Gamification in Technical Higher Education: Playful Education for Generation X/Y/Z/…

Dr. eng. Alexandru Iosup, representing a whole team*
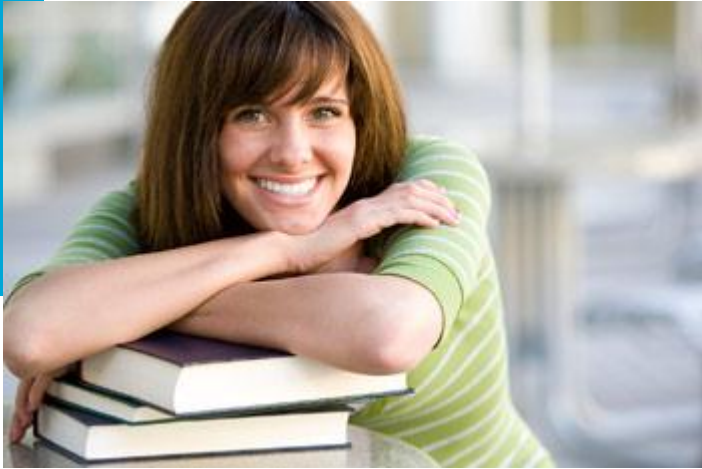
TUDelft Delft University of Technology

A Testimonial About How Gamification Can Change Your Life

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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Gamification* = Rich Challenge and Opportunity for Higher Education

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Image source: http://www.bcsea.org/learn/educational-opportunities

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* A modern education technique, good for innovation

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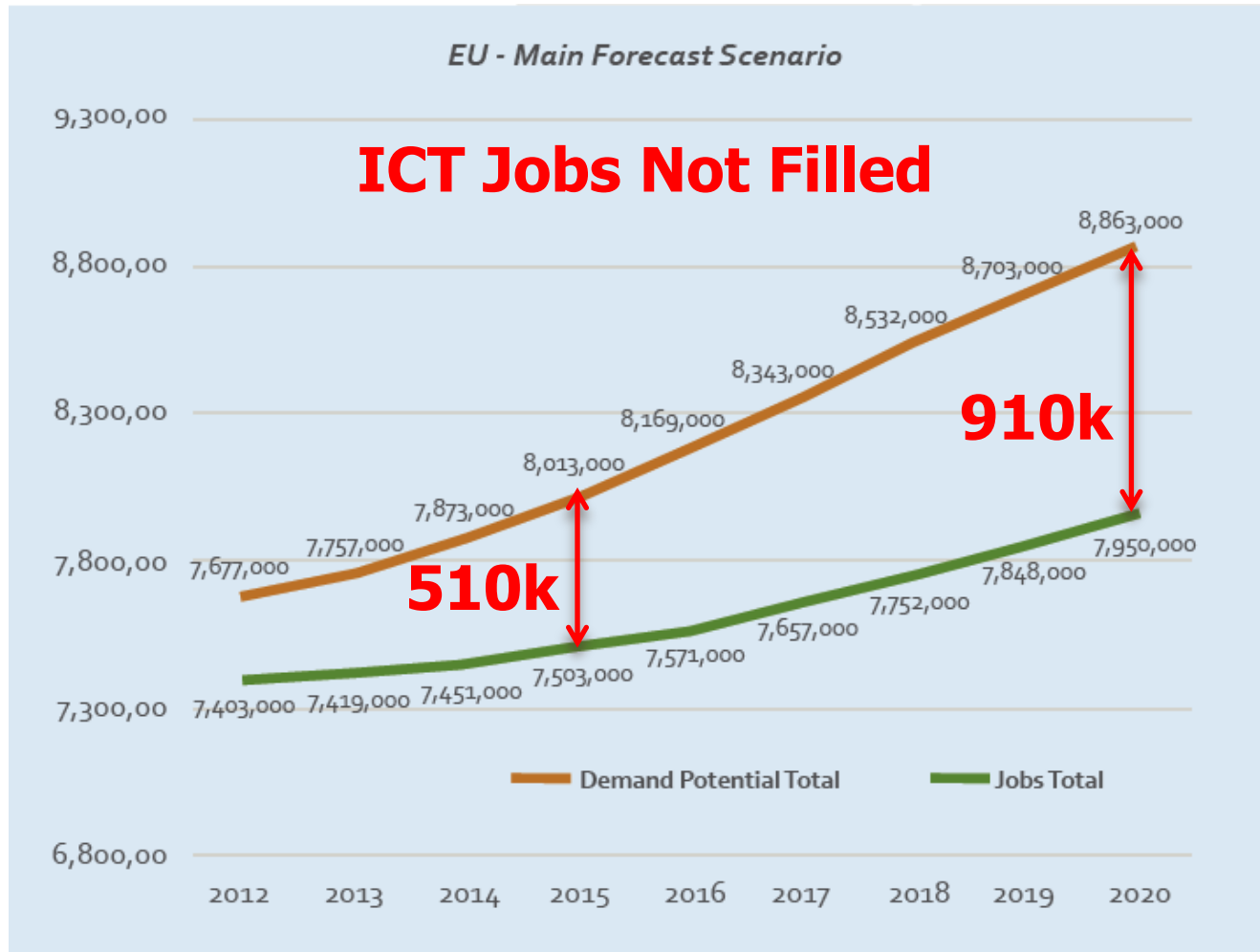
* Making courses similar to social game universes

* A modern education technique, good for innovation

* To choose your path of advancement (my innovation)

only for that reason it was usually worth getting up for every lecture.

The World Needs Work-Ready Graduates

EU - Main Forecast Scenario

ICT Jobs Not Filled

910k

510k

9,300,00
8,800,00
8,300,00
7,800,00
7,300,00
6,800,00

8,863,000
8,703,000
8,532,000
8,343,000
8,169,000
8,013,000
7,873,000
7,757,000
7,677,000

7,950,000
7,848,000
7,752,000
7,657,000
7,571,000
7,503,000
7,451,000
7,419,000
7,403,000

Demand Potential Total   Jobs Total

2012   2013   2014   2015   2016   2017   2018   2019   2020

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Source: Korte et al., e-Skills for Jobs in Europe: Measuring Progress and Moving Ahead, Sep 2014.

TUD Lectures on Education   6

But Current Education Approaches Do NOT Motivate and Engage Enough Students

- A major technical university in the Netherlands (Top-20 in the World, QS Rankings 2013—2014)
  - Cannot select input students
  - Does not want to lower expectation
  - Does not want to make education a chase for diplomas

- Completion in time of the BSc (# years + 1) <35%

- Similar numbers across technical universities with similar setting

Good education requires innovation

A New Education Approach: Gamification Can Activate All Students, But Difficult to Adapt for Classroom

| 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.
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My Approach: Innovative Gamification in Higher Education

- Content Specifically Designed for Each Student Type

- Emphasizing Exploration and Social Interaction, Next to Achievement

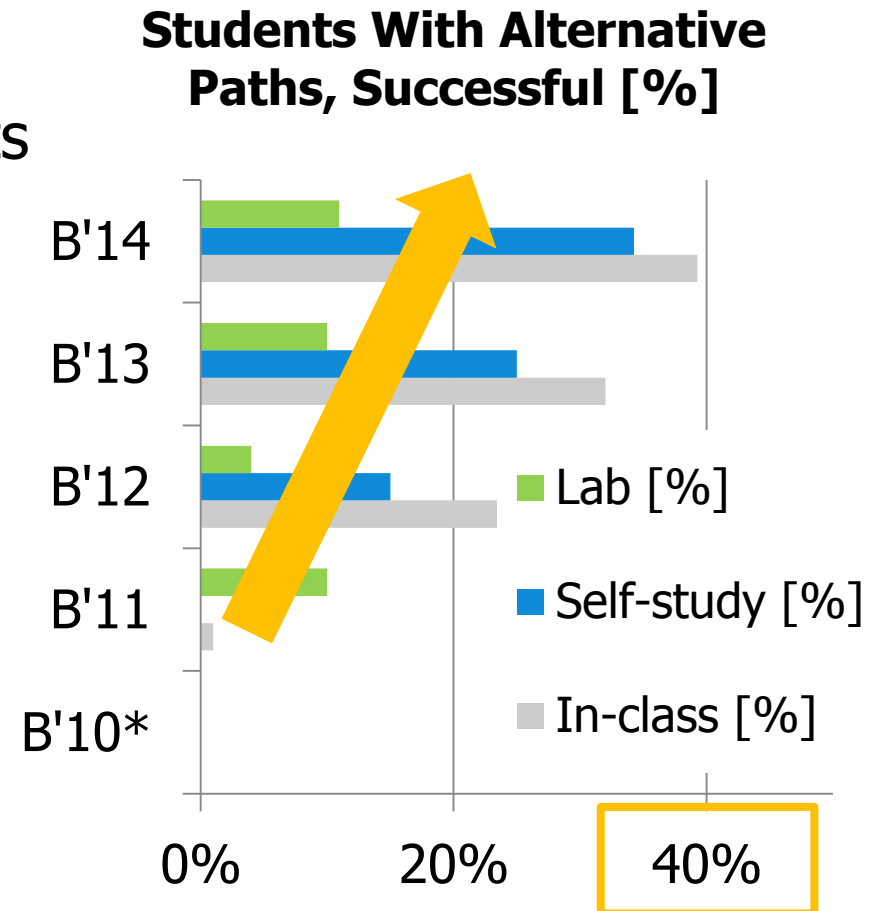- A Fair Scoring System with Byte-Sized Challenges

- >10 Operational Years, in the Classroom
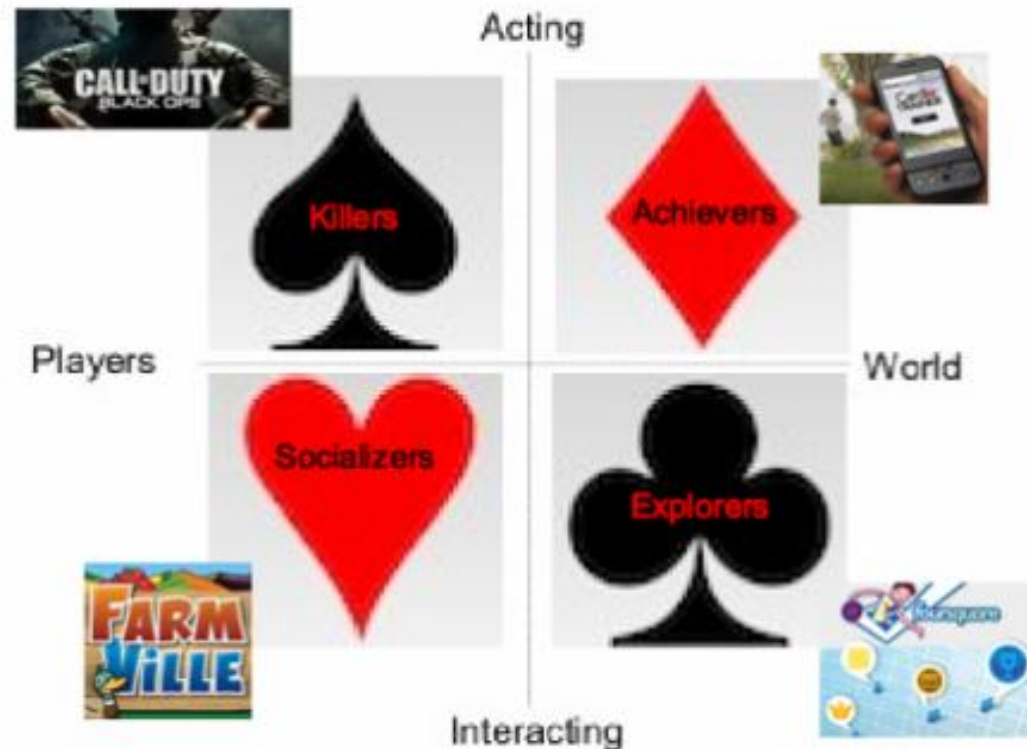
Richard Bartle's "Players who suit MUDs"

Gamification, the Numbers: Successful Via Alternative Paths

Successful = bonus-worthy

- A significant fraction of students take alternative paths of advancement

Students With Alternative Paths, Successful [%]

Legend:
- Lab [%]
- Self-study [%]
- In-class [%]

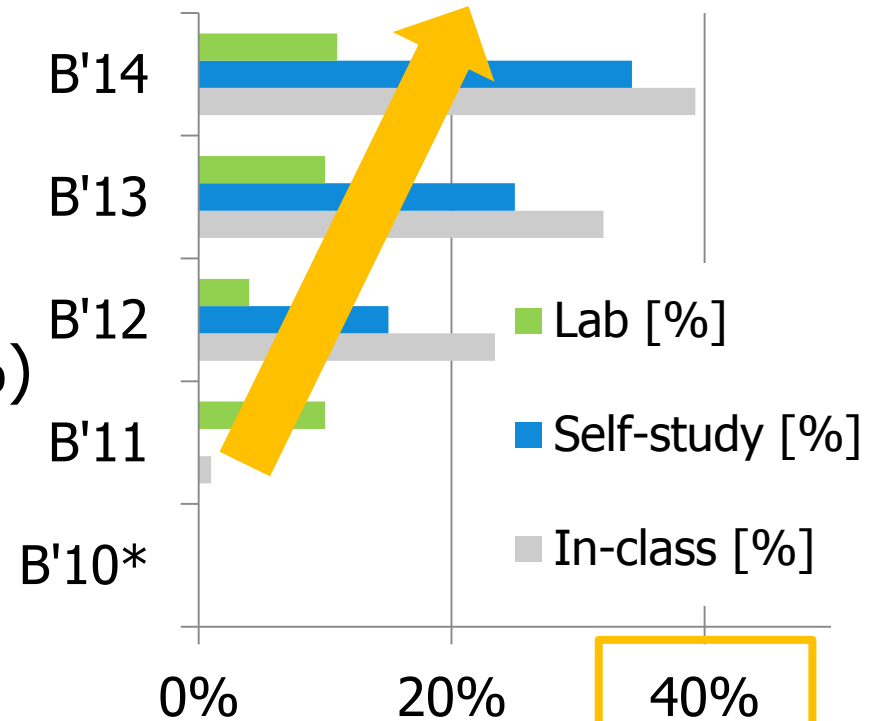Categories: B'14, B'13, B'12, B'11, B'10*

Axis: 0%, 20%, 40%

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Gamification, the Numbers: Successful Via Alternative Paths

Successful = bonus-worthy

- A significant fraction of students take alternative paths of advancement

- Increasingly more students benefit from each alternative (warning: natural limit at 100%)

- At least one successful alternative? 45%

Q: Is it good for so many students to receive bonuses?
(Hint: In-class bonus=0,5%/item)

Students With Alternative Paths, Successful [%]

Legend:
- Lab [%]
- Self-study [%]
- In-class [%]

Categories: B'14, B'13, B'12, B'11, B'10*

Axis: 0%, 20%, 40%

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

The TU Delft Gamification Movie
This is Good Education!

- Best Lecturer of the TU Delft, 2013—2014
  http://goo.gl/NtORVi

Why Gamification*?

> ## * Making courses similar to social game universes

*"**Science and scholarship are much like games**. […] playing involves **creating, testing and revising strategies as well as the skills necessary for progressing** in the game."* Mayra 2009


From Together Alone …

+

… to Social Gaming in a Museum

*" **51% US households own a console …**
58% Americans play … 45% are women"* ESA'14

Used Diverse Gamification Elements

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

- Onboarding (dynamics)
  - Entry quiz
  - Story every lecture

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

- Different player types
  - Ladders, ranking, end-lecture quiz: mostly for Winners
  - Content unlocking (dynamics): Explorers and Achievers
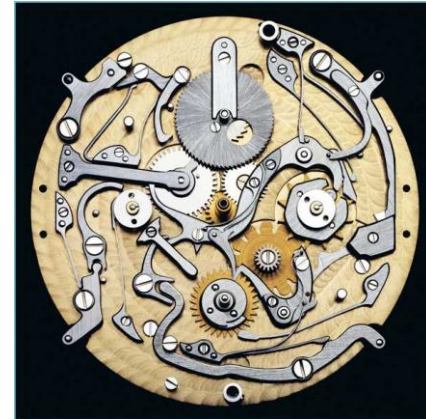
The Scoring System

1. Course Points	2. Access Tokens	3. Brownie Points
10,000 for straight 10	Start with 1	
+1,000 t		
+1,000		e
+500		*you*!
+300 co		rce (hem)
+50		
Lab/Le		
+25 correc		
+500 entry quiz	Rec. letter	

1. Gamification =
more tracks of advancement
(Lab, Lectures, Tutorial, Self-Study) +
keeps top students involved in the classroom

2. Decoupling grading schemes =
responding to diploma hunters ("cultuur van zesjes")

3. Access to unlocked content =
content, both graded and not, offered
as reward for achieving/excelling at course milestones

A. Iosup and D. Epema, An Experience Report on Using Gamification in
Technical Higher Education, Under submission. http://goo.gl/V97zSW

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Our Work at TU Delft, 10+ Operational Years Since 2007

- B.Sc. Courses
  - Computer Organization (5 years, ongoing)
    (previously, was rated consistently lower than others, considered tough and boring course, different type of learning—comp.systems)
  - Bachelorseminarium (5 years, evolving form)

- M.Sc. Courses
  - Cloud Computing (2 year, pair teaching, new course)
  - Distributed Computing Systems (1 year + ongoing, new course)

Take-Home Message

Gamification* in Higher Education = Rich Opportunity

* Making courses similar to social game universes

Gamification = mechanics, dynamics, content (art)

10+ operational years of experience at TU Delft

Gamified courses can deliver results at least as good as traditional approaches, with more student engagement

Tip: Ask me about results.

There's no free lunch!

Tip: Ask me about costs.

TODO: which mechanisms? Longitudinal studies. Etc.

*T̃U*Delft

Tip: Ask me about future work.

Why Fix It If It Ain't Broken?

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

- New generation of students
  - Attention span
  - Is higher education needed?
  - A technical education?!

- New understanding of students
  - International means multi-cultural
  - Aware of individual personality and skill-level

- It's not you, it's me

- New ambition of GamificationU (Top-20 Eng/Tech*)
  - <35% finish 3-year B.Sc. Curriculum in 4 years …
  - … but cannot select students

Gamification, the Numbers: Overall Participation and Success

Participants in-class, count

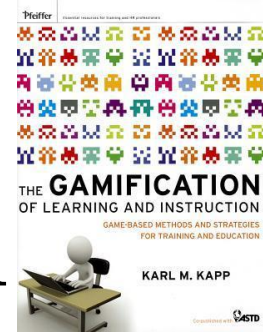**Final exam, passed 1st try [%]**

2.4x
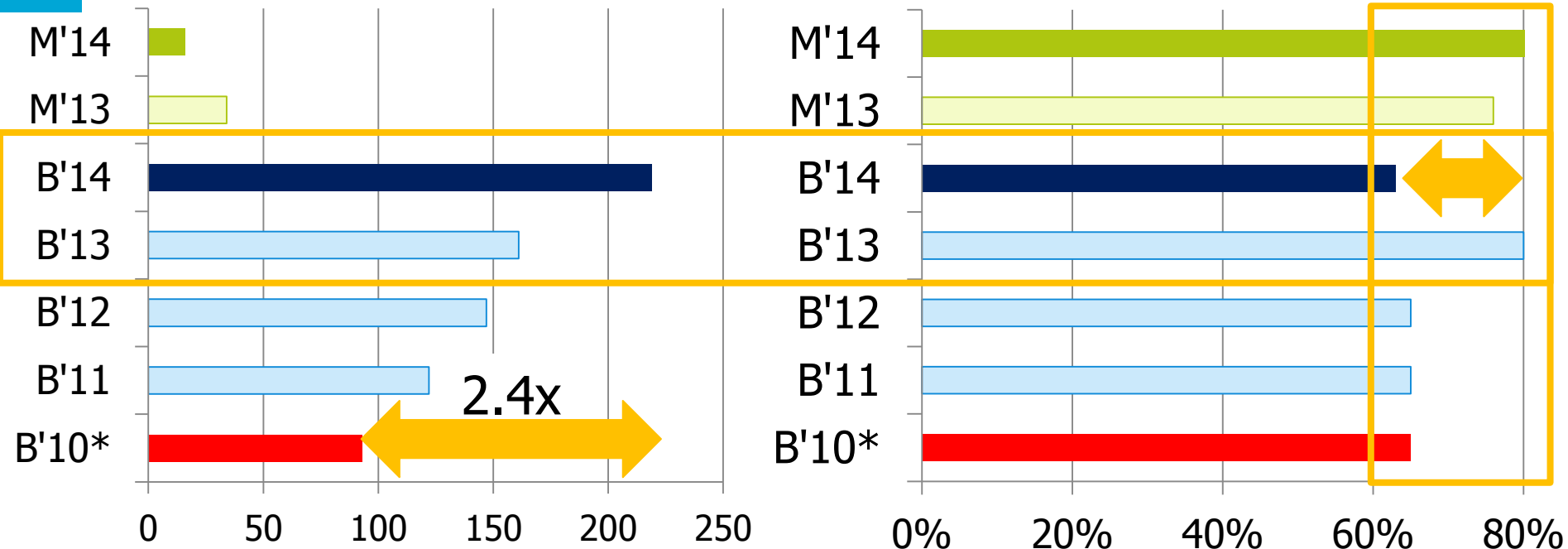
- Increasing number of students, B.Sc. (M.Sc. designed for ~15)
- Exam results: Gamification delivers at least as traditional approach
- Scalability limit with gamification? Future work.

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

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

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

> **Q:** May I help you **gamify your course**?

VENI — Alexandru Iosup

Grids/Clouds
P2P systems
Big Data
Online gaming

Dick Epema

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

VENI — Ana Lucia Varbanescu

HPC systems
Multi-cores
Big Data
e-Science

Henk Sips

HPC systems
Multi-cores
P2P systems

VENI — Johan Pouwelse

P2P systems
File-sharing
Video-on-demand

Home page

- www.pds.ewi.tudelft.nl

Publications

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

A. Iosup and D. Epema, An Experience Report on Using Gamification in Technical Higher Education, ACM SIGCSE'14. http://goo.gl/v97zSW