# A comparison of self-paced and instructor-paced online courses: The interactive effects of course delivery mode and student characteristics

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## **1. INTRODUCTION**

Massive open online courses (MOOCs) appeared in 2013. Since then, the number of courses has increased rapidly, and parallel to this, the course formats and modes of delivery keep developing as well. Lately, a growing number of MOOCs is offered in a self-paced (or a self-paced-approaching) format.

Self-paced formats can differ from one another, e.g. depending on the platform, institution, or even the course itself, which also presents a challenge to research this topic, as there is no one design of a self-paced course. However, usually such courses are offered (open) for a longer period, all materials and activities are available from the beginning, and there is only one due date at the end of the course. This means students can choose more flexibly when they want to study. For example, a certain student might complete the whole course in a couple of days of intensive studying, while another student might work through the course over several months. As such, MOOCs are approaching the characteristics of offerings of open educational resources (OERs), where one can find various materials, from video lectures, to readings, and exercises and exams available at all times. In contrasts to OERs, however, self-paced MOOCs are packaged within an idea of a classroom, albeit a less structured one, where students drop in and drop out at various times, but might still have a possibility of interaction with others, or even receive support from teachers or other staff members.

The self-paced mode of delivery can be attractive from several perspectives, e.g. from a student, teacher, or organizational perspective.

From a *student perspective*, the self-paced format offers increased flexibility, since students are only bound by one due date. This "promise of time" could be especially beneficial for students who have difficulty finding time for studying, for example busy professionals, or students without a computer at home. In a self-paced course they can take additional time to finish the course. Studies indeed show that students from less developed countries are usually less successful in MOOCs (e.g. Hennis, Topolovec, Poquet, & Vries, 2016; Kizilcec & Halawa, 2015; Kizilcec, Perez-Sanagustín, & Maldonado, 2017), and one possible explanation could be that they have fewer possibilities due to a poorer internet connection, or lack of resources at their disposal at all times. Additionally, the self-paced format can seem beneficial for students in general, because the main obstacle to completing courses is lack of time, or time-management difficulties, as reported in several studies (Bonk & Lee, 2017; Kizilcec & Halawa, 2015; Nawrot & Doucet, 2014; Yeomans & Reich, 2017).

From a *teacher perspective*, it may be easier to run a course once over a longer period in a self-paced format than multiple times in an instructor-paced format, especially if lower teacher involvement would be expected in such courses by design. Rhode (2009) indicated that students indeed understand that interactions in a self-paced course are challenging, even though they consider interactions one of the most important parts of their learning experience. This suggests that having less teacher support and involvement available in such courses might not be incompatible with students' expectations.

From an *organizational perspective*, self-paced courses might be beneficial in two ways. Firstly, they can lead to better financial outcomes, for example courses that are offered over a longer period can attract more students, and more of them might buy a certificate. Costs connected with every run can also be lower, depending on how the organization operates and finances activities related to a given course run. Additionally, they can support organizational efforts and ambitions to contribute to social good. Self-paced courses can be easily available constantly, rather than once or twice a year in a fixed interval. This means the availability of open education for students around the world can be increased, and can this can contribute to the ambition of opening up education even further.

However, self-paced courses may also come at a price. Online courses are already challenging for students, the majority of them not completing the courses (e.g. Henderikx, Kreijns, & Kalz, 2017; Hennis et al., 2016; Reich, 2014), even those who intend to (Blackmore, 2014; Henderikx et al., 2017; Kizilcec et al., 2017; Reich, 2014; Yeomans & Reich, 2017; Wilkowski, Deutsch, and Russell, 2014). Good self-regulatory skills are important for student success (Hood, Littlejohn, & Milligan, 2015; Kizilcec et al., 2017; Nawrot & Doucet, 2014), which could explain why students with higher educational background, and thus more previous learning experience, as well as older students in online courses generally perform better (e.g. Hennis et al., 2016; Kizilcec & Halawa, 2015; Kizilcec et al., 2017). Self-regulatory skills could be even more important in self-paced courses, since the learning experience is less directed from outside. Furthermore, low or almost nonexistent interaction that is often associated with self-paced courses, could be an important downside since studies show that students find interaction important (e.g. Kizilcec & Halawa, 2015;

Rhode, 2009). It is possible teachers could foster an interactive self-paced course despite asynchronous learning paths of students, however, it would likely require a lot of effort and staff commitment that the self-paced mode often tries to minimize.

Despite its growing prominence as the choice for delivery mode, surprisingly little research is devoted to exploring the self-paced format, its effectiveness, and its impact on learning outcomes.

Southard, Meddaugh, and France-Harris (2015) compared the self-paced and instructor-paced delivery mode of a specific course, and concluded that the selfpaced course can be equally, or even more effective than the instructor-paced course. However, their design of the self-paced course differed from the instructor-paced course in more than just the mode of delivery; in their study they already tried to offset the potential shortcomings of a self-paced course by adapting the course design, and by setting GPA requirements needed to enroll in the self-paced course. With that, rather than demonstrating whether the delivery mode can affect the outcomes, they showed that self-paced courses can be as effective as instructor-paced courses if certain design choices are made. However, steps such as setting a higher GPA requirement for students to enter the course is not the best approach to solving possible shortcomings of a self-paced mode if the aim is to serve everyone around the world, and even more so if the aim is to offer free education to those who have less access to it otherwise. In another study, Carey, Kleiman, Russell, Venable, and Louie (2008) found that both versions of the course (self-paced and facilitated cohort group) were rated highly, and both were effective in altering teacher's pedagogical beliefs and increasing their knowledge, which, together with their follow-up study (Russel, Kleiman, Carey, & Douglas, 2009), also indicates that a well-designed selfpaced course can be effective, despite having minimal interactions.

However, no research has focused on comparing these two course formats more directly. A well-designer course, whether a self-paced or an instructor-paced will likely have a positive impact on learning outcomes, however, do self-paced courses need different approaches to their design to facilitate the best experience and learning? Could characteristics of a self-paced course affect student motivation, enjoyment, satisfaction, or learning? Does flexibility and more time actually lead to better outcomes?

The present study aims to explore the effects of the delivery mode of online courses (self-paced compared to instructor-paced mode) on performance and completion. While there have been many studies focusing on prediction of student success, performance, or retention in the past, both using behavioral characteristics and student characteristics (e.g. Engle, Mankoff, & Cabrey, 2015; Gerlich, Mills, & Sollosy, 2009; Kennedy, Coffrin, & Barba, 2015; Lim, 2016), no such study yet has focused on the comparison of instructor-paced and self-paced delivery modes. This study

focuses on this comparison specifically, as well as on the interaction of the delivery mode with other characteristics that can influence student performance in a course, such as gender and age, previous experience, or learning preferences. With this, it aims to explore whether self-paced format indeed hampers student performance, as well as if the delivery mode has a different effect on different students. Such insights can support future decisions, for example which steps need to be taken, or which interventions should be deployed in self-paced courses, to support students most efficiently.

## 2. METHOD

### 2.1. Courses

This study uses data from 35 different courses (8 courses ran twice, for a total of 43 runs) offered by Delft University of Technology that ran in 2016 and 2017 on the edX platform. These courses were chosen because they had the same survey deployed, they had no other experiments running in them, and they did not have a possibility to receive an honor certificate (a certificate in the free track).

Courses differed in subject, course design, length, and delivery mode, for example. Altogether there were 14 runs in self-paced mode. Of these, one course ran as selfpaced twice, and 5 of courses also ran in the instructor-paced mode once during the included period. There were 29 instructor-paced runs of courses, of these, one course ran in the instructor-paced mode twice.

### 2.2. Participants

In total, 12 739 participants were included in the analysis (7 923 from instructorpaced courses, 4 751 from self-paced courses). Students were included based on the following criteria: (i) they indicated they intended to complete the course in the presurvey; and (ii) they enrolled before the start date in instructor-paced courses, or 90 days or more before the end date in self-paced courses). While students might still be able to pass the course even if they enroll late, the extent of this possibility greatly depends on course design itself, like the length of the course, the number and weight of graded assignments, and how due dates are set up. Therefore, a uniform cut-off of enrolment before the start was used in instructor-paced courses. Self-paced courses also differ greatly in terms of their open period, and the number of modules they contain, but students can still enroll after the course opens and have all the chance to pass the course, and enjoy the benefits of the self-paced format. Since one of the promises of the self-paced mode is flexibility, which allows students to work around their schedules and other responsibilities better, the cut-off of three months before the course ends was used. This ensures that students have more time available to complete the course than they would otherwise have in a regular, instructor-paced course of certain length.

A detailed list of all courses and related participant numbers included in the study is available in Appendix A.

## 2.3. Data

Pre-survey was deployed at the beginning (i.e. In the first/ introductory module) of all courses. The survey is standard and contains questions about students motivation, experience, and demographics. For the purpose of this study, the following variables were used:

- *gender:* male or female; due to low numbers, the "other" category was excluded from the analysis;
- *age*: self-reported age 16 years or more, and up to and including 80 years;
- *experience*: whether students indicated they had completed at least one online course before or not;
- *education*: coded as "higher" if the level was bachelor level or higher, and coded as "lower" otherwise;
- *English*: level of English proficiency, self-rated on a 5-point scale from poor to very good;
- *relevance*: to what extent students agreed they enrolled in the course for their work/ career, self-rated on a 5-point scale from strongly disagree to strongly agree;
- *pace preference*: the self-rated preference for following the course at set pace as opposed to their own pace, rated on a 5-point bipolar scale;
- *available hours*: how many hours students rated they had available on average per week, from 0 to 20 hours (integer);
- *Human development index (HDI)*: HDI was determined based on the country that was recognized automatically by the survey tool. The HDI values are based on data obtained from "Human Development Reports" (n.d.).

Additionally, the following data were used in the analysis from the data file available from edX:

- pass: indicates whether students passed the course or not, and were therefore eligible for a certificate;
- track: whether students were enrolled in the free track (audit) or paid for a certificate (verified). This information does not differentiate between students who already paid at the beginning of the course, or later during the course. Every students who was enrolled in a verified track at the end of the course is considered "verified".

### 2.4. Analysis

During the process of data preparation, the duplicated responses for students were dealt with in the following manner, and in this order:

- (i) within the same course: All complete responses on aforementioned survey variables were sorted by date, and the first response was kept in the analysis;
- (ii) between different courses: one random response (from a random course) for each participant was kept in the analysis.

For the aim of this study, a logistic regression was performed with "pass" as the outcome, and other survey and platform variables as predictors, including the course delivery mode (self-paced or instructor-paced). Interaction terms of all these predictors with the delivery were included in the model as well, and courses were included as fixed effects. Other exploration of data was conducted to shed additional light on results, and support interpretation.

## 3. RESULTS & DISCUSSION

This study aimed to research the effects of the course delivery mode and its interactive effects with different student characteristics and ratings. Experience shows that self-paced courses record lower completion numbers, and this can be observed in this sample as well: 11.60% students passed the course in the self-paced courses, and 20.02% in instructor-paced courses. The average passing rates per course were similar, 12.46% and 20.02% respectively. In fact, a logistic regression that fits the delivery mode as the only predictor indicates the mode is a statistically significant predictor of whether a student will pass a course or not (p<0.001).

To explore the effect of the self-paced mode on course completion, particularly in interaction with different characteristics, a logistic regression model that was performed included several other variables as main effects, as well as their interaction with the delivery mode. Since courses can differ very much in terms of length, design, difficulty levels, etc., courses were included in the model as fixed effects. The results are presented in *Table 1*, and are in general similar to previously identified factors related to student success in MOOCs, such as a higher HDI, age, previous experience, or higher education (e.g. Hennis et al., 2016; Kizilcec & Halawa, 2015; Kizilcec et al., 2017).

Furthermore, the self-paced mode has an interactive effect on student success in combination with certain characteristics. The interactive effects between the two variables of interest are presented in *Figure 1*.

#### Table 1

Results of the logistic regression with the outcome whether students passed the course or not.

	estimate	SE	z-value	р
track (verified)	3.51	0.10	35.56	< 0.001
experience (yes)	0.50	0.09	5.38	< 0.001
age_centered	0.02	0.003	4.66	< 0.001
pace preference	0.11	0.03	3.58	< 0.001
HDI_centered	1.22	0.35	3.46	< 0.001
available hours_centered	0.03	0.01	2.94	0.003
education (higher)	0.29	0.10	2.81	0.005
mode (SP) : pace preference	-0.13	0.05	-2.66	0.008
mode (SP) : track (verified)	-0.37	0.15	-2.49	0.013
mode (SP) : age_centered	-0.02	0.01	-2.42	0.015
mode (SP) : hours_centered	0.03	0.02	1.90	0.057
mode (SP) : English	-0.08	0.08	-1.01	0.313
mode (SP) : HDI_centered	0.56	0.57	0.98	0.326
relevance	0.03	0.04	0.97	0.332
gender (female)	-0.08	0.08	-0.92	0.358
mode (SP) : relevance	-0.05	0.06	-0.75	0.451
mode (SP) : gender (female)	0.09	0.14	0.64	0.520
mode (SP) : education (higher)	-0.03	0.16	-0.21	0.831
mode (SP) : experience (yes)	0.01	0.14	0.05	0.959
English	0.002	0.04	0.04	0.972
mode (SP)	0.005	0.25	0.02	0.985
Intercept	-3.754	0.26	-14.64	< 0.001
Fixed course effects <sup>a</sup>				

*Notes.* Centered variables were centered around the mean. Other continuous variables (5-point scales) were centered around the middle option.<sup>a</sup> Course effects are available in Appendix B.

The relationship between course success and preference for the course mode is reversed for self-paced and instructor-paced courses (*Figure 1a*): while students with a higher preference for self-directed pace perform slightly better in self-paced courses, the opposite is true for instructor-paced courses. This finding is not unexpected, but it not necessarily relevant as something that can support course design: courses are usually offered either in one mode or the other at one time, which means students do not have the option to choose a course based on their preference. However, if the course was offered in both modes at the same time, and students could choose, this could lead to better learning and completion outcomes. Another possibility would be to make it possible to bring the self-paced mode of a course closer to student preferences for a set pace with technical solutions, e.g. if the platform would allow students to set their own due dates, which they would then need to respect.



*Figure 1. (a)* The relationship between self-rated pacing preference and passing rates between two course pacing modes. *(b)* Differences in success rates of audit and verified students in two course pacing modes. *(c)* The relationship between age and passing rates between two course pacing modes.

When it comes to the enrolment track of students (*Figure 1b*), a larger difference in performance is observed for verified students in the self-paced compared to instructor-paced courses, than for audit students. To put it another way: even though students in the verified track more likely complete the course in general, students benefit slightly less from a paid track in self-paced courses. This study did not take into account at what point in time students upgraded to the verified track. Students who did so already in the beginning might have been more motivated than students who only paid after they passed the course. However, it is possible that even the latter students could see buying a certificate as a possibility *if* they pass the course even before they actually upgrade, which could also motivate them to continue. It must be noted, however, that the audit students in the instructor-paced courses already have very low passing rates, which means that the passing rates can decrease much less than in the verified track.

Furthermore, older students have less of an advantage over younger students in selfpaced courses (*Figure 1c*), which means they are more affected by the self-paced mode. This is an interesting finding, because we could expect younger students to be less experienced in self-regulation and self-directed learning, which are important aspects for success in online courses (Hood et al., 2015; Kizilcec et al., 2017; Nawrot & Doucet, 2014), and possibly even more in self-paced courses. However, similarly as with the enrolment track, the youngest students already have very low passing rates in instructor-paced courses, which means that their performance in self-paced courses cannot decrease as much as among older students. These results suggest that the self-paced mode could have a moderating effect on student success through other characteristics and aspects, however, it might not affect all students equally. What does it mean in relation to general lower passing rates of students in self-paced courses? There are two possible explanations, which can also be intertwined.

Firstly, the course design might not support students in the best way in self-paced courses, and one group could be more affected. However, the effects of the majority of factors do not interact with the delivery mode of the course, which means that they are similar in both modes. Furthermore, age interacts with the mode in an unexpected direction, for example, which makes the interpretation based on self-regulatory skills, and its translation into strategies for course design, more difficult. As indicated previously, students with a higher preference for a set pace could be supported, however not as much within the self-paced format itself, since the nature of the self-paced course is precisely that – that it is *self*-paced. Therefore, based on these results alone, it is difficult to understand what, if anything, could be done to address this with the course design and student support activities.

Secondly, it is likely that the audience in self-paced courses is different than in instructor-paced courses, which contributes to overall lower passing rates in self-paced courses. Indeed, a look at the variables included in the model shows several differences between the self-paced and the instructor-paced mode. In self-paced courses there are less students in a verified track (9.34% vs. 13.36%), with previous experience with completing an online course (64.88% vs. 69.16%), students are younger (30.94 vs. 33.56% years old), and slightly less educated (74.07% vs. 80.42% with "higher" education), which are all factors connected with lower success in MOOCs in general. Therefore, it seems that there can be slightly more students in the self-paced courses with less favorable characteristics for course success, which can contribute to overall lower completion rates.

However, it must be noted that the general differences in characteristics could also be accentuated by the courses included in this study, especially in the self-paced track, where only 13 different courses were included. For example, in the self-paced group of courses there is a course with many participants, and a very young audience on average. On the other hand, there is a course in the instructor-paced group with a much older audience on average than other courses, though the effect in this case is smaller. Additionally, even if we expect that the difference in audience does exist because of observed differences in passing rates, it is difficult to interpret. For example, it is not easy to understand why self-paced courses would attract a slightly younger audience. Additional research should be conducted, for example exploring why students of different ages find the self-paced mode attractive.

This study also has some limitations. First of all, while a relatively high number of courses was included in the analysis, the numbers are still rather limited and can bias the results if we consider vast differences between courses in terms of their subject, difficulty, design, etc., especially within the smaller pool of self-paced courses. Furthermore, a couple of variables on a 5-point Likert scale were included, and considered as continuous variables, working under the assumption that distances between options are equal, which might not hold true. Additionally, this study aimed to explore factors of students success within a group of students who indicated they wanted to complete the course. It can be argued that "completion" can be interpreted differently by different students. For example, someone might interpret this as passing the course, someone else as participating in the course until the end, and the third student as participating in all graded assignments. This means that the passing rate might not necessary be the best measure for all students who indicate they want to "complete" the course.

### **4. CONCLUSIONS**

The present study suggests that the relationship between the course mode (selfpaced or instructor-paced) and the success in course is more complex than simply saying the self-paced mode is related to lower completion rates. While factors of success are similar in both modes, particular groups of students might be (more) affected by the self-paced mode. Furthermore, self-paced courses might be more populated by students with characteristics that are in general connected to lower success rates, although it is not necessarily easy to understand why, and especially, how this can be translated to adaptations in course design or preparation of interventions that could address this specifically. More research is needed into selfpaced delivery mode of courses, how it interacts with other aspects, and how course design and platform solutions can best support students in self-paced courses.

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## Appendix A: Courses, their delivery mode, and numbers of participants

Table 2

Courses, their delivery mode, and numbers of participants

	mode	Ν
AE1110x-3T2016	self-paced	657
BMI.1x-3T2016	instructor-paced	128
BMI.2x-1T2017	instructor-paced	105
BMI.3x-1T2017	instructor-paced	33
BMI.4x-2T2017	instructor-paced	19
BwN101x-1T2017	instructor-paced	212
CircularX-1T2016	self-paced	491
CircularX-3T2016	instructor-paced	77
CTB3300WCx-3T2016	instructor-paced	268
CTB3365DWx-1T2017	instructor-paced	89
CTB3365DWx-3T2016	self-paced	151
CTB3365STx-1T2017	instructor-paced	116
CTB3365STx-3T2016	self-paced	167
DDA691x-3T2016	self-paced	478
DDA691x-4T2016	instructor-paced	102
DPB001x-2T2017	self-paced	49
DPB001x-3T2016	instructor-paced	259
EIT001x-3T2016	instructor-paced	93
EnergyX-2T2016	instructor-paced	602
EX102-1T2016	instructor-paced	829
EX102-2T2016	self-paced	332
EX103x-2T2016	instructor-paced	385
Frame101x-2T2017	self-paced	99
GEO101x-1T2016	instructor-paced	570
LfE101x-3T2016	self-paced	1189
MathMod1x-2T2017	instructor-paced	193
MED01x-1T2017	instructor-paced	211
MEP101x-3T2016	instructor-paced	534
NGIx-3T2016	self-paced	189
NUCLEAR01x-3T2016	instructor-paced	237
OG101x-2T2017	instructor-paced	84
OT.1x-3T2016	instructor-paced	99
RCUC101x-1T2017	instructor-paced	709
Spatial101x-2T2017	instructor-paced	150
TBP01x-3T2016	instructor-paced	310
TP101x-1T2017	self-paced	193
TP102x-3T2016	instructor-paced	25
TPM1x-2T2016	self-paced	1045
TW3421x-1T2016	self-paced	367
TW3421x-3T2016	self-paced	319
UrbanismX-1T2017	instructor-paced	256
Visual101x-1T2016	instructor-paced	253
Visual101x-2T2016	instructor-paced	65
Total		12739
instructor-paced		7923
self-paced		4751

## Appendix B: Course effects

Table 3

Course effects from the logistic regression presented in Table 1

	estimate	SE	z-value	р
BMI.1x	1.18	0.34	3.46	0.001
BMI.2x	0.71	0.40	1.80	0.073
BMI.3x	1.31	0.53	2.49	0.013
BMI.4x	1.89	0.63	3.02	0.003
BwN101x	1.48	0.29	5.03	< 0.001
CircularX	1.00	0.22	4.53	< 0.001
CTB3300WCx	0.24	0.33	0.72	0.471
CTB3365DWx	-0.12	0.31	-0.39	0.700
CTB3365STx	0.55	0.27	2.01	0.045
DDA691x	-0.26	0.26	-1.00	0.318
DPB001x	0.72	0.28	2.55	0.011
EIT001x	3.32	0.32	10.38	< 0.001
EnergyX	0.75	0.26	2.89	0.004
EX102	1.73	0.22	7.94	< 0.001
EX103x	1.00	0.27	3.71	< 0.001
Frame101x	0.63	0.42	1.49	0.136
GEO101x	1,67	0.25	6.72	< 0.001
LfE101x	0.78	0.20	3.81	< 0.001
MathMod1x	-1.96	0.76	-2.58	0.010
MED01x	0.36	0.32	1.14	0.256
MEP101x	-0.15	0.28	-0.53	0.597
NGIx	1.44	0.27	5.39	< 0.001
NUCLEAR01x	0.95	0.31	3.10	0.002
OG101x	0.63	0.42	1.49	0.137
OT.1x	1.16	0.37	3.14	0.002
RCUC101x	1.29	0.25	5.17	< 0.001
Spatial101x	-0.30	0.43	-0.70	0.487
TBP01x	0.50	0.30	1.67	0.094
TP101x	-0.28	0.40	-0.71	0.479
TP102x	0.36	0.76	0.48	0.632
TPM1x	0.16	0.22	0.73	0.464
TW3421x	0.61	0.22	2.71	0.007
UrbanismX	0.60	0.30	1.97	0.049
Visual101x	0.29	0.31	0.92	0.358

*Note.* The course AE1110x was used as a base group.