lecture (Hoorcollege) Lab (Practicum) Tutorial (Instructie) Exam

TUD Lectures on Education 47

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

A: From the Course Schedule

weeknr.	36	37	38	39	40	41	42	43	44	45
weektype	C	C	C	C	CT	C	C	CW	CWT	T
onderwijsweek	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10
maandag	Open.	9	16	23	30	7	14	21	28	4
dinsdag	3	10	17	24	1	8	15	22	29	5
woensdag	4	11	18	25	2	9	16	23	30	6
donderdag	5	12	19	26	3	10	17	24	31	7
vrijdag	6	13	20	27	4	11	18	25	1	8
zaterdag	7/09	14/09	21/09	28/09	5/10	12/10	19/10	26/10	2/11	9/11
zondag	8/09	15/09	22/09	29/09	6/10	13/10	20/10	27/10	3/11	10/11

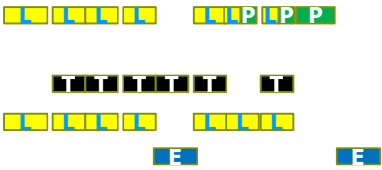
 Lecture (Hoorcollege) Lab (Practicum) Tutorial (Instructie) Exam

TUD Lectures on Education 48

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

From the Course Schedule

1. Extract activities from the Course Schedule



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Lecture (Hoorcollege)
Lab (Practicum)

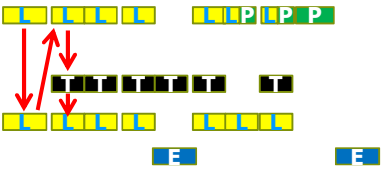
Tutorial (Instructie)
Exam

TUD Lectures on Education 49

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

From the Course Schedule

2. Add dependencies between activities



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Lecture (Hoorcollege)
Lab (Practicum)

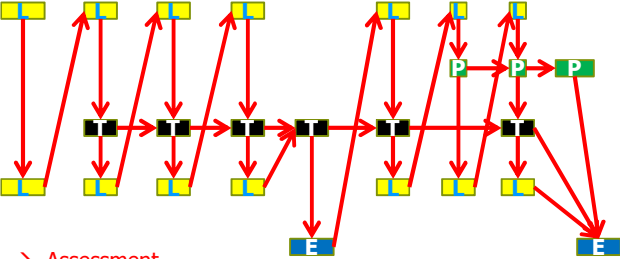
Tutorial (Instructie)
Exam

TUD Lectures on Education 50

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

From the Course Schedule

2. Add dependencies between activities (continued)



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Lecture (Hoorcollege)
Lab (Practicum)

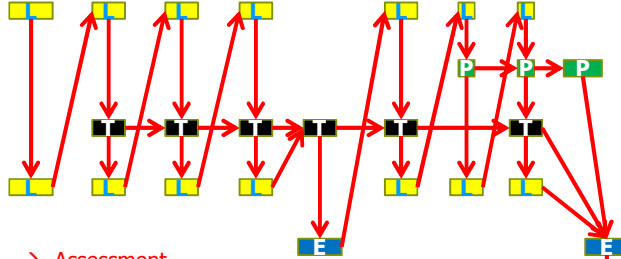
Tutorial (Instructie)
Exam

TUD Lectures on Education 51

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

From the Course Schedule

3. Add important states, such as Winning



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Lecture (Hoorcollege)
Lab (Practicum)

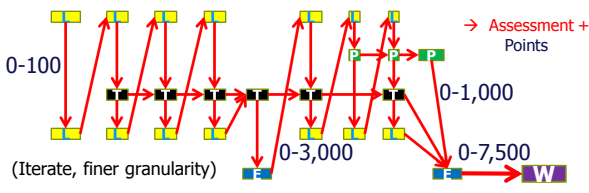
Tutorial (Instructie)
Exam

TUD Lectures on Education 52

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



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Lecture (Hoorcollege)
Lab (Practicum)

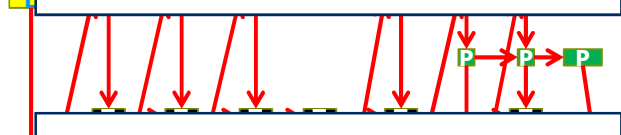
Tutorial (Instructie)
Exam

TUD Lectures on Education 53

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

From the Course Schedule

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



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Lecture (Hoorcollege)
Lab (Practicum)

Tutorial (Instructie)
Exam

TUD Lectures on Education 54

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.







TUD Lectures on Education55


Assessment That Motivates!

10,000 points for a 10

+50 for good activity
+1,000 for most challenging activity


Badges, unlocked content






TUD Lectures on Education56

Our Diverse Scoring System

1. Course Points	2. Access Tokens	3. Brownie Points
10,000 for straight 10	Start with 1	
+1,000 team self-study		
+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	




TUD Lectures on Education57

A Framework for Gamification in Higher Education

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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.

Wrap-up w bonus: Content/Aesthetics

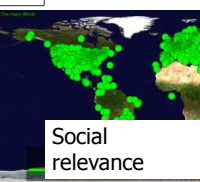

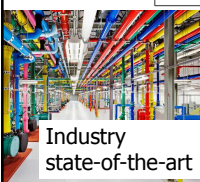



TUD Lectures on Education58

Challenging and Diverse Content to Activate Diverse Students

Learning Objectives

BSc-CO, 6EC (168h)	MSc-CC, 5EC (140h)
Digital Logic and Data Representation	Overview of cloud computing
Computer Architecture and Organization	Scheduling and Resource Management
Interfacing and I/O Strategies	Data Centers and Energy Efficiency
Memory Architecture	Multi-tenancy concepts, incl. virtualization
Functional Organization	Cloud programming models
Multiprocessing	Case studies
Performance Enhancements	Guest lecturer
	Directions in Computing






Photos: (left) courtesy Google Inc. (middle) <http://www.flickr.com/photos/dmitrisotropolis/4204766418/> (right) personal library of A. Iosup
TUD Lectures on Education59

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.



TUD Lectures on Education60

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

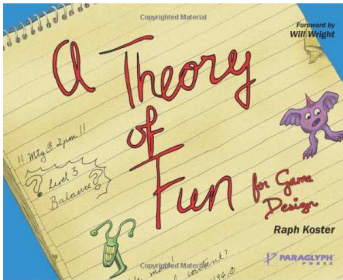





TUD Lectures on Education 61

1. What Leads to Fun?

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





TUD Lectures on Education 62


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

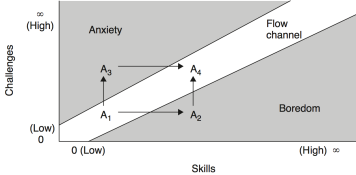




TUD Lectures on Education 63


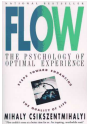
3. Balance Leads to Flow


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



The diagram shows a graph with 'Challenges' on the y-axis (Low to High) and 'Skills' on the x-axis (Low to High). A diagonal line represents the 'Flow channel'. Above the line is 'Anxiety' and below is 'Boredom'. Points A1, A2, A3, and A4 are marked along the flow channel, showing progression from low challenge/skill to high challenge/skill.

- Balance between challenge increase and skill growth






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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.



TUD Lectures on Education 65

>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!**



TUD Lectures on Education 66

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?

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Does gamification work?

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Gamification works!

Course	Lab Extra-work [%]	Group Study [%]	In-class [%]
Gamified, BSc 2014	~10	~35	~40
Gamified, BSc 2013	~10	~25	~30
Gamified, BSc 2012	~10	~15	~25
Gamified, BSc 2011	~10	~10	~20
Traditional, BSc 2010	~10	~10	~20

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

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.”

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Agenda for Today or Gamification. Because Every Student Counts!

	Time Units
1. Introduction, with high-level goal and low-level objectives	1
2. An intuition behind gamification	1
3. A practical framework for gamification in higher education (getting your courses gamified)	5½
1. Learning Objectives to content (refresher on higher-education basics)	½
2. Understanding student types	1
3. Designing the gamified experience, focus on MDA* framework	½
4. Designing the gamified experience, focus on dynamics and mechanics	½
5. Designing the gamified experience, focus on assessment	1
6. Playtesting for fun and motivation, and against common pitfalls	1
7. Operating a gamified course	1
4. Wrap-up	½

* Mechanics, Dynamics, Aesthetics

1 Time Unit (TU) ~ 7 minutes.
Total time 8 TUs ~ 55 minutes.


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Designing a course is like creating a complex puzzle

TUD Lectures on Education72

Gamification as
concept & intuition, mechanics & dynamics, ...

Gamification works!



Lumaxart Trophy Winner

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TUD Lectures on Education73

A Framework for Gamification in
Higher Education

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- 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.

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Thanks from our team.



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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



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TUD Lectures on Education76

Does Gamification Work for **Me**?



Q: But, Alexandru, surely not every course can use gamification!? I mean, there is no technique for my concept / activity / entire course...

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A: Wonderful Advances in Gaming, Last 10
Years: diverse individual challenges


Beyond eyes



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A: Wonderful Advances in Gaming, Last 10 Years: diverse social challenges

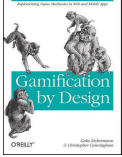


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Gamification Mechanics & Dynamics

- 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




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A. Iosup and D. Epema, An Experience Report on Using Gamification in Technical Higher Education, ACM SIGCSE'14. <http://goo.gl/V97zSW>

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




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A. Iosup and D. Epema, An Experience Report on Using Gamification in Technical Higher Education, ACM SIGCSE'14. <http://goo.gl/V97zSW>

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

What?	How? Common teaching elements
Facts	Story w terms, acronyms, and jargon Taxonomies and Venn diagrams Games of repetition, recognition, matching
Concepts	Story w metaphors Boundary examples Games to experience, classify, compare sort
Procedures (Rules)	Top-to-bottom view, story w Why? What? Role-playing (Mechanics + feedback)
Systems	Tutorials to experience under guidance Using all the other elements for complete XP



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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?

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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? → SurfDrive!

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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!**



References (Shortlist, brief info)

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