TU Delft
Dropout rates of regular courses and MOOCs
24-7-2016

Léon Rothkrantz
Technical University of Delft,
Czech Technical University in Prague
Outline presentation
1. MOOCs at TUDelft
2. High dropout rates of MOOCs
3. Possible reasons for high dropout
4. Psychological assessment
5. Didactical solutions high dropout rate
6. Examples use of social media
MOOCs at Technical University of Delft (DUT)
**WHY MOOCs?** (Arno Smets-TUD)

MOOCs are not for everyone but for many

### Pioneering Education
- Insight in learning behaviour
- New teaching tools
- Improving performance of students
- Cost effective
- Replacement for lectures
- Continuing education

### Marketing
- Showing world-top education
- Positioning of Brand TUDelft
- Claiming world authority
- Scouting talents

### Idealistic
- Increasing impact of education

**Equal educational opportunities for everyone**

MOOCs are not for everybody but for many (Obama)
MOOCs platforms
Anke Mulder-TUD
Platform
(Anke Mulder-TUD)

- Harvard
- MIT
- Berkeley
- TU Delft
- Lausanne
- Wellesley College
- Georgetown University
- McGill
- Australian National University
- University of Texas Systems
- Rice
- University of Toronto
DeLftX MOOCs

Next Generation Infrastructures
Next Generation Infrastructures
Drinking Water Treatment
Functional Programming
Data Analysis to the MAX()

Delft Design Approach
Industrial Biotechnology
Introduction to Solar Energy
Responsible Innovation
Treatment of Urban Sewage

Credit Risk Management
Introduction to Water & Climate
Creative Problem Solving
Aeronautical Engineering
The Basics of Transport Phenomena

Framing
Topology in Condensed Matter
Pre-University Calculus
Circular Economy
Delft-Blue MOOCs centre (Frans van Dam-TUD)
Virtual University in the Netherlands
(Frans van Dam-TUD)
European MOOCs centre (Wikipedia)
Is it possible to set up a European equivalent of edX, Coursera, etc.?
Why are dropout rates of MOOCs so high?
Two MOOCs as examples (TUD)

Introduction to Water Treatment

Solar Energy
# RESULTS

(Arno Smets)

<table>
<thead>
<tr>
<th></th>
<th>Water Treatment</th>
<th>Solar Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td># Enrollments</td>
<td>29.179</td>
<td>56.809</td>
</tr>
<tr>
<td># students accessed the course</td>
<td>23.617</td>
<td>47.183</td>
</tr>
<tr>
<td># tried at least 1 HW</td>
<td>5.917 (25%)</td>
<td>9.580 (20%)</td>
</tr>
<tr>
<td># Certificates</td>
<td>534 (2.3%)</td>
<td>2.912 (6.2%)</td>
</tr>
<tr>
<td># perfect score</td>
<td>2</td>
<td>162</td>
</tr>
</tbody>
</table>
Pass rates dramatically increase when students pay $50 for a verified certificate (de Vries, Dexter, TUD)
Students activities (Arno Smets-TUD)
Progress Work Students (Arno Smets-TUD)
Evolution Enrollments (Arno Smets)

- **Solar Energy, EWI**
- **Water Treatment, CITG**

Enrollments over time (months):
- April: 0
- May: 0
- June: 0
- July: 0
- August: 0
- September: 0
- October: 0
- November: 0

Course started:
- 400/day
- 300/day
- 200/day
- 100/day
MOOCs worldwide (TUD)
Age distributions (Arno Smets)

Age Distribution of DelftX Registrants
(self-reported, >80% reporting rate)
MOOC – design (Frans van Dam)
The power of video and animation
Learning Analytics-1

Micro blogging sites such as Twitter can play a vital role in spreading information

• The volume and velocity of tweets posted during a course today tend to be extremely high
• Messages that are entirely off-topic or personal in nature, to messages containing critical information
Learning Analytics-2

• More than 200,000 unique tweets were selected by monitoring the Twitter Streaming API using the hashtag #MOOC-TUD a few days after launching the MOOC
• To process the data the authors use NLP technology, such as n-grams, Part of Speech (POS), and Verbnet for example
• Bayesian classifiers were used to automatically classify a tweet in pre-defined classes
Analysis of Social Networks

- Students disconnected from the network
- Students central to the network
Two projects-clusters in a learning network, which partners should be connected so that the whole network is fully connected?
1. Special learning analytics software tools are needed to process data generated by MOOC students
2. How to store-process-analyze the big data, around MOOCs?
Possible reasons for dropout

1. Self paced courses
2. Missing adapted didactic models
3. No entrance exam is required
4. Missing individual tutoring
5. Failing cooperation in student networks
6. Missing personal characteristics
How to teach 21st century skills?
- critical reflection
- cooperating
- networking
- creativity
- ability to handle big data
- ability to solve real life problems
- ability for life-long
1. Current education academic education focused on realization of qualification goals
2. How to include socialization and personal development?
Bildung (Wikipedia)

First defined by Wilhelm von Humboldt (1767-1835)

Not only focussed on acquisition of knowledge

Abilities for critical thinking

Ability for moral judgement
Teaching adagio (source unknown)

• We teach today students

• With yesterday knowledge

• For a future we don’t know
How to transform a Network without communication and interaction to a social network of actors connected by dyadic ties and cooperate via social media?
Social learning includes cooperation and modelling, How to implement in MOOCs?
Learning material could enable individual learning
For a good harmony orchestration, cooperation fine tuning is needed, How to implement in MOOCs?
Recent developments around MOOCs at TUDelft

How to increase student participation?
How to involve societal relevant applications?
How to use social media?
Fresh-up course mathematics starting students (TUD)
Focus on real life applications
Solar cars challenge race (TUD)
How to design a course? (TUD)
Mathematics from real life (TUD)
Introduction Pre-Un Calculus (TUD)
Pre-University calculus MOOC offered worldwide via edX

<table>
<thead>
<tr>
<th>Number of participants</th>
<th>Number attempted one exercise</th>
<th>Number attempted all exercise</th>
<th>Number passed final exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.186</td>
<td>4.150</td>
<td>273</td>
<td></td>
</tr>
<tr>
<td>794</td>
<td>420</td>
<td>40</td>
<td>46</td>
</tr>
</tbody>
</table>

Worlwide

TUDelft
**Distribution of students who enrolled and didn’t enrol in the MOOC (TUD)**

<table>
<thead>
<tr>
<th>Column</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td># students that didn’t enrol</td>
<td>101</td>
<td>764</td>
<td>1017</td>
<td>703</td>
<td>332</td>
<td>52</td>
</tr>
<tr>
<td># students that enrolled</td>
<td>32</td>
<td>173</td>
<td>200</td>
<td>166</td>
<td>63</td>
<td>10</td>
</tr>
</tbody>
</table>
1. Grades at secondary school are good predictors of a successful academic study
2. Is there is need of psychological assessment?
3. What could be the contribution of BIG Five personality test?
Big Five personality test
Average score, 5-point scale, 20 items

<table>
<thead>
<tr>
<th></th>
<th>10189</th>
<th>179</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extroversion</td>
<td>3.05</td>
<td>3.05</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>3.84</td>
<td>3.69</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>3.38</td>
<td>3.06</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>2.98</td>
<td>3.39</td>
</tr>
<tr>
<td>Openness</td>
<td>4.05</td>
<td>3.71</td>
</tr>
</tbody>
</table>
BigFive personality test
Average score, 5-pointscale, 20 items

<table>
<thead>
<tr>
<th>Item/response</th>
<th>--</th>
<th>-</th>
<th>-/+</th>
<th>+</th>
<th>++</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 On parties I talk to many people</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 I work according to timeschedules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 I have problems to imagine things</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 I complain about things</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 I don’t mind being the centre of interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BigFive profile

- Extraversion
- Emotional stability
- Imagination
- Open minded
- Goal directed
### Big Five personality Test (Wikipedia)

<table>
<thead>
<tr>
<th>Personality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Openness</strong></td>
<td>Interest in searching new things and inexperienced stimuli, unconventional</td>
</tr>
<tr>
<td><strong>Conscientiousness</strong></td>
<td>Self-discipline, prudence, following rules, strong will, active planning, organizing and completing tasks</td>
</tr>
<tr>
<td><strong>Extroversion</strong></td>
<td>Socializing, cheerfulness, searching new options and experiences</td>
</tr>
<tr>
<td><strong>Agreeableness</strong></td>
<td>Obedience, cooperation, friendliness, helping others</td>
</tr>
<tr>
<td><strong>Neuroticism</strong></td>
<td>Emotional lability, shyness, sadness, embarrassment</td>
</tr>
</tbody>
</table>
### Felder-Silverman learning style model (1993)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing – Intuitive</td>
<td>Facts and experiments vs. principles and theories</td>
</tr>
<tr>
<td>Visual – Verbal</td>
<td>Learning via pictures and diagrams vs. via verbal explanation</td>
</tr>
<tr>
<td>Active – Reflective</td>
<td>Active experimentation vs. passive observation</td>
</tr>
<tr>
<td>Sequential – Global</td>
<td>Linear reasoning process vs. intuitive leaps when problem solving</td>
</tr>
</tbody>
</table>
Distribution item responses (D. Chuda)
Psychological Assessment at TUDelft 1953-1957

- All first years students (2,500) were requested to take part in the psychological assessment procedure
- The following tests were used:
  - NAT’70 Mathematical ability test-Figure series
  - NPV Personality Questionnaire
  - NVA Non verbal Abstraction
  - VAT ’69 Verbal Analogies
  - APT Calculus with characters
  - DT Test using diagrams

Conclusion: Outcomes psychological test has no added value to scores mathematics, physics, Dutch at secondary school.
Study-progress/delay/dropouts in percentage crossed with average score mathematics/physics grades at school, cohort 1953

<table>
<thead>
<tr>
<th>Study progress ≥ 150%</th>
<th>0%</th>
<th>4%</th>
<th>11%</th>
<th>15%</th>
<th>7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study progress ≤ 150%</td>
<td>0%</td>
<td>8%</td>
<td>13%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Delayed students with Incomplete first year</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Dropouts during second year</td>
<td>2%</td>
<td>6%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Dropouts during first year</td>
<td>2%</td>
<td>9%</td>
<td>9%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Average math/physics grades at school exam</td>
<td>5-6</td>
<td>6-7</td>
<td>7-8</td>
<td>8-9</td>
<td>9-10</td>
</tr>
</tbody>
</table>
Study-progress/delay/dropouts crossed with number of passed exams

<table>
<thead>
<tr>
<th>Studyprogress ≥ 150%</th>
<th>0%</th>
<th>1%</th>
<th>7%</th>
<th>14%</th>
<th>16%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studyprogress ≤ 150%</td>
<td>3%</td>
<td>8%</td>
<td>8%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Delayed students with Incomplete first year</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Dropouts during second year</td>
<td>2%</td>
<td>6%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Dropouts during first year</td>
<td>6%</td>
<td>9%</td>
<td>5%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Numbers of exams passed successfully in first period</td>
<td>0%</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
</tr>
</tbody>
</table>
How to find matching study partners in global online learning?

The matching algorithm from dating sites can provide a solution
McKinlay researched online data-sites and discovered that one of these dating sites sorted people into profiles using the answers to thousands of questions posed by other users on the site. By creating fake profiles and writing programs to answer questions he discovered the underlying algorithm and was able to create successful matching profiles. He used collaborative filtering by collecting the preferences of many people, and grouping them into sets of similar users.
Groups of study-friends in social networks

- Partners who chat for a longtime are stable, better fitting partners
- Groups with balanced abilities are stable groups
- Formation of groups of excellent students results in groups of less excellent students (underscoring students)
Analysis social interaction

- Students, interaction and frequency of interaction can be displayed on a map
- Groups can be detected as clusters, groupleader barycentre
- Stable groups, partners are characterised by continuous stream of interactions
- Problem of outliers, students with minimal of interactions
Features used in our matching algorithm

- Students provide scores of basic abilities as mathematics, programming, report writing, groupworks on a 5-point scale (possibility to upload academic record)
- Personal characteristics measured by Big Five personality test
- Data on personal websites, CV (if provided in a standard form)
- Problem of fake data
Matching form students

Profile

Basic information:
Name: 
Email: 
Basic information: 
Password: 
Repeat: 

Skills:

Programming: 
Documenting: 
Mathematics: 

Save

Profile image

Upload
How to use social media in open online learning?
Some examples
FETCH 2.0 didactical model using social media
Rotunda Holy Cross at Prague and its geometrical ground-floor
Data collection via social media (Wikipedia)
Hanan Al-Kutubi, best graduate 2016

“With a good network you can perform experiments you couldn’t do normally.”

(TUD)
Escape from prison of Alcatraz at San Francisco Bay (TUD)
A piece of pie to celebrate pie day (TUD)
Didactical Background
Teaching is more than knowledge transfer
Mathematics as an educational task
Improving the ability to learn

FeedbackFruits facilitates blended learning

Our partners in modernizing education
Successfull example of non-participatory learning Bob Ross (TUD)
### Attribution of success according to Killen (1994)

<table>
<thead>
<tr>
<th>Items pertaining to success</th>
<th>Rank students</th>
<th>Rank lecturers</th>
<th>P level (if &lt;.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in the course</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Self-motivation</td>
<td>2</td>
<td>1</td>
<td>.00001*</td>
</tr>
<tr>
<td>Self-discipline</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Regular attendance at lectures</td>
<td>8</td>
<td>16</td>
<td>.04243</td>
</tr>
<tr>
<td>Effective study techniques</td>
<td>13</td>
<td>5</td>
<td>.00442*</td>
</tr>
<tr>
<td>Maturity</td>
<td>14</td>
<td>8</td>
<td>.03006*</td>
</tr>
<tr>
<td>Ability to reason logically</td>
<td>20</td>
<td>7</td>
<td>.00062*</td>
</tr>
<tr>
<td>Enthusiastic lecturers/tutors</td>
<td>26</td>
<td>12</td>
<td>.03940*</td>
</tr>
<tr>
<td>Items pertaining to failure</td>
<td>Rank students</td>
<td>Rank lecturers</td>
<td>p level (if &lt;.05)</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------------</td>
<td>----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Insufficient effort</td>
<td>1</td>
<td>1</td>
<td>0.01846*</td>
</tr>
<tr>
<td>Lack of self-motivation</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Too many demands on students’ time</td>
<td>3</td>
<td>15</td>
<td>0.00053</td>
</tr>
<tr>
<td>Lack of self-discipline</td>
<td>5</td>
<td>4</td>
<td>0.03186*</td>
</tr>
<tr>
<td>Heavy course workload</td>
<td>7</td>
<td>35</td>
<td>0.00001</td>
</tr>
<tr>
<td>Lecturers who are out of touch with students’ needs</td>
<td>8</td>
<td>24</td>
<td>0.00223</td>
</tr>
<tr>
<td>Boring presentations by lecturers</td>
<td>12</td>
<td>26</td>
<td>0.00022</td>
</tr>
<tr>
<td>Failure to realize that uni ≠ high school</td>
<td>31</td>
<td>12</td>
<td>0.00102*</td>
</tr>
</tbody>
</table>
Student models of student success

(M.vdBoogaard-TUD)
Preliminary model for DUT first year student success (M.vd Boogaard-TUD)
Generalised DUT model for first-year student success (M vd Boogaard-TUD)
Life Long Learning & Deeltijsonderwijs
FUTURE EDUCATION AND TRAINING IN COMPUTING:
HOW TO SUPPORT LEARNING AT ANYTIME ANYWHERE

TOGETHER WE CAN DO MORE

EUROPEAN THEMATIC NETWORK
Future Education and Training in Computing:
How to Support Learning at Anytime Anywhere

REPORT on WORK PACKAGE WP6
Questionnaires on possible roles of social media
Deliverable(s) WP6-3
Acknowledgement

- Colleagues from TUDelft
- Anke Mulder
- Arno Smets
- Marianne Vos
- Teachers mathematics
- Frans van Dam
- Maartje van den Boogaard
- Daniela Chuda