Delft University of Technology

TU Delft Online Learning Research Working Paper #5

DelftX MOOC Course Report NGI101x Next Generation Infrastructures

TUDelft

This report is to give more insight in the background, the implementation of the course and the results. The purpose is to provide useful information (and clean data) to the team of developers and teachers and to others to support their aspiration to improve online education. A comparative analysis of the first five DelftX MOOCs can be found in the 'Working Paper DelftX MOOCs, the first year (2013-2014)'.

Course report NGI101x Next Generation Infrastructures

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Summary

Name course	NGI101x Next Generation Infrastructures
Date	April 22nd - July 8th, 2014, a period of 8 weeks
Faculty	Faculty Technology, Policy and Management
Teachers	Principal teachers: Dr. Margot Weijnen, Dr. Ernst Ten Heuvelhof, Ir. Joost Groot Kormelink. Other lecturers: Dr. Hans Bruijn, Dr. Tineke Egyedi, Dr. Rudi Hakvoort, Dr. Jeroen van den Hoven, Dr. Sebastiaan Meijer, Dr. Piet van Mieghme, Dr. Eve Mitleton-Kelly, Dr. Igor Nikolic, Dr. Erik Pruyt, Dr. Johan Schot, Dr. Wijnand Veeneman, Dr. Alexander Verbraeck
# of students	16091 registered and 517 certified completers
Level and prerequisite	Introductory level, no special requirements. Analytical skills, curiosity about new developments and interest in design and governance of infrastructures for better future
Course resources	Video lectures, divergent exercises, real-life problems, analytical skill tutorials
Special features	Taught by 14 lecturers, peer assessment, real life-related assignments, discussion of real-life problems in various parts of the world, Visual collective map of group answers, filmed in authentic locations
Expected workload	8 hours weekly

The course originated from the encompassing 10 year THE research program on New Generation Infrastructures, and covered the general discussion on infrastructural systems in the world with the purpose to develop a broad understanding. Most assignments revolved around authentic world-problems to provide a good balance between theory and examples. One of the achievements was the collective development of a World map on infrastructures, where students contributed with an array of materials.

The course was intended as highly collaborative, and as an opportunity for crowd-sourced knowledge about the world infra-systems. The design of the course showed a constructivist orientation, was learner oriented and had a certain degree of student autonomy. This is slightly different from the regular xMOOC, which use in most instances a more instructionist approach focusing on knowledge transfer. The different pedagogy put pressure on the appropriate handling of feedback, assessment, and peer reviews. Nevertheless the experiential character of the course made it a very daring process and the approach was perceived as a well-curated online course with high class content.

1. Introduction

The course NGI101x Next Generation Infrastructures from the Faculty Technology, Policy and Management of the Delft University of Technology ran for 8 weeks from April 22nd to July 8th 2014. This course was designed from scratch on the basis of a significant international research project on Next Generation Infrastructures. In total 16091 participants registered and ultimately 402 completed the course and received a certificate. The goal of the course was to introduce the complexity of infrastructure systems, familiarize students with main concepts within the area and with the variety of conceptual and methodological approaches to their infra-systems analysis.

This report contains additional information about the background, the implementation of the course and the results with the purpose to add to the knowledge base of MOOC environments. The information in this report has been collected from different sources like edX subscription data, edX student data, including the use of the forum. Using a pre- and a post-course survey made it possible to collect qualitative information on issues like expectations, motivation, prior knowledge level, and relevance and correlate the outcome with other data. In addition the teachers and the development team were interviewed to acquire more insight in their experiences and perceptions.

The main purpose of the analysis was to provide useful information (and clean data) to the team of developers and teachers to improve the design and facilitation of subsequent online courses. This was organized by the O2E research team (Open and Online Education) from the TU Delft in close collaboration with researchers from the University of Southern Australia, Stanford University, and the University of St. Barbara.

2. Course Design and Pedagogy

2.1 Design, Learning Resources and Workload

Next Generation Infrastructures was creatively put together by a large group of lecturers: 14 experts and each had their own contribution to the content of the course. The overarching aim of this course was to give a proper introduction to understanding the complexity of infrastructure systems. This was done from a multitude of perspectives illustrating various driving forces and their implications for design and governance of infra systems; through basic explanation of a Complex Adaptive System Approach, and through applying its conceptual tools to learners' own cases, e.g. problem demarcation and actor analysis.

The decisions behind the learning design as well as the language-in-use by the instructors indicate that the course was planned as having a constructivist orientation. The course was not assessment-oriented, it was multi-disciplinary and non-linear. Learners from the very first minutes were encouraged to contribute to the general discussion about infrastructural systems in the world, and the general tone of the lecturers was more about coming together as learners to contribute to global understanding of infra systems. A number of tools were designed to facilitate it, such as a collective map that showed collectively submitted open-ended responses of learners about world infra systems. The course team was learner-oriented, giving students choice as to which assignments to submit and which topics to write about. The team strived to provide the balance between theory and examples, as well as bring in content that was reaching beyond eurocentric problems. Interesting authentic examples, wide array of topics, and inclusion of authentic locations and a simulation all demonstrate the creativity of the course team.
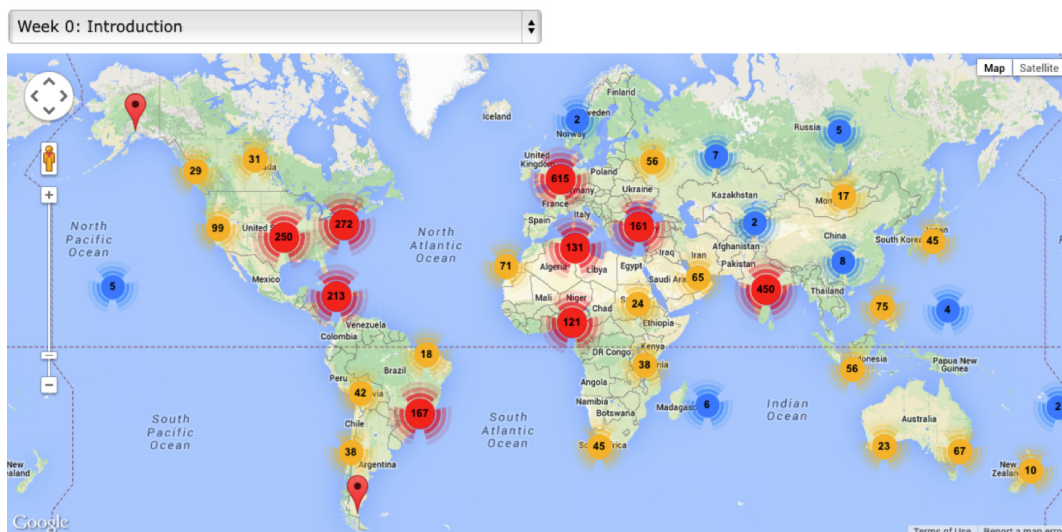

Image 1. Screenshot of a NGIx Map from the introductory week. Map allows zooming in to the level of the individual and reading the text the individual submitted.

The amount of web-lectures and other content-related videos totals 10 hours, i.e. about an hour weekly. Usually in the course, videos were accompanied by a generous amount of adapted introductory text prior to the video-content and 1-2 suggested readings, as well as an occasional un-assessed quiz. Additionally, on average each week required submission of individual assignments - open-ended written problems requiring sufficient prior research, but only half of them were sufficient for assessed work. Recommended workload for the course was 8 hours, and the average of 8 hours was also reported by 258 students who responded to the post-course survey.

Learning resources in the course were not well-balanced, as shown in Graph 1. Most of the resources were either web-lectures of reading materials related to the content of the class. Usually, a space for discussion was to be found at the end of the sub-module, separately from either readings, or lectures. Since not all content materials (video or text) were accompanied by a communication space, the sheer number of discussion places was also out of balance with the rest of the content.
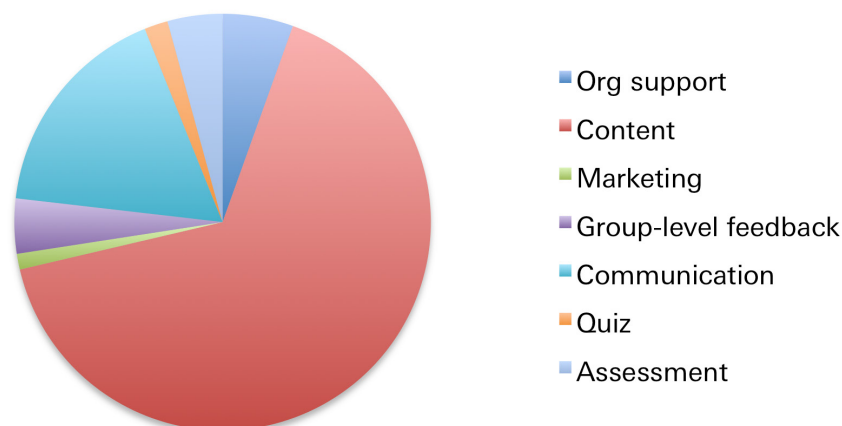
Graph 1. Representation of the ratio between different types of learning resources in NGIx. (Approach adopted from Weller, M. (2014). Characteristics and completion rates of distributed and centralised MOOCs. MOOC Research Initiative Report.)

2.2 Pedagogy

The control over the course was shared between the teachers and the students. On the one hand the deadlines were set strict, which indicates a higher degree of teachers control. On the other hand, for each assignment, the students had a choice of whether to submit it, as well as they had a choice of completing from 3 to 6 assignments. Such approach indicates certain degree of student autonomy. Activities and assignments revolved around authentic world-problems, to which the course content needed to be applied. Occasional quizzes did not carry any value towards assessment were more convergent, and geared towards comprehension check.

The structure of the course was non-linear, i.e. not requiring a specific sequence to be followed. However, the choice of presentation within a unit was not always consistent, e.g. learning objectives would appear as the third item in the module, or the video with the feedback on the previous week would be placed at the very end of the following week.

Feedback can be characterized as infrequent. A feedback video for the students was provided weekly. However, week 4-6 only provided one feedback video shown to the students in the last week. Forum feedback from the teachers on the content would include positive reinforcement, but lacked specificity. Staff, student and community assistants were helpful in relation to practical and technical issues.

The course decisions raised some concerns. The evaluator's impression was that many meaningful decisions were not implemented well, i.e. learners autonomy in relation to the selection of what to submit, clarity for how to assess peer submissions, technical glitches related to the map submission, close-ended questions for stimulating forum discussions, connecting the dots between a wide array of topics in somewhat confusing manner, showing video trailers and marketing trailers without specifying their relation to the content. Finally, several lecturers provided exclusively paid content (walled publications under the price of 100$) as suggested readings for their modules, and one lecturer included a link to google books without a preview to his only suggested reading. To conclude, on the one hand, suggesting paid content raises serious accessibility issues, especially when no alternative is given; on the other hand, it seemed that the course resembled well-curated online courseware repository with high-class content, rather than teacher-supported delivery of an educational provision.

2.3 Assessment

In order to pass NGIx 1, students had to receive a grade of 70% or more. The grade was derived by two major parts: 60% of the grade were dependent on the on-going submission of 3-6 papers, and 40% of the grade were given to the final Issue paper, that cut across skills the learner was supposed to develop throughout the course.

Assessment in this course was not smoothly implemented due to a number of choices. First, it made no difference whether the learners submitted 3 or more papers during the course as well as the actual quality of the papers was not differentiated upon. If a learner submitted anything from 3 to 6 times, it counted 60% of the grade. Learners were not clear as to how their written assignments were to be graded. Moreover, the course team gave learners a choice as to whether they wanted submitted papers to count toward the grade or not. This was done through the introduction of a special button that was placed at the bottom of the page, under the "Submit" button, and was not clearly introduced. Additionally, learners could submit assignments to the common map, where all the answers were accumulated. These were all creative ideas to make the course more fun and flexible, which in practice resulted in some level of confusion among the learners. The learners were allowed to re-submit any paper they wanted to count towards the grade in the last week of the course. Finally, the valuable 40% of the course grade were given to the Issue paper. Its grading was decided by other students, i.e. it was peer-reviewed. A student had to grade several papers written by other students, and there was little guidance as to how to conduct peer review. The most likely reason for the chaotic and unclear peer-assessment procedure is a late decision not to use the edX integrated peer-assessment tool, because it lacked functionality and was not tested sufficiently yet to be used in a real course. The course team tried, in the final weeks before the course started, to develop an alternative method for supporting peer-assessment in the course.

3. Student Demographics

This sub-section elaborates on the basic demographics of registered students and those who received a certificate of completion at the end of the course, in relation to their age, gender, cultural group, previous background, professional relation to the subject, educational level, and intention for enrollment. Detailed graphs related to this information are to be found in Appendix 1.

3.1 Registered Students

16091 students enrolled in the NGI course. 70% of the registered students were male. Over 50% of the registered participants were 19-30, and 20% of the registrants were 31- 40 years old. The largest cultural group registered for the course was representatives from the English-speaking countries (almost 30%), followed by participants from Latin American cultures, South East Asia and Latin European countries[1]. This is the first DelftX course where the largest registered group is not South East Asia. About 44% of the registrants reported having some background in the content of the course. About 1/3 of the registrants stated having no previous background in the topic, around 40% reported having the same level of content understanding as they expected from the course, and only 10% believed that their level of knowledge in the topic is higher than the course level. 37% stated that their occupation is related to the topic of the course. Around 35% of registered student had bachelor's level education, and around 30% had master's level education. Over 17% of the registrants had high school level education.

3.2 Students Receiving Certificate of Completion

402 students received certificates of completion from the course team of the Next Generation Infrastructures MOOC. 80% of this group was male. Learners aged 19-30 made up 40% of all completers, and the representation of students older than 30 years old got slightly higher within the group of completing students. 40% of the completing group culturally represented Latin America and English-speaking countries, both groups being equal in size. Followed by a large South East Asian group and a smaller group of Latin European learners, these four cultures made up 70% of the course learners. 57% of completers reported that their background was related to the course content, while 25% - reporting having none. Finally, 34% of completing and certified students reported having no prior experience in the topic, while 41% reported that their experience with the topic was the same as the course is taught at, and 7% believed that their experience with the topic was more advanced. Similarly, to the registrants group, participants with bachelor's and master's level educational background make up more than 60% of the course. Students with master's level background were much more likely to complete the course.

3.3 Intentions for Enrollment

Top five reasons for enrolment reported in both completing group and among those registered are reported below:
1) Most reported reason: want to increase my knowledge in skills;
2) Because they find the topic interesting;
3) Because they want to get a certificate of completion;
4) Because they want to improve their employability;
5) To challenge themselves.

[1] Mensah, Y., & Chen, H.-Y. (2013). Global Clustering of Countries by Culture - An Extension of the GLOBE Study (No.4) (Vol. 4, p. 51).

4. Retention and Formal Performance

The change in the numbers of students who engaged with weekly assessed written assignments can be seen on Graph 2. 944 students attempted the first assignment, followed by 608 and 504 for the second and the third assignments. Technically, doing only three assignments was enough to get the necessary 60% of the grade, so some students only did that. The last written assignment before the issue paper was completed by 155 students. It could be seen that some students opted to keep their first three assignments from the number of people who submitted peer-assessed Issue Paper. The Issue paper was submitted by 410 people, but only 330 scored high enough to make it count for them. We do not know whether the quality of their submissions was not good, or there was a misunderstanding on the peer review process. Completed written assignments in the early weeks of the course served an indicator of students motivation to complete the course and attempt assessment. From the post-course surveys, external obligations and the lack of time were reported as main reasons for disengagement.

403 students received certificates of completion, with an average grade 0,93.
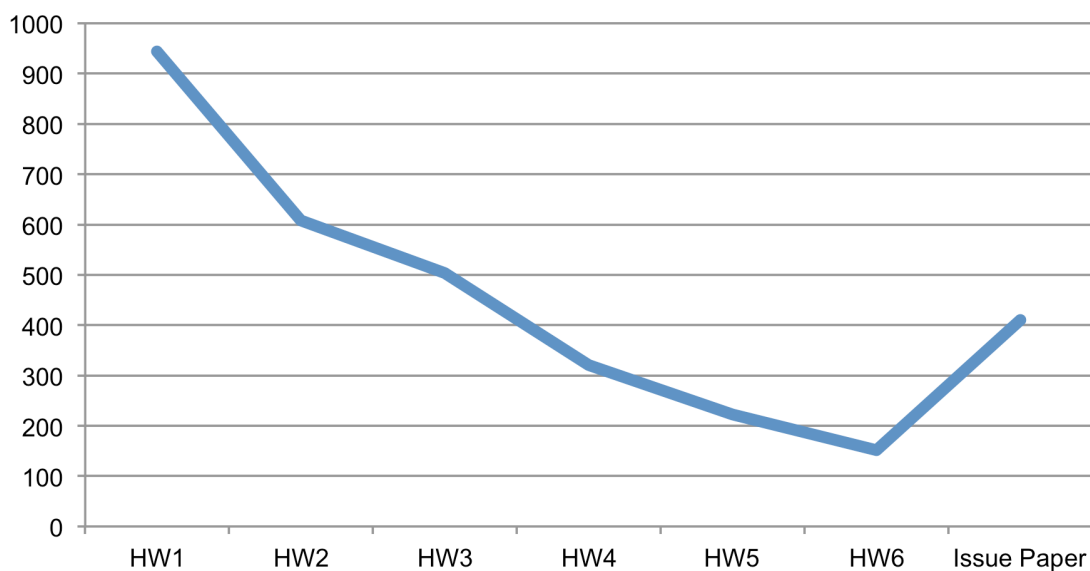
Graph 2. Students' opting-out of formal assessment activities over the course progression

5. Course forum and student interaction

Most students were not active on the edX forum. The forum though shows unusual dynamics by completing students, i.e. very high number of people who made 1-3 comments. That is explained by the fact that the students were asked to post their thoughts about the lecture/ topic, as well as to paste their written assignments. Also, the forum has quite a low number of superposters.

Table 1. Use of edX Forum by registered and completing students.

	Registered Students	Completing Students
Superposters (50-700 posts per person)	0.04 (7)	1.35 (7)
Very active (30-49 posts per person)	0.11 (18)	3.1 (16)
Active (15-29 posts per person)	0.33 (54)	8.7 (45)
Moderately active (7-14 posts per person)	0.8 (129)	16.83 (87)
Inactive (4-6 posts per person)	0.91 (147)	16.25 (84)
Passive (1-3 posts per person)	3,5 (570)	28.05 (145)
Did not post (0 posts)	5.15 (829)	6 (31)
Never logged in the forum	89.1 (14337)	19.72 (102)

5.1 Student Feedback on Using the Forum

291 students answered the post-course survey, among them:

- 28% of the students (N=78) reported contributing questions or answers to online forums often or all the time.
- Over 60% of the students found the forum important for them in the course.
- 12% reported reading the discussions daily, and 45% weekly.
- 7% of the students reported interacting with another student or the course team weekly or daily, and 34% reported doing so only a few times.

The students reported that "clunky" structure of edX forum, confusing posts, difficulty in navigating, difficulty in relating to what others have said, no reason to connect to another student, lack of time, shyness, insecurity about their English skills, fear of virtual environment as reasons for not participating in edX forums. In other words, judging from the qualitative responses, non-participation in edX discussions was caused by a variety of reasons, such as the features of edX forums, pedagogical decisions around the integration of forums in the overall activities, or personal reasons, including the lack of personal skills.

5.2 Student Community

About 50% of all the posts on the forum was made by 150 people. The largest number of posts per person is under 200 posts.

Demographically forum was dominated by students from English-speaking countries (21%), students from South East Asia (21%), Latin American students (15%), students from so-called Germanic cultures, e.g the Netherlands (13%), and African culture (7%). Such cultural representation is very much in line with the cultural background of the overall group of completers.

6. Looking back

A post-course survey for students and a post-interview with the teachers and developers of the course allowed us to collect some qualitative information on the experiences of the participants. The post-survey had 291 respondents while 402 students received a certificate, so this could mean a 72% response assuming that only the completers filled out the survey.

From a research perspective it was interesting to see what these students were doing and what their perception was looking back after successfully finishing the course. Therefore the post-survey zoomed in on issues like confidence 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 the question if the course inspired them to continue learning.

Most completers were from the start on rather confident that they would do well in the course (80%) and were determined to finish the course (86%). This coincides with the firm belief of most students that one can influence her performance by working hard (79%). It is known from other TUD experiences with the MOOCs that the edX forum is a bit clunky. This shows in the comments of the students as feedback on the forum (see paragraph on forum) and that students would have liked to connect more to other students (59%), to share experiences (58%) and to be helped by other students (40%). This does not mean that the students did not feel at ease. Most of them felt like they belonged in the course (76%) and felt comfortable with other participants (80%). They also felt that the course instructor cared about their learning experience (74%), which is being supported by the fact that a majority of respondents obviously enjoyed the course (89%).

The moderate social interaction is shown by the fact that a small number of students joined any study group (16%), made friends (21%) or contacted the instructor (25%). A majority though looked for extra materials (92%) and posted a comment or question (83%). If we look at the outcome of the survey question emphasizing the actions taken, than 30% connected with other students, shared experiences (51%), was helped by others (36%) and found the course forum helpful (73%). So clearly this is a mixed picture that needs further analysis to make sure that the opportunities for improving social exchange are reviewed for further use.

Considering the involvement of the students in the course the following matrix (Table 2) is helpful to get a better and broader understanding of the interest and the experiences of the students relative to their actual situation.

Table 2. Expectations and perseverance of the students

Question	Not at all	A little	Somewhat	A lot	Extremely
My expectations were realistic	0%	5%	21%	56%	18%
My prior knowledge was helpful	4%	8%	23%	46%	20%
The course was relevant for my profession or occupation	7%	5%	25%	35%	27%
The course was compulsory for me	45%	6%	21%	19%	9%
I planned and organized my learning well	1%	6%	33%	46%	14%
I worked really hard at things I did not understand	1%	13%	33%	35%	16%
I sometimes had to put aside family or work obligations in order to be able to follow the course.	9%	18%	35%	26%	11%

The expectations were well balanced. From the link with prior knowledge, the relevance for the profession and somehow the obligation to do the course, it shows that the course in itself has a high impact on a majority of the participants. So, doing a MOOC for fun is only part of the picture, this MOOC shows that apparently there is a serious condition that comes with it. The fact that 37% regularly had to make an effort to create time to do the MOOC, also shows that this is more than a hobby. In this context it is good to notice that 43% of the students would have liked to work with others! Notably there were hardly any problems with the technology, the software or internet access.

On a day-to-day basis the students felt rather in control and confident that they could handle any obstacle in the course (71%). In that sense the course exceeded the expectations (53%) or was exactly was what expected (38%). Words used to describe the course were: wonderful, interesting, comprehensive, excellent, complex, insightful. The overall quality of the course was valued as very good (63%) and good (30%). Also the quality of the assessment and exams were rated rather well (very good to good 88%). The appreciation for the feedback given on completed exercises, quizzes and assignments gives a slightly different view with 20% very good, 36% good, 25% average and 13% poor. This coincides with the support from the course team which was regarded being 20% very good, 47% good, 25% average and 5% poor. The course was considered difficult by 36%, neither easy nor difficult by 54%. The amount of work needed was considered about right (83%) as was the pace of the course (84%) and the duration (86%). 67% of the students would recommend the course to another person and would take another course given by this team of teachers. Apparently the course increased the appreciation for the TUD and inspired 58% to continue studying in this field.

Teacher / developer experiences and views

MOOC instructors were interviewed prior and after the course. They reflect on the experience as inspiring, but a challenging-endeavor, especially when the course is new and many experts are involved. The need to prepare well, be in time and ready for the unexpected, makes it a different experience. This tension stays on during the whole period of being online and in contact with the students. The learning curve is steep, but manageable and the results are rewarding when students show to be satisfied and do contribute for example with their crowd-sourced knowledge on world infra-systems. The course was intended to be collaborative and sure this different pedagogy raised the pressure on handling feedback, assessment, and peer reviews. Overall, instructors acknowledge that they have learnt a lot while engaged in the process of MOOC production and delivery.

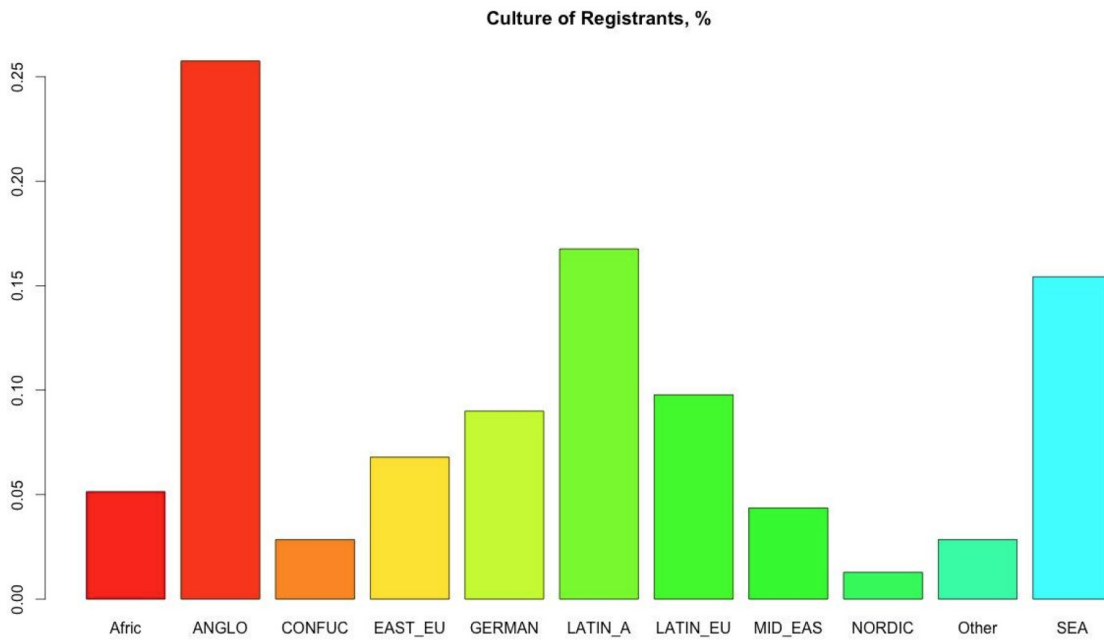# Appendix 1. Demographics of Registered vs Completing Students
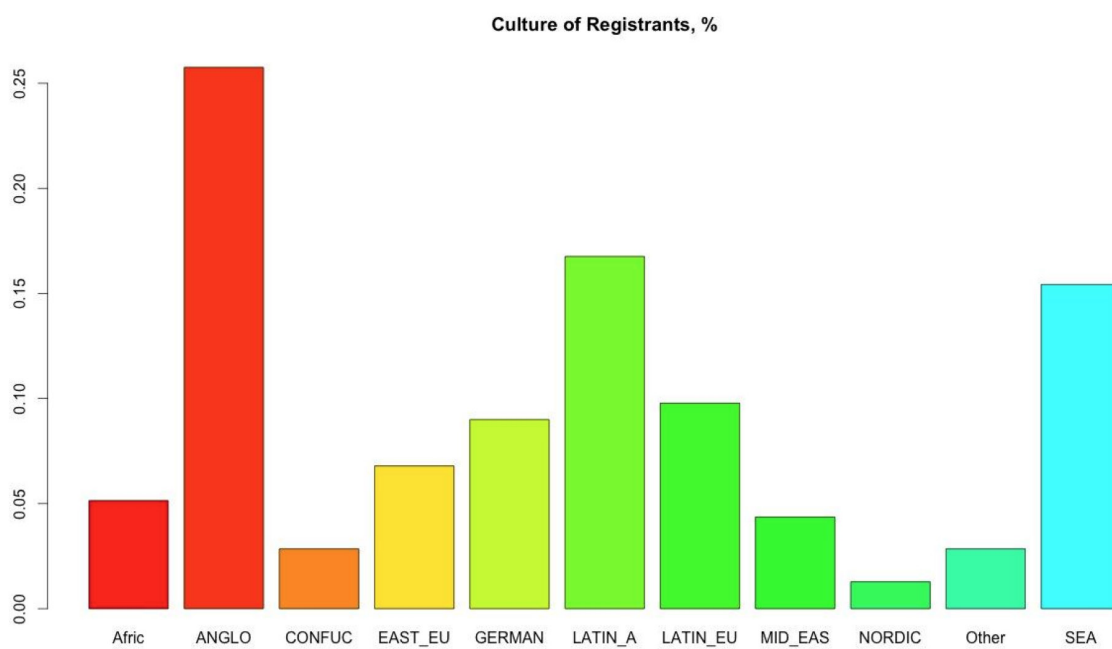
A) Age of Registered Students
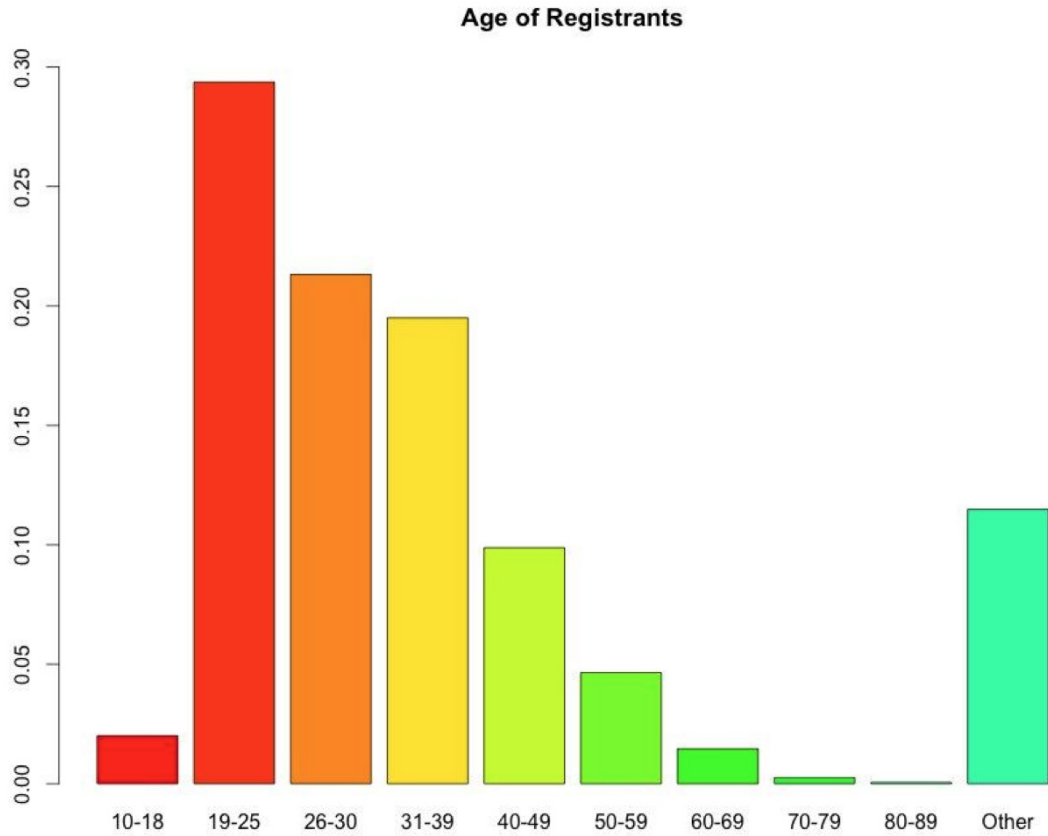
Age of Registrants

B) Age of Students who Received Certificate of Completion

Age of Completers, %
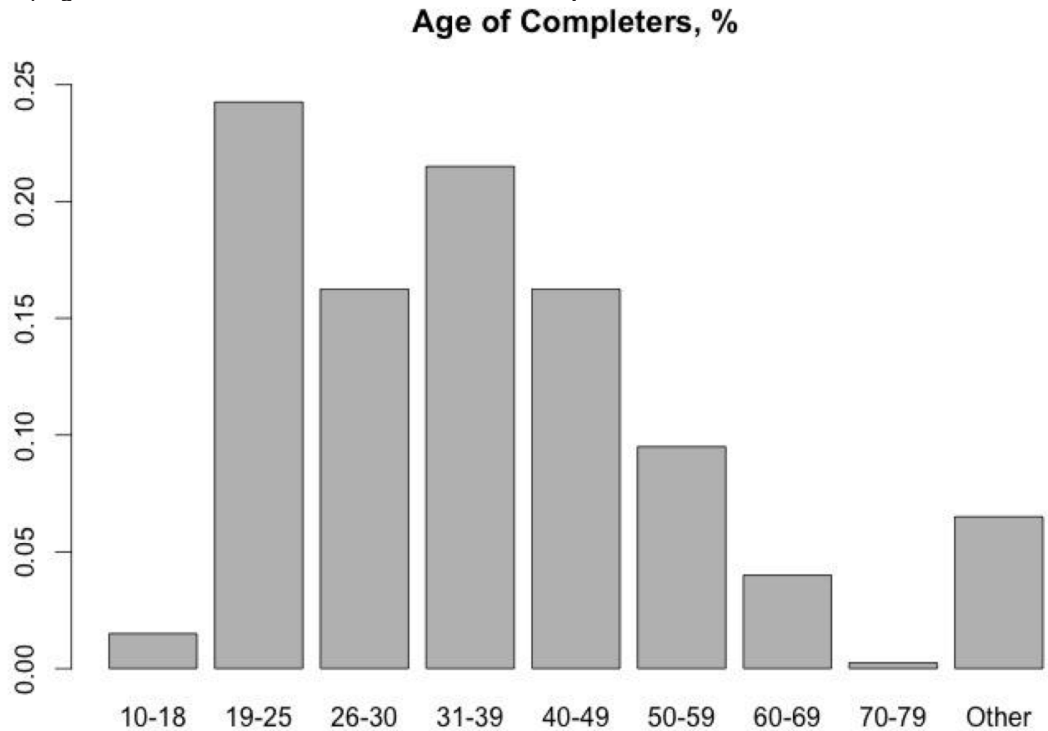
C) Culture of Registered Participants

Culture of Registrants, %

D) Culture of Students Receiving Certificate of Completion
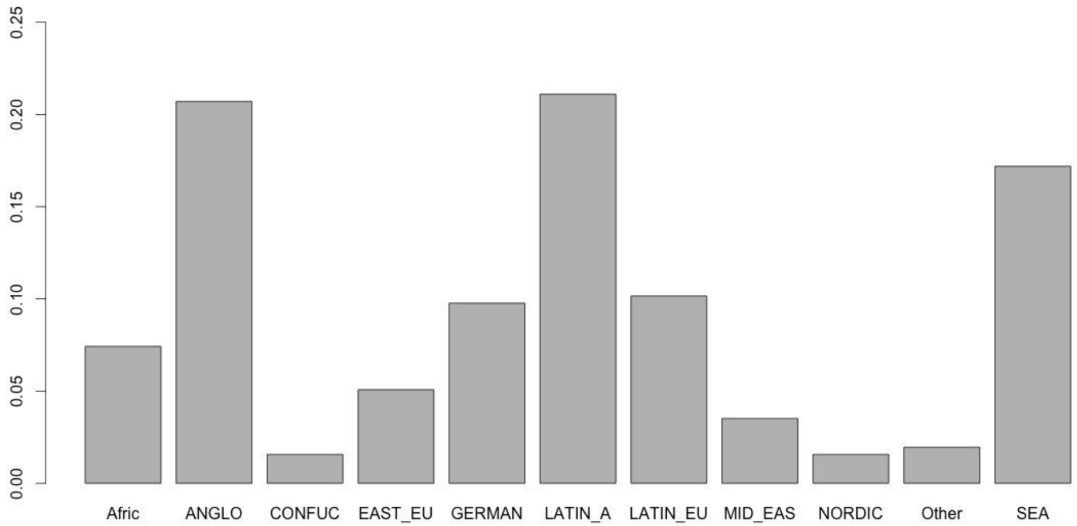

Culture of Registrants, %

E) Education Level of Registered Students

Edu Background of Registrants, %
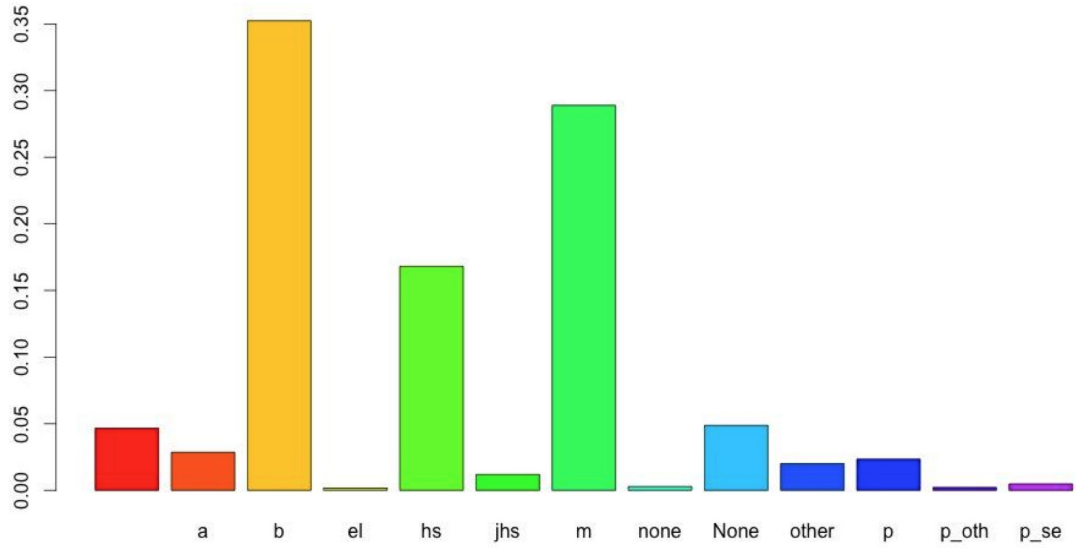
F) Education Level of Students Receiving Certificate of Completion

Culture of Completers, %

Appendix 2. Course Design and Weekly Workload

A) Weekly workload, as reported by 257 students who filled in the post-course survey

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