The Value of Engineering MOOCs from a Learner's Perspective

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INTRODUCTION

Universities are indebted to clarify their objectives for their investment in online education and especially in MOOCs. Although the reasons mentioned for the growing energy spent on MOOCs become better and more realistic, they stay rather superficial in the sense that most arguments mentioned are very general statements about the desire to serve the world, to open up education for the masses, to learn and gather experiences so on campus education can profit from it and the plea that doing online learning will in the end be a win situation for all. Although there is "no shortage of prophecies about [MOOC's] potential impact" [1-23], the academic community has yet to develop an in-depth understanding of learner experiences in MOOCs. There is no general theory yet which is firm enough to qualify MOOCs as the denominator for learning innovation. A university might decide that their investment is worth the effort, in the end though the decisive argument should be the appreciation of the learning offerings by the student. This argument is mentioned in most literature, but there has not been an extensive discussion yet and with this paper we would like to widen the argumentation and discourse. So the fundamental question here is the appreciation of the courses by the students and how valuable the students consider these in relation to their learning demands.

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The decision of the TUD to start with MOOCs was based on prior involvement and experiences with Open and Online Education. The TUD has been an active member of the Open Courseware Consortium since 2007 and developed awareness, experiences, and a general sense of urgency towards open and online education. The TUD joined the edX consortium, founded by MIT and Harvard University, in 2013 with the intention to strengthen the presence in the field of open and online education. In the first year five MOOCs were developed, which are being analyzed in this paper. The strategy of the TUD is an intensive 2-year program in line with the Roadmap 2020 to expand and diversify the online portfolio, to innovate online didactics and campus pedagogy and strengthen the international collaboration in the field of education [5].

One of the first research aims at the start of the MOOC endeavor of the Delft University of Technology (TUD) was to get a better understanding of the thousands of individuals participating in their engineering MOOCs and what they were hoping to achieve [2, 3]. This was addressed in a previous paper [4] which focused on describing demographics of learners, including age and gender, as well as prior background in the subject, education level, cultural ties and the preference for individual or collective learning. This paper looks at the perceived value students adhere to the DelftX MOOC engineering courses they have taken, in other words what is the course worth in the context of their learning needs? Are you doing the course because you are curious, you want to get more knowledgeable on the topic, you need to know something related to your work, you do it for other professional reasons. This research will not cover all arguments as it is a first endeavor to get to know the learner better from the value perspective.

The following chapter is about the methods for data collection and the connecting analysis. Chapter two focuses on the results of the analysis and the discussion to frame the learning analytical approach and is followed by conclusions and the summary.

1   DATA COLLECTION AND ANALYSIS

With the emergence of the MOOCs the university is confronted with a very different population of learners and a promising new data context that can help to discover the working field of the MOOCs. A bit of caution is needed though, because for the working of the new data, new lines of research are needed to develop strategies for the improvement of teaching and learning in such environments [6,3]. Therefor the analysis reported here are to be used and interpreted with care.

Table 1 shows an overview of the five courses in the first year of MOOCs at TUD that are the focus of the research in this paper. Some have a rerun in the season 2014-2015 and are used in addition to online courses, campus courses or in a mixed mode often in a flipped classroom format. They comprise a mix of topics, are generally based on existing campus courses, ran for six to eight weeks, attracted in total almost 140.000 registrants with a completion average of 3, 7% and were all on bachelor level.

Table 1 Overview of the first five DelftX MOOCs (For a detailed description, see [2]

Course Name	Period	#Students	# Receiving Certificate of Completion	Level	Description

#1 ET3034TU Solar energy	16.09 – 6.12.2013	57.091	2.730 (4,8%)	Bcs	A foundation course in Solar Energy, requiring basic knowledge of physics and some mathematical skills. The main learning goals were the discovery of solar energy power and the design of a complete photovoltaic system.
#2 CTB3365 Introduction to Water Treatment	16.09 – 25.11.2013	29.088	545 (1,9%)	Bcs	An introduction to Water Treatment systems with a focus on basic drinking water and wastewater treatment technologies for urban water services
#3 1110X Introduction to Aeronautical Engineering	03.03 – 19.5.2014	15.820	578 (3,7%)	Bcs	This course provides an overview of and introduction to the fundamentals of aeronautics, using the history of aviation as a story line. It comprises a general introduction to aeronautics taking a closer look at aerodynamics and flight performance.
#4 TW3421 Credit Management	18.04 – 30.6.2014	20.925	709 (3,4%)	Bcs	This course offers an introduction to credit risk modelling and hedging. The approach of credit risk is taken from the point of view of banks, but most of the tools and models can be beneficial at the corporate level as well.
#5 NGI101x Next Generation Infrastructures	23.04 – 8.7.2014	16.091	517 (3,2%)	Bcs	Covered the general discussion on infrastructural systems in the world with the purpose to develop a broad understanding. Originated from the encompassing 10 year THE research program on New Generation Infrastructures.
Total		139.015	5.079 (3,7%)		

The data were collected using different methods, including such diverse tools as statistical analysis of the systems data, social network analysis and interviews. More specifically, we included analysis of the subscription data from the participants, a pre- and post- survey, measured learning-related outcomes (i.e. performance and retention), interviews with teachers and developers, and the analysis of interaction in the forum and other media like Facebook. The heterogeneity of the participants, the subjects and the learning approaches as such, only allow for not domain specific data to be collected and compared. A domain specific analysis is needed to collect meaningful information on the learning activities and learning process that is taking place, which is not the case in this research.

The analysis for this paper focused on data that contribute to the understanding of the perceived value of the MOOCs for the learner [7]. The primary sources were the pre- and post-surveys, issued right at the beginning and close to or after the closure of the courses. The survey questions zoomed in on issues such as the confidence of students in handling the course, how determined they were to finish the course, the use of the online forum, social interaction, the relevance of the course, the challenges, their expectations and experiences, course quality and if such a course inspired them to continue learning and their additional comments. One should keep in mind though that the large majority of the students who filled in the post-course

survey presumably were completers, so the review is biased, but still worth looking at when it comes to the appreciation of the students for the learning opportunities.

2   RESULTS AND DISCUSSION

The following results are derived from user data and surveys conducted at the beginning and at the end of the MOOC. It should be said that the post-course survey response was only a fraction of the pre-course survey response, but the average percentage of respondents of the post-survey was over 60%. The following table shows the number of respondents per course. Due to technical problems at the start, the data from the courses Solar Energy and Water were not reliable enough to be taken into account in this table. That is why only three courses are covered here.

Table 2 Numbers of respondents for three courses

	AERO	CREDIT	NGI
Pre	3072	3648	2257
Avg. grade	.17	.17	.20
Post	336	314	329
Avg. grade	.71	.71	.87

When we look at the difference in average performance (grade) of pre and post-course survey respondents, it immediately becomes clear that we have a very strong selection bias in our sample.

An indication of the performance in general of the students can be shown by the distribution of grades. This is rather similar: the largest group of students is comprised of those who have not participated in the formal assessment (and are likely those who have not participated to a high degree). These students have a grade between 0 and .15.(see figure 1). The second largest group is comprised of those students with a passing grade, hence between .55 and 1.0, with a higher density of students towards these 'boundary marks'.
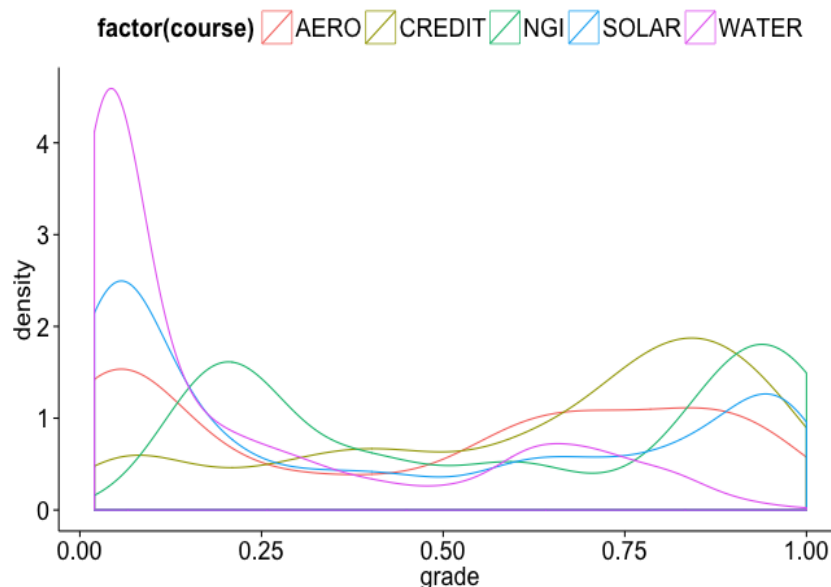

Figure 1 Pre-course survey respondent' grade distribution

A rather limited group of students received a final grade between .2 and .55, which would indicate a medium effort or lower interest in receiving a certificate of completion. The distribution of grades for these courses can be seen in Figure 2.
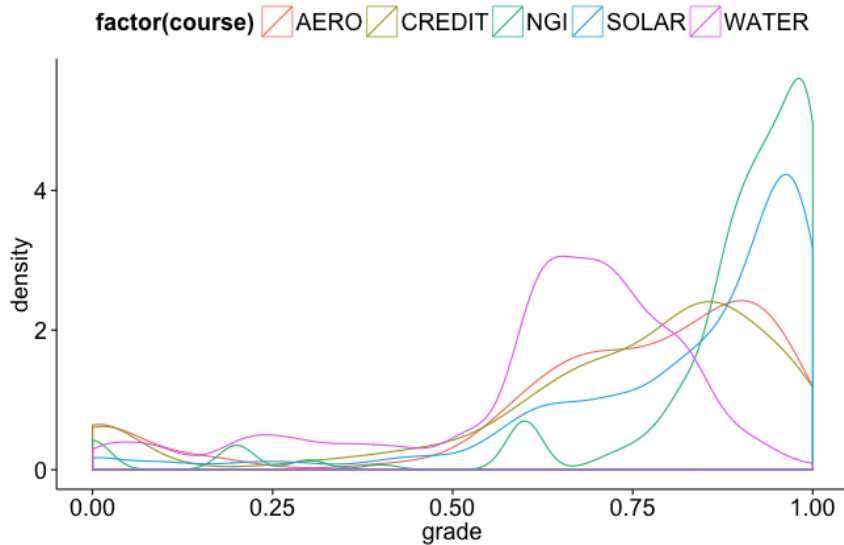

Figure 2 Post-course survey respondent' grade distribution

The distribution of grades of students who filled in the post-course survey is rather different: clearly, a much larger part of these students were participating up until the end, received value from the course, and possibly felt indebted to make the effort to fill in a post-course survey. In our study, we are aware of this sample bias, however we also argue that those who took the course up until the end, are the ones that are most capable of giving an opinion about it.

Figure 2 shows the grade distribution of just the post-course survey respondents. As expected, the graph shows clearly that the post—course survey respondents are primarily completing students, i.e. those with a passing grade at the end of the course. However, as can be seen in table 3, there is still a significant percentage of students who failed to achieve a passing grade (around 15%: 312 respondents).

Table 3 Passing grade of the post-course survey respondents

Course	Fail	Pass
SOLAR	115 (9%)	1201 (91%)
WATER	103 (22%)	367 (78%)
AERO	39 (15%)	225 (85%)
CREDIT	41 (17%)	198 (83%)
NGI	14 (6%)	215 (94%)

The distribution of grades gave some insights in the performance of the post-survey respondents who are the main source of information for the following summaries on quantitative and qualitative responses. In these summaries we have collected all available issues which can be considered indicators for the appreciation and perceived value of the course by the students.

2.1 Quantitative response summary

Looking at the outcome of the surveys [2] it shows that overall the students were very confident (over 80%) that they could handle the requirements and were rather determined to finish the course and pass the examination (over 80%). They also believed that working harder would help them to achieve more (over 60%).

When it comes to social interaction, most indicated (over 50%) that they would have wanted to connect with other students more than they did. This would than include experience sharing, giving or receiving help and the use of the course forum. The participation in the course forum shows a pattern that is more or less equally spread from no participation (20%+), rarely (30%), sometimes (30%), often (10%), to all the time (5%). So there is something to gain when it comes to social interaction and this is confirmed by the reactions on the questions concerning online participation. It is only a small percentage (10%) that joined a study group or made friends. A larger group (over 40%) contacted the instructor or teaching assistant for support or looked for extra materials (over 80%).

In general the students as participant in the course felt rather well. A clear majority (over 80%) suggested that they had a feeling of belonging and believed that the course instructors cared about their learning experience (over 80%). So, no wonder that a good 90% of the students said that they really enjoyed the course or courses.

Especially the experiences in the first few weeks made clear that students face all kinds of challenges to continue with the course of which lack of time seems to be the most important reason, but also health and the political environment played a role in the decision to stop. Some mentioned that they were bothered by a slow internet or electricity problems, but the majority had no such complications. As time is an important issue, students felt during the course a little (31%) or somewhat stressful (34%), but felt quite in control of things (over 80%) and perceived that things turned out well (over 80%).

Important for the justification of participation are the expectations. A clear majority (over 70%) of the students said that their expectations about the course were realistic. This is also shown in the fact that 60% believed that the course exceeded their expectations and 36% found that the course was exactly what they expected. The overall quality of the course was rated good to very good (97%). Also the overall quality of assignments and exams, the balance between lectures and exercises and the feedback were rated good to very good (90%), but with some flaws in the case were rather new peer review technics were introduced and partly not well understood or even confusing.

Most students (over 70%) would like to do another course by the same team of teachers and this positive perspective apparently also spurred the appreciation for the TU Delft (positive over 80%). This did not mean though that everybody wanted to apply for an online graduate program (absolutely 20+%, probably 15%+ and maybe 25%). Nonetheless the courses inspired most of the students (absolutely over 60%), to continue studying in the field of their course and this is good news, because this is one of the objectives why the TU started the MOOCs, namely opening up opportunities for those who might otherwise not be able to acquire new knowledge and insights in their particular fields.

Answering the question of the perceived course value by the students can built on previous indicators, but to finish this section on the quantitative responses we zoom in on a few survey questions that can be interpreted to more directly deal with the notion of perceived value. Considering the involvement of the students in the course the questions and numbers in table 2 are helpful to get a better and broader understanding of the interest and the experiences of the students relative to their actual situation. For the discussion here we just look at the bandwidth of the scores for a first indication.

Table 4 Indicators for student course relevance

Question	Not at all	A little	Somewhat	A lot	Extremely
1. My prior knowledge and skills were helpful to complete assignments or/and understand lectures	4%	8%	23 – 26%	39 - 46%	20 - 25%
2. The course was relevant for my profession or occupation	7 - 24%	5 - 12%	17 - 25%	22 - 35%	24 - 30%
3. The course was compulsory for me	45 - 55%	6 - 9%	13 - 18%	16 - 19%	9%
4. I believe that the level at which this course has been delivered will help me advance in my career/professional field	4 - 14%	10- 13%	24 - 29%	27 - 34%	22 – 25%
5. I sometimes had to put aside family or work obligations in order to be able to follow the course.	9- 21%	18 - 24%	31%	19 - 26%	5 -11%

From the link with prior knowledge it shows that there is a strong alignment with previous knowledge and skills of a majority of the participants. The relevance in relation to profession or occupation is evident. Also the notion that this course will help one to make professional progress is rewarded. So, doing a MOOC for fun is only part of the picture, this table shows that apparently there is a serious condition that comes with it. The fact that a majority regularly had to make an effort (question 5) to create time to do the MOOC indicates that this learning opportunity meets learning demands. This confirms the notion that the MOOC participant looks much more like a non-traditional student in search of job relevant skills. MOOC providers therefor should consider adult learning theory as well to better understand what works for this emerging group of learners [7].

2.2 Qualitative response summary

Participants were asked about their opinion on the course and the following is a summary of their open answers. Among the thirty qualitative responses as to why they disengaged from the course, the students have predominantly mentioned the lack of time to take the course. Among reasons that did not allow participants to allocate sufficient amount of time, they named such as upcoming exams, work and personal commitments. A few mentioned the lack of skills to keep up the pace, and their inability to find more time they can invest in honing their mathematical skills. Some reported the course becoming boring with on-going difficult videos and multiple choice tests. Students also reported health reasons, lack of computer to work on, as

well as social and political situation in their countries, although these were one-time instances.

Among reasons given as to why a student did not interact with others, MOOC participants' answers mainly fell into two groups: they either did not have the time to engage socially with the others, or did not see the need for it. Many reported reading the forum, pointing out that there was no need for them to ask questions since somebody had asked and answered those questions for them already. A few people named their shyness, in confidence in their ability to ask good questions, as well as poor English skills as obstacles for engagement. Some also pointed that they have not engaged due to the lack of appropriate feedback, although such opinions were occasional. Some people also complained about the forum interface. That being said, the overwhelming majority of qualitative responses related to the lack of time, need or interest.

Over a third of respondents in three courses left their suggestions for course improvement, and the length and enthusiasm of these responses indicate that participants felt responsible to provide feedback to course organisers. Suggestions do vary, and range from a number of technical issues, such as smaller size videos, ability to watch videos at slower pace, and with downloadable subtitles; to various ideas as to how the teaching could have been improved. Participants name the need for more training material for those without strong background in a subject, for better scaffolding, shorter less information-heavy videos, more trials for open-ended multiple choice questions, and a common and easily identifiable space for reporting mistakes in the videos or exercises. Most of the feedback is generous and course-specific, but overwhelmingly relates to a simple need for structure, access, information and support in understanding.

3   CONCLUSIONS

A university might decide that their investment in MOOCs is worth the effort just by the number of participants. Part of the argument though will always be what the appreciation and perceived value is for the students. The intention of this paper is to contribute to the argumentation and discourse on the notion of the learner's perspective. There is a need to develop strategies for the improvement of teaching and learning in such a new learning context as the MOOC. The initial reflex was to copy campus education into an online format [8]. The data from the DelftX MOOC show that the audience is quite different with a category of completers as a very serious cohort of learners wanting to get a certificate and/or satisfy their learning needs. Also the learner is not a traditional student, but looks very much like an adult learner in search of meaningful knowledge and skills to be put in practice. To extend the usefulness of MOOC education and in general online learning for the end user, there is a need to take the appreciation and perceived value as a core issue in the design strategies where adult learning theory ought to be one of the pillars.

4   SUMMARY

The focus of this paper is on the appreciation and the perceived value by the learners of the first generation engineering MOOCs at the Delft University of Technology (2013-2014). To answer this question we applied learning analytics on the collected user data, including qualitative data retrieved from a pre- and post-survey of in total 139.000 registered students of which 5.070 completed their courses [3]. Thereby we looked at figures concerning the demography and retention, but concentrated on the issues that help to develop a better understanding of the perceived value of the

course by the student. These comprise questions on confidence in handling the course, determination to finish, the use of the online forum, social interaction, the relevance of the course for job or other purposes, the challenges like time investment, their expectations and experiences, and if such a course inspired them to continue learning. It is of great interest for the university to get to know the learner better in this new learning context and use the appreciation and perceived value of the participants as a source of inspiration to better prepare for this expanding field of learning demand.

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