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Can demographic information predict MOOC learner outcomes?

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Abstract: There has been much written about the disruptive nature of Massive Open Online Courses on Higher Education, and online learning over the last two years. During that time, universities have been delivering online courses to many thousands of participants from around the world. Studies are beginning to use the data gathered from participants before, during and after courses to understand and evaluate these online learning courses. Generally, to date studies have focussed on the drop-out rate of learners from courses. This study uses pre-course survey data and online learner behaviour data gathered from five MOOCs delivered by the University of Leeds in 2014 to understand which learner characteristics might impact on completion. The results show that four characteristics are significantly associated with degree of completion. However, further examination of the data reveals anomalies and suggests that the MOOC population is much more complex than the headline data implies.

Introduction

Massive Open Online Courses (MOOCs) have caused unprecedented debate within the academic community over the last 3 years, with some commentators speculating that they will result in a revolution in Higher Education (Agrawal, 2013). Since the advent of the modern form of MOOCs in Canada in 2008, their popularity with online learners globally has risen rapidly. The first MOOCs were cMOOCs or connectivist MOOCs, which encouraged networks of learners to connect and create learning communities using a variety of web tools. In 2012, the creation of the Coursera and Udacity platforms heralded the first xMOOCs, which are more didactic in nature, providing courses with video lectures, discussion and quizzes to many thousands of online participants. In 2013, the Open University launched FutureLearn in the UK. By January 2014, these main xMOOC providers, along with the edX platform, had offered almost 700 xMOOCS and enrolled more than 8 million users worldwide (Perna et al., 2014). The FutureLearn platform has over 800,000 registered participants and partnerships with over 35 universities and other organisations from the UK and countries around the world. FutureLearn has a social constructivist pedagogy underpinning its design, and is labelled as a social learning platform, by virtue of its 'water-cooler' style discussion areas provided alongside learning content (Ferguson & Sharples, 2014).

MOOC learners are an extremely heterogeneous group, consisting of male and females learners of all ages from across the world, with a wide range of prior educational attainment, prior online experience, employment status and motivations. However, focus has been drawn to the relatively high proportion of male 26-35 year old professionals with a bachelor's degree taking online courses on the large xMOOC platforms (Ho et al., 2014), even though this group normally only represents around a quarter to half of the learner cohort. Interestingly, FutureLearn has more women registered than men: around 58% are women. However, over 70% of people registered on the platform already have a degree or higher and over 50% are working. FutureLearn users are from a wide age range: the largest group (23%) are aged between 26 and 35, but around 13% are over the age of 55 (Press Association, 2014). Other platforms have similar learner profiles (Breslow et al., 2013; Palin, 2014; Perna et al., 2014), and whilst there are emerging patterns about 'typical' MOOC learners, there are platform differences. As yet there is not a shared understanding of the most appropriate definition of a MOOC student (Perna et al., 2014).

A continual criticism of MOOCs has been their low completion rate, with reported rates of between 5% and 12% (Jordan, 2014; Perna et al., 2014) However, as discussed by a number of commentators, completion rates in MOOCs are not necessarily an indicator of educational success, as participants may achieve their learning goal through engaging in only a proportion of the course (Liyanagunawardena et al., 2014; Reich & Ho, 2014). Despite a lack of agreement as to what constitutes success, there is a growing body of literature that has analysed the characteristics of learners on MOOCs and how these characteristics are related to success in terms of completion. Kizilcec et al. (2013) examined MOOC completion rates, and categorised 'completion' into four classifications of engagement trajectories ('auditing', 'completing', 'disengaging' and 'sampling'), to gain insight into those learners who may have varying motivations for enrolling on a MOOC and therefore may 'drop out' after what they feel is a satisfactory point.

There have been very few empirical studies of the relationships between MOOC learners' demographics and completion rates. Guo and Reinecke (2014), in their study of four edX MOOCs with data from 140,546 students, found that age was positively correlated with the volume of coverage, which in turn was positively correlated with grade. However, Breslow et al. (2013) found no correlation between age and 'success', where 'success' was defined as achievement in terms of the grade awarded rather than completion. Guo and Reinecke (2014) also found that learners from countries with lower student-teacher ratios

(e.g. the US and European countries) covered more content and gained higher grades. Cisel (2014) found when examining data from the first French MOOC, that geographical location was associated with achievement. Also, learners from countries with a high HDI (Human Development Index) had higher achievement (Cisel, 2014), something which Kizilcec et al. (2013) also found for levels of engagement. Cisel (2014) also found that employment status had an impact on achievement: unemployed learners achieved higher grades than students in work. However, Cisel found no association between gender and achievement, nor did Breslow et al. (2013). Although much has been written about learners on MOOCs having a high level of prior educational attainment (Breslow et al. 2013; Palin, 2014), Breslow et al. (2013) only found a marginal association between highest degree earned and achievement.

Method

The aim of this study is to explore MOOC participants' patterns of engagement on five MOOCs delivered by the University of Leeds on the FutureLearn platform. The five courses were: Physical actor training (Actor); Anatomy: Exploring the abdomen (Anatomy); When Worlds Collide (WWC); Innovation: the key to business success (Innovation); and Starting a business (Enterprise). Participants' online learning activity was combined with their responses from a pre-course survey to explore relationships between completion and demographic factors, including age, gender, prior online learning experience, educational attainment, country of residence and employment status. The study attempts to answer the research question 'Do MOOC learners who complete courses to differing degrees share any similarities in terms of demographic profile?'

Building on the work of Kizilcec et al. (2013) we have categorised learners into four groups according to classifications adopted by FutureLearn to identify learners' level of engagement:

1. Learners who only engaged in the first week of the course, termed 'Week 1 only';
2. Learners who complete the first week, and return to the second week but do not complete the course, termed 'Returning learners';
3. 'Completers' - those who complete at least 50% of the steps and all of the assessments (required by FutureLearn to be eligible for a certificate);
4. '100% engaged' - those who complete all the steps and assessments.

Data collection

Data for this study was collected by FutureLearn and supplied to the University of Leeds. FutureLearn users are advised that data collected on the platform may be used for research purposes, and this study was conducted in accordance with the FutureLearn Code of Practice for Research Ethics. Two data sources have been used in this study: (1) responses from a pre-course survey sent to all enrolled learners prior to the start of all courses, and (2) online learner activity populated by participants visiting course 'steps' and completing course activities. FutureLearn uses the term 'step' to define the chunks of content within each course. A step can be a video, a discussion, some textbook style content etc. Data from each source has been linked using a unique code for each participant (where available) for analysis in this study. All data is completely anonymous and individuals can not be identified by the University of Leeds. The results provided in this study offer a preliminary analysis of this large and complex data set.

Data Analysis

The data provided by FutureLearn is categorical and therefore all analyses in this paper employed non-parametric methods. The chi-square test was applied to assess whether differences in the distribution of learners across groups are statistically significant at the $p<.05$ level. This was performed for all independent variables across all five courses combined and at an individual course level. For some courses, the expected group sizes did not meet the minimum required to meet the assumptions of the chi-square test, therefore, where possible Fisher's exact test was run instead, with the categories of 'week 1 only' and 'returning learners' collapsed into 'non-completer' and the categories of 'completers' and '100% engaged' collapsed into 'completer'. Age data was collected in the form of age group. Therefore it is not possible to calculate means; rather, estimated median ages have been calculated for each learner group. The median split test has been used to gauge whether the groups differ significantly by age.

Results

Enrolments on the five courses totalled 27,859 FutureLearn users, which includes learners, educators, administrators and moderators. Many enrollers did not engage meaningfully with their course. For the purposes of analysis we have excluded any learner who enrolled but did not complete at least two steps of the course. 16,365 users enrolled on the five courses and completed at least two steps. Table 1 shows how these users are split across course and by completion group.

Our aim in this study is to compare degree of completion by various demographic variables. Therefore, for analysis purposes we are including only those learners who completed some or all of the pre-course survey (We are assuming that no educators, administrators or moderators completed the pre-course survey and thus define those who did as 'learners'.) 2,338, or 14.3% of engaged enrollers completed the survey. Table 1 shows the number of learners categorised into the four groups according to degree of completion of their course. The largest group of learners is on the Enterprise course, followed by Innovation, and the smallest number is on When World Collide. In terms of completion, overall and for each course, except When Worlds Collide, the largest group is those who did not complete the first week. For each course and overall, the smallest group is 'completers'.

Table 1: Course statistics, overall and by course, and by completion group

	Overall	Actor	Anatomy	WWC	Innovation	Enterprise
Participants[2] (enrolled[1])	16365 (27859)	1172 (3467)	3784 (8590)	1087 (3514)	5179 (14958)	5002 (12901)
Course duration		3 weeks	3 weeks	2 weeks	3 weeks	2 weeks
Learners who completed pre-course survey[3]	2338	131	496	113	752	846
Week 1 only (% of course)	1035 (44.27%)	54 (41.22%)	210 (42.34%)	28 (24.78%)	318 (42.29%)	425 (50.24%)
Returning learners (% of course)	639 (27.33%)	44 (33.59%)	145 (29.23%)	31 (27.43%)	251 (33.38%)	168 (19.86%)
Completers (% of course)	132 (5.65%)	13 (9.92%)	51 (10.28%)	22 (19.47%)	17 (2.26%)	29 (3.43%)
100% engaged (% of course)	532 (22.75%)	20 (15.27%)	90 (18.15%)	32 (28.32%)	166 (22.07%)	224 (26.48%)

1. Enrolled – those who enrolled
2. Participants – those who enrolled and completed at least two steps
3. Learners – subset of participants who completed the pre-course survey

Table 2 provides details of the characteristics of the data sample, overall and by course. The median age of the sample is 36.17 years old (n=2338) and contains more females (59.83%, n=1397)) than males (40.17%, n=938). Average age is fairly consistent across courses. The Actor and Anatomy courses have a strong female bias with over 70% female enrollers, the When Worlds Collide and Enterprise courses also have a female bias but not so strong. Only Innovation has more males (50.13%, n=377). Overall, less than half, 42.7%, (n=986) of learners had taken a course mostly or fully online before. The Innovation course learners were the least experienced with just 34.47% (n=253) having this type of experience. Across the courses, the majority (55.89%, n=1305) of learners were UK-based, which leaves a substantial minority of 44.11% (1030) who were not. The next largest group came from the US (3.4%, n=80) followed by India (2.9%, n=68). The geographical location of learners varied quite widely across courses, from 76.62% (n=379) of learners on the Anatomy course being UK-based to just 38.91% (n=293) of the Innovation learners. Overall, these learners are most likely to be educated to degree level, with a large majority (75.08%, n=1747) educated to degree level or above. The most highly educated course is When Worlds Collide with 83.19% (n=94) of learners having a degree or higher. The least educated are the learners on the Anatomy course, with 63.82% (n=314) of learners having at least a degree, although this still means almost two-thirds of learners on this course are already educated to degree level. Overall, the majority of learners were working, and within that category most were working full time.

Table 2: Characteristics of learners in sample, overall and by course

% of overall and for each course (n)		Overall		Actor		Anatomy		WWC		Innovation		Enterprise	
Median age (years)		36.17 (2338)		39.37 (131)		40.07 (496)		38.50 (113)		34.34 (752)		36.06 (846)	
Gender		M	F	M	F	M	F	M	F	M	F	M	F
		40.17 (938)	59.83 (1397)	28.03 (37)	71.97 (95)	27.88 (138)	72.12 (357)	37.17 (42)	62.83 (71)	50.13 (377)	49.87 (375)	40.81 (344)	59.19 (499)
Online experience[1]		Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
		42.70 (986)	57.30 (1323)	51.52 (68)	48.48 (64)	45.40 (222)	54.60 (267)	52.63 (60)	47.37 (54)	34.47 (253)	65.53 (481)	45.60 (383)	54.40 (457)
Country of origin		UK	Non-UK	UK	Non-UK	UK	Non-UK	UK	Non-UK	UK	Non-UK	UK	Non-UK
		55.89 (1305)	44.11 (1030)	46.21 (61)	53.79 (71)	76.72 (379)	23.28 (115)	65.49 (74)	34.51 (39)	38.91 (293)	61.09 (460)	59.07 (498)	40.93 (345)
Prior educational attainment	Less than secondary	1.68 (39)		5.30 (7)		2.24 (11)		0.88 (1)		0.93 (7)		1.55 (13)	
	Secondary	23.25 (541)		15.15 (20)		33.94 (167)		15.93 (18)		19.47 (146)		22.62 (190)	
	Degree	47.83 (1113)		49.24 (65)		41.46 (204)		49.56 (56)		48.67 (365)		50.36 (423)	
	Masters	23.98 (558)		27.27 (36)		18.29 (90)		28.32 (32)		27.73 (208)		22.86 (192)	
	Doctorate	3.27 (76)		3.03 (4)		4.07 (20)		5.31 (6)		3.20 (24)		2.62 (22)	
	Degree and above	75.08 (1747)		79.54 (105)		63.82 (314)		83.19 (94)		79.60 (597)		75.83 (637)	
Empt Status	Not working	20.77 (475)		25.00 (24)		23.89 (118)		30.09 (34)		13.34 (99)		23.75 (200)	
	Education	14.12 (323)		12.50 (12)		23.48 (116)		15.93 (18)		11.19 (83)		11.16 (94)	
	Working (ft/pt)[2]	65.11 (1489) **(72.80/27.20)**		62.50 (60) **(70.00/30.00)**		52.63 (260) **(58.85/41.15)**		53.98 (61) **(75.41/24.59)**		75.47 (560) **(82.68/17.32)**		65.08 (548) **(69.34/30.66)**	

1. Online experience – the sample is split into those who have taken a course fully or mostly online (Y) before and those who have not (N)
2. Learners who are working are also split into those who are in full-time employment and those in part-time employment (%)

To what extent are these demographic characteristics associated with degree of completion? Table 3 provides details of the characteristics of the data sample, overall and by completion group. 'Completers' has the highest median age at 42.79 years (n=132), whereas those who drop out in the first week are the youngest group with a median age of 34.3 years (n=1035). The gender composition of completion groups is fairly similar and all groups have more females than males, although '100% engaged' has the smallest proportion of females (57.49%, n=307). Those who drop out in the first week have the least prior online experience with 39.37%, (n=402) whilst 'completers' has the most experience with 48.84% (n=63) having studied online before. All

groups have more UK-based learners than non-UK; 'completers' has the largest proportion of UK-based with 65.65% (n=86), whilst 'returning learners' has the least with 53.36% (n=341). For all groups the majority of learners are educated to degree level or above. '100% engaged' has the highest proportion of learners with a degree or above (76.88%, n=409), with 'returning learners' having almost the same proportion (76.81%, n=487) and those who drop out in the first week have the lowest proportion with 73.01% (n=752), but these proportions are very similar across all four groups.

Table 3: Characteristics of learners in sample, overall and by completion group

% of overall and for each completion group (n)										
		All learners		week 1 only		returning learner		completer		100% engaged
Median age (years)		36.17 (2338)		34.30 (1035)		36.54 (639)		42.79 (132)		38.49 (532)
Gender		M	F	M	F	M	F	M	F	M	F
		40.17 (938)	59.83 (1397)	39.96 (412)	60.04 (619)	39.03 (249)	60.97 (389)	37.88 (50)	62.12 (82)	42.51 (227)	57.49 (307)
Online Experience[1]		Y	N	Y	N	Y	N	Y	N	Y	N
		42.70 (986)	57.30 (1323)	39.37 (402)	60.63 (619)	42.95 (271)	57.05 (360)	48.84 (63)	51.16 (66)	47.35 (250)	52.65 (278)
Country of origin		UK	Non-UK	UK	Non-UK	UK	Non-UK	UK	Non-UK	UK	Non-UK
		55.89 (1305)	44.11 (1030)	55.87 (576)	44.13 (455)	53.36 (341)	46.64 (298)	65.65 (86)	34.35 (45)	56.55 (302)	43.45 (232)
Prior educational attainment	Less than secondary	1.68 (39)		1.07 (11)		2.05 (13)		3.82 (5)		1.88 (10)	
	Secondary	23.25 (541)		25.92 (267)		21.14 (134)		20.61 (27)		21.24 (113)	
	Degree	47.83 (1113)		47.57 (490)		50.16 (318)		40.46 (53)		47.37 (252)	
	Masters	23.98 (558)		22.72 (234)		23.66 (150)		28.24 (37)		25.75 (137)	
	Doctorate	3.27 (76)		2.72 (28)		3.00 (19)		6.87 (9)		3.76 (20)	
	Degree and above	75.08 (1747)		73.01 (752)		76.81 (487)		75.57 (99)		76.88 (409)	
Empt status	Not working	20.77 (475)		17.46 (176)		22.93 (144)		20.63 (26)		24.57 (129)	
	Education	14.12 (323)		15.48 (156)		12.10 (76)		16.67 (21)		13.33 (70)	
	Working (ft/pt)[2]	65.11 (1489) **(72.80/27.20)**		67.06 (676) **(73.37/26.63)**		64.97 (408) **(75.00/25.00)**		62.70 (79) **(65.82/34.18)**		62.10 (326) **(70.55/29.45)**	

1. Online experience – the sample is split into those who have taken a course fully or mostly online (Y) before and those who have not (N)
2. Learners who are working are also split into those who are in full-time employment and those in part-time employment

Which of these demographic characteristics has a significant effect on degree of completion and can we discern whether those who complete more of their course share any similarities in terms of demographic profile?

We carried out chi-square analyses to test the extent to which these characteristics are significantly associated with degree of completion. There is very strong evidence of an association between age and degree of completion (chi-square = 59.7, df=18, p<0.001), with older learners completing more of their course (see Figure 1).
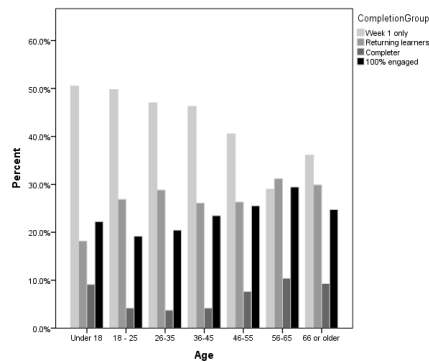

Figure 1. Completion group by age (%)

We have examined gender for the whole sample, both at the level of the four completion groups and with collapsed groups of 'completer' and 'non-completer' and have not found any evidence to suggest that gender has an effect on the degree of completion, although there are some differences by course, which for the whole sample cancel each other out. This suggests that gender differences may well be a function of the content and /or the design of the course and this area merits further research.

There is strong evidence of an association between prior online experience and degree of completion of the course (chi-square =11.28, df=3, p=0.010) (see Figure 2).
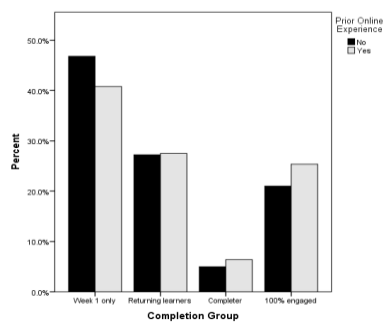

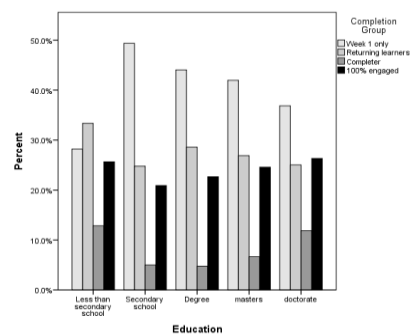Figure 2. Completion group by prior online experience (%)

Figure 3. Completion group by educational attainment (%)

Does prior educational attainment impact on degree of completion?. The association is significant (chi-square = 9.83, df=4, p=0.043), and for most groups it appears that the higher the prior educational attainment the more likely the learner is to complete (see figure 3).However, contrary to expectation given this trend, those who have less than secondary education have the highest completion rate at 38.5% (n=15).
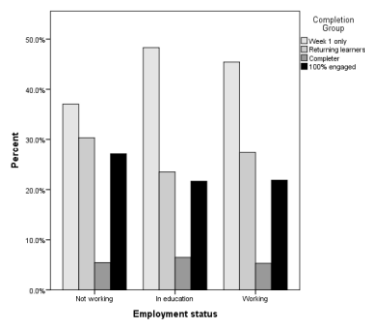

Figure 4. Completion group by employment status (%)

There is also strong evidence of an association between employment status and degree of completion of the course (chi-square =15.75, df=6, p=0.015), with those not working being more likely to complete more of their course (see Figure 4).

Discussion

The analyses above have shown that four of the variables investigated have a significant association with degree of completion; namely age, prior online learning experience, prior educational attainment and employment status. Some of our findings concur with previous studies. The relationship of age with completion is similar to the findings of Guo and Reinecke (2014), although Breslow et al., (2013) found no such relationship. Knox suggests that MOOCs may be overwhelming and that they 'can disorientate learners who may be expecting the orderly setting of the classroom or lecture hall' (Knox, 2014, p.170). It is not surprising therefore that we found that learners with experience of participation in an online course previously complete more of their course. Although no prior qualifications are required for access to any of these MOOCs, over three-quarters of learners on these MOOCs have a degree or higher, with this rate reaching as high as 83.19% for When Worlds Collide. Our analysis has found that the higher the prior educational attainment the greater the completion. Those who have been through education successfully are used to 'finishing' things or at least completing the requirements for a qualification. Breslow et al. (2013) also looked at this variable, but only found a marginal association. We have also found, in common with Cisel (2014) that those learners not working are more likely to complete more of their course. This is not too surprising as this group of learners probably have more free time. We did not find overall statistical significance for gender, which aligns with the findings from Breslow et al. (2013) and Cisel (2014). However, when we looked at gender at course level we did find it was significant for two courses, although be aware that the groups are small (n = between 5 and 29) and any findings should be treated with caution. Is it related to the content, the design, the length, the number of steps, the types of steps, or something else entirely?

However, when these results are examined more closely there are anomalies within our findings. When we found that age and completion were strongly associated, and that those who were not working were more likely to complete more than those working or in education, it was thought that this may be accounted for by a group of retired learners who have more time than most learners completing all, or most of, the course they enrolled on. However, despite the trend for older learners to complete more, the oldest group, aged 66+ are slightly less likely to complete than the 56-65 age group. We also found that prior educational attainment is associated with degree of completion, except for the group of learners who had the lowest level of prior educational attainment. Learners who had less than secondary education (the lowest category of educational attainment) were likely to complete more of their course than any other group, even than those with doctorates. Again, the 'less than secondary education' group is small (n=39) in relation to the whole sample and their results should be treated with caution.

What these anomalies suggest is that whilst we can find trends in the behaviour of learners, there are also anomalous groups which buck these trends. More detailed analyses which examine small groups such as those who have less than secondary school education may help us to understand them better. Are they 'unemployed' rather than retired and thus have more time on their hands and a particular motivation to finish the course, to make themselves more employable? Actually, when this group was examined further we found that it contains 39 learners, 55% of whom are under 18, and 53% of them are in full time education, i.e. they are still in full-time compulsory education and have not yet finished secondary education, rather than being older learners who did not reach this educational attainment. The two courses that these learners were most likely to be enrolled on are the two that are aimed at school level learners; Enterprise and Anatomy.

Limitations

Motivation of the learner may also have a significant effect in terms of the learners' goals and intentions in relation to the course (Hew & Cheung, 2014; Wang & Baker, 2014). For example, if a learner enrols intending to audit a course, success for them may consist of remaining engaged with the content but without completing assignments. Our four completion categories miss those learners whose intention from the outset was to audit the course, a category which Kizilcec et al. (2013) does include. They are captured in the 'Returning Learners' in our categorisation, but this group includes others too. However, Breslow et al.'s (2013) work suggests that learners may not be dropping out where they feel it is a satisfactory point for them individually and that there may be other reasons for non-completion. Yuan and Powell (2013) also argue that it is important to find out more about those who drop out, and suggest looking at why and at what stage they drop out.

Conclusions

We have found that learners who are older, not working, those with prior online experience and having a high prior educational attainment are more likely to complete more of their course. Much of this is not surprising, but we have also found that some groups of learners buck these trends. In order to understand the different groups of learners enrolling on MOOCs and whether they complete their course, or even whether they want to complete their course, further analysis is required. This more detailed analysis should examine the learner's context, e.g. they may be school students on a course aimed specifically at them, which is highly relevant to some other aspect of their formal education and thus motivation to complete 100% of the course is high. Or they may be a

young university student with limited time who wants to know more about a particular area of statistics, for example, who enrols on a MOOC finds out what they need and exits. Our future work will explore analyses which group learners by multiple characteristics, and thereby provide a starting point to build portraits of different types of learners, with different motivations and intentions, as well as different characteristics, which may then help us to understand who might need support to achieve their learning goals.

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