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DIFFERENCES IN ONLINE STUDY BEHAVIOUR BETWEEN SUB-POPULATIONS OF MOOC LEARNERS

[DIFERENCIAS DE COMPORTAMIENTO ENTRE GRUPOS DE ESTUDIANTES DE CURSOS EN LÍNEA ABIERTOS Y MASIVOS (MOOC)]

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ABSTRACT

Information was gathered about learners who were studying on repeat offerings in 2013-14 of six University of Edinburgh MOOCs on the Coursera platform. Two sources of information were used in this study: learner-contributed information about themselves and their study intentions collected in voluntary surveys, and data about learner behaviours, including performance on the courses, collected from the platform software during the MOOC deliveries. Three aspects of learner attributes and behaviours were analysed to investigate: whether learners who took the same MOOC twice performed better the second time; whether learners managed to achieve the goals that they said they had before the course began, in particular, achievement of a Statement of Accomplishment (SoA), and whether learners who did persist in the MOOCs and gained SoAs exhibited different behaviours with respect to their use of the online features of the MOOC platform.

Of the small number of MOOC repeating learners, most were drawn from those who had been active in their first round of study, and of those who were not active in their first round, they mainly failed to be active in their second, suggesting structural reasons for their lack of activity. A small number of MOOC repeat learners gained a second SoA.

There was a very strong age-dependency in the likelihood of gaining an SoA, and younger learners were much less successful at turning intention to gain an SoA into that outcome.

In terms of use of online tools, apart from watching videos, in which learners who did not achieve an SoA were similar to those who did, SoA-learners used the online tools more frequently, in an particular reading and posting to the online forums.

The implications for course design and support are discussed.

KEY WORDS

Online courses; MOOC; student behaviour; online learners; Coursera; Statement of Accomplishment.

RESUMEN

Se ha recogido información de los alumnos que han seguido 6 cursos MOOC, ofertados por segunda vez en 2013-14, en la plataforma Coursera de la Universidad de Edimburgo. Se manejaron dos fuentes de información para este estudio: encuestas voluntarias que respondieron los estudiantes con información sobre sí mismos y sus intenciones de estudio, y datos sobre los comportamientos del alumno, incluyendo el rendimiento en los cursos, recogidos en el software de la plataforma durante las entregas de tareas en el mismo MOOC. Se analizaron tres aspectos sobre las características y el comportamientos del alumno: si los estudiantes que realizaron el mismo MOOC dos veces, la segunda vez lo cursa mejor; si los estudiantes logran alcanzar las metas que indicaron que tenían antes de que comenzara el curso, en particular, la consecución de una Declaración de Logro (SoA), y si los alumnos que permanecieron en los MOOCs y ganaron SOAS manifiestan diferentes comportamientos con respecto al uso de las funciones online de la plataforma MOOC.

Por el reducido número de alumnos que repiten MOOC, la mayoría procedieron de los que habían estado activos en su primera experiencia de estudio, y de los que no estuvieron activos en su primera experiencia, tampoco fueron activos en su segunda experiencia, lo que sugiere razones estructurales ante su falta de actividad. Solo un pequeño número de estudiantes que repitieron MOOC obtuvo un segundo SOA.

Se dio una muy fuerte relación entre edad y la probabilidad de obtener un SOA, ya que los estudiantes más jóvenes manifiestan menos éxito en obtener un SOA como resultado. En relación al uso de herramientas en línea, además de ver vídeos, en los que los estudiantes que no alcanzaron un SOA eran similares a los que lo hicieron, los estudiantes que obtienen un SOA utilizan las herramientas en línea con más frecuencia, con un modo particular de lectura y participación en los foros en línea.

Se exponen las implicaciones para el diseño y desarrollo de estos cursos.

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PALABRAS CLAVE

Cursos en línea; MOOC; comportamiento estudiantes; alumnos en línea; Coursera; Declaración de Cumplimiento.

INTRODUCTION

Since universities began offering MOOCs in 2012, they have been interested in why very large numbers of people enrolled on their courses, what helped them to keep studying, and whether they ways they studied online varied depending upon such attributes as purpose, age and prior educational experience. Over the first two years of research, all MOOCs had similar compositions of learners, who were mainly well-educated adult learners from developed countries, with a mixture of reasons for studying including general interest in the subject and career enhancement (Grainger, 2013; Breslow, Pritchard, DeBoer, Stump, Ho, & Seaton, 2013). In addition, some technical approaches to studying online learning activities were developed which had not been possible before very large numbers of online learners could be observed (Sinha, Li, Jermann & Dillenbourg, 2014). Along with these exciting research opportunities has come an increased awareness of the ethical issues involved and a desire to define good practice approaches to the use of digital learning data in research (Asilomar Convention, 2014).

We in the University of Edinburgh have shared these interests, and from the outset we have gathered data from our learners through our own surveys, and more recently we have begun using information given by to us by the MOOC platforms in which we are partners (Coursera and Futurelearn). We wanted to understand whether the early patterns of learner demographics and online behaviours change as both MOOCs and the learners mature, so that we might be able to design MOOCs with more informed approaches, and also predict likely enrolment and learner persistence.

Some of our early analyses have been published (Macleod et al, 2015; Haywood & Macleod, 2014; Haywood et al, 2015), and most of the data to which we refer below is online through our open website [http://moocs.is.ed.ac.uk/]. In this paper we analyse the online behaviour of returning learners, the gap between intent and outcome, and the variations in online behaviour of learners of different ages. The data used were obtained from the first six of our MOOCs on the Coursera platform, all of which were offered twice, once in 2013 and once in 2014. They spanned a wide academic range (AI Planning, Astrobiology, Critical Thinking, Education & Digital Culture, Equine Nutrition, and Introduction to Philosophy).

METHODOLOGY

MOOC learners were surveyed at the start and the end of each MOOC, using the online survey feature of the Coursera platform. By using the Coursera system rather than independent, external, survey software we were able to link responses to the surveys to learners individual behaviour online, and their academic performance in the course. This was a change for us from the first iterations of our six Coursera MOOCs, when we used external software to enhance anonymity. The lack of ability to link survey responses with on-course performance was felt to be too restrictive and so for second and subsequent iterations of each MOOC we have used the Coursera software. The questions asked in the entry and exit surveys were the same, regardless of the software used. The survey data presented here are derived from entry surveys only. We do not retain any personally identifying information and so maintain learner anonymity in our analyses.

Information collected included age range, gender, country of residence, intention to achieve a Statement of Accomplishment, prior educational attainment and current employment status. The response rates to the surveys varied from 7% to 29% of active learners, with a mean of 17%.

Information was also gathered about the use of the various online software features («tools») deployed in the MOOC being studied by every learner. These data are different to the survey data in that we count every learner who enters the course website once after the course begins as «active» (these learners are always much fewer than the number of learners who enrol), and each action that every learner takes is recorded by the platform software.

Coursera provide us with a SQL extract of this activity data for each iteration of a course, and we process this locally to create a secure standardised data set that then supports a number of our analysis activities. Information in our standard data set includes number of forum posts read, forum posts replied to, videos watched, quizzes attempted, peer assessments undertaken, the number of days a student persisted on the course, and whether they achieved a Statement of Accomplishment or not.

Returning learners are identified in this analysis by comparing the standard data set for two iterations of a course, and detecting Coursera IDs that appear in both populations. The additional information about persistence and achievement on each course is then used to determine whether returning learners were active, and whether they completed.

For our tool based analysis we used the information in our standard data set to determine simply whether a learner had interacted with a tool or

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not (with an appropriate adjustment to account for the use of the Coursera quiz tool for the entry survey). This simplified set of usage information was then combined with the entry survey data, augmenting the responses with the additional information about engagement with content and activities.

Learners were aware from the Coursera website when they create an account that anonymised data may be used for educational research purposes.

MOOC LEARNERS: ENROLMENT, ENGAGEMENT & COMPLETION

As a background to the more detailed analyses to follow, we present here general data on the patterns of engagement by learners on our first six Coursera MOOCs, with the first three iterations of each MOOC shown as 001, 002 & 003.

Table 1

Conversion rates of Edinburgh MOOC learners (shown as %) between participation type: those who signed-up to the course (enrol); entered the course site (active); and completed the course to gain a statement of accomplishment (SoA)

Course	Enrol> Active	Enrol> SoA	Active> SoA
AI Planning 001	57%	2%	4%
AI Planning 002	52%	2%	4%
Astrobiology 001	45%	17%	37%
Astrobiology 002	57%	12%	21%
Critical Thinking 001	40%	8%	20%
Critical Thinking 002	49%	6%	11%
EDC 001	55%	4%	8%
EDC 002	50%	2%	3%
Equine Nutrition 001	81%	36%	44%
Equine Nutrition 002	65%	19%	30%
Intro to Philosophy 001	47%	8%	18%
Intro to Philosophy 002	59%	6%	11%
Intro to Philosophy 003	65%	6%	9%

For all our MOOCs, in common with every other MOOC, the numbers of active learners fell throughout the course, and only a small percentage of learners achieved Statements of Accomplishment (SoA) by completing all assessments to a minimum standard (Table 1). Some MOOCs had more

learners who gain SoAs (e.g. Equine Nutrition), and some MOOCs had high enrolments but low numbers of active learners in Week 1 (e.g. Intro to Philosophy). The first iterations (001) had higher enrolments than the second (often almost double), with a further decrease to the third (003).

RETURNING MOOC LEARNERS

The opportunity to re-take courses is not common in higher education. In general either the regulations, the cost or the student time commitment are barriers to re-takes, and even the option to re-take single tests or exams can be very limited. As a consequence, mastery learning (Bloom, 1974) in which a learner practices a skill or knowledge, is uncommon. The openness of MOOCs, and their lack of fees for study, resulted in claims that mastery learning could take place (Do, 2014), and so we were interested in whether there was evidence for this in our MOOC data. We analysed the data from the first two iterations of our six Coursera MOOCs, looking for the same Coursera IDs in both, and found that learners did indeed repeat the same MOOC, albeit generally in quite small proportions (Fig 1). Care is needed with these analyses as the numbers of returning learners were quite small. It is clear that returners were generally quite active online in their first study of the MOOC, but that very few of them completed the MOOC a second time; indeed in this respect they were little different to MOOC learners taking a course for the first time. A small number of the most very active learners (i.e. those who frequently post valuable comments to the forums) will be those invited by the academic team to return as «community teaching assistants», but for the others there is probably a social and affiliative motivation[1].

Interestingly, MOOC returners were mainly drawn from the active learners of the first course, and less so from the general enrolment (Table 2, the sum of Active and Completed in Course001 eg 68% for Intro Phil vs 20% in Enrolled). As many more learners enrol than become active (on average 46% of learners only enrol[2] and are never active in these MOOCs), the returners who were active first time around were disproportionately represented in our returners.

It is mainly the case that few learners who completed a MOOC first time around returned to re-take it, but there are exceptions, as evidenced by the Astrobiology and Equine Nutrition MOOCs in Table 2. These MOOCs had the highest proportions of successful completers from their first iterations who returned to re-take the same course in its next offering (16% and 27% respectively). Of these returners, in the Astrobiology MOOC 14% (2/16) gained a second SoA, and in Equine Nutrition 15% (4/27) gained a second SoA (ie Complete / Enrolled+Active+Complete). For Equine Nutri-

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tion, 11% of their returners in total gained SoAs in the second iteration (1%+6%+4%).
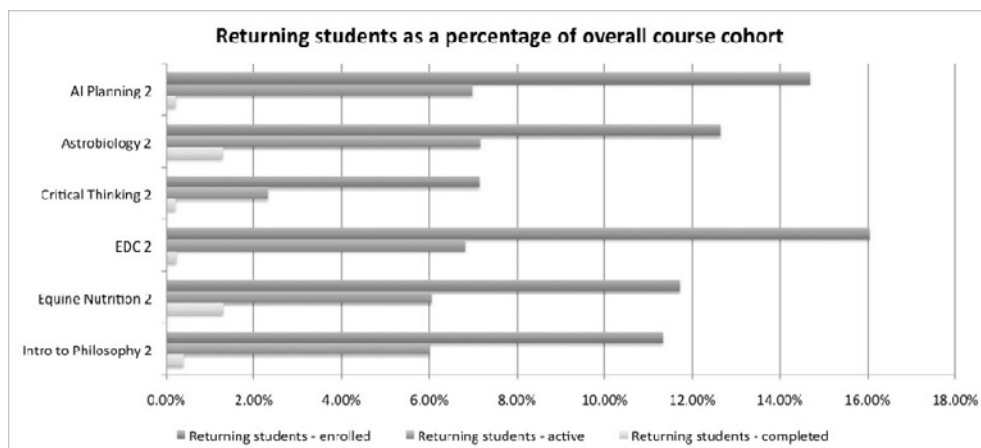

Figure 1. *Returning learners on second-iteration Edinburgh MOOC shown as a % of overall course cohort and further classified by participation type*

Table 2

The spread of participation type of returning learners across the two iterations of a given course, shown as a % of the overall returning learner cohort per course. Engagement accounting for 25% or more of the total cohort has been highlighted in bold

Course 001	Course 002	AI Plan-ning	Astro-biology	Critical Thin-king	EDC	Equine Nutri-tion	Intro Phil
Enrolled	Enrolled	20%	19%	**33%**	21%	9%	19%
	Active	8%	13%	10%	8%	3%	1%
	Complete	0%	2%	1%	0%	1%	0%
Active	Enrolled	**30%**	19%	**32%**	**36%**	**28%**	**27%**
	Active	**35%**	**25%**	18%	**28%**	**26%**	**32%**
	Complete	1%	6%	1%	1%	6%	2%
Complete	Enrolled	1%	7%	3%	2%	13%	2%
	Active	2%	7%	1%	2%	10%	4%
	Complete	0%	2%	0%	0%	4%	1%

COMPLETION OF MOOCS AND LEARNER DEMOGRAPHICS

We know from our earlier analyses (data not shown) that many who enrol in a MOOC and become active learners never complete it, and so never

receive a Statement of Accomplishment. Data published previously has shown that «intent to complete» is a good predictor of success (Koller, 2013; Liyanagunawardena, 2014), but as we had shown previously that younger learners were more career focussed in their MOOC studies than older learners (Macleod et al, 2015) we were interested to discover whether that interest was converted into action in their completion data. Fig 2 shows the percentage of all our MOOC learners in each age group who stated that they intended to achieve a SoA in their entry survey and the percentage who actually did gain a SoA. There was a clear age related difference between intent and outcome. The youngest learners (up to 24 years) did have the highest intention to gain an SoA but less than half of them reached that goal, whereas for the oldest groups (55 and over) the reverse was true; fewer intended to get an SoA but more did so than expressed that intent. Indeed the older learners were the most «diligent», probably mainly due to less time constraints militating against study.

However, as the numbers of learners in each age group varied considerably, many more younger learners gained SoAs than did older learners, and this too varied between MOOCs (Fig 3). Young learners were more prevalent in the AI Planning and Astrobiology MOOCs whereas those in the EDC MOOC were generally older.
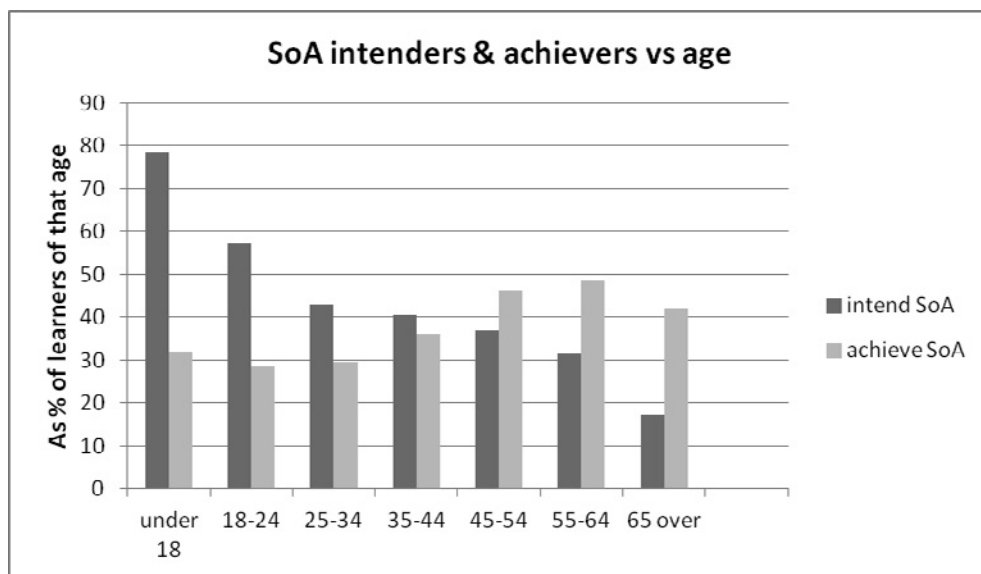

Figure 2. *Intention to achieve a SoA, as self-identified on the course entry survey, compared to actual achievement by age group, shown as a % of learners in each age group*
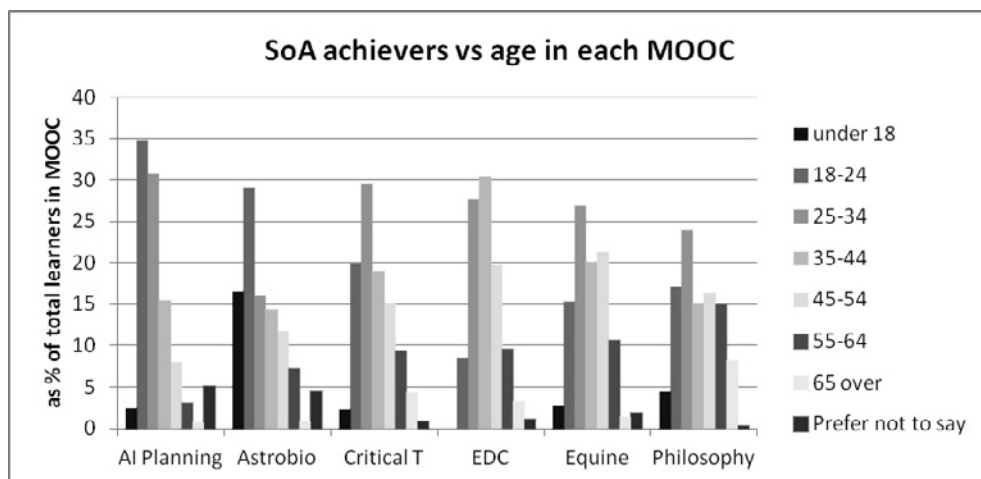
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Figure 3. *Age breakdown of SoA achievers by course, shown as a % of overall course cohort*

USE OF ONLINE TOOLS BY MOOC LEARNERS

MOOCs generally consist of a suite of online features («tools») that offer content (e.g. video, readings) and activities (e.g. quizzes, discussion forums), and these form part of the «system» that is open for teachers to use to construct their course, selecting the tools appropriate to their educational goals. Almost all MOOCs offer videos to be watched, and quizzes for self-testing or as part of formal assessment that contributes to course completion and award of a certificate. Most MOOCs have a discussion forum running alongside the course content and activities, which may be used as an important component of the course for structured discussion, or be present mainly for raising simple queries. In the first two iterations of the six Edinburgh Coursera MOOCs we measured learners' engagement with online tools. (One use is counted as «used» for each of the five tools: videos, quizzes, reading forums, posting to forums, peer assessment participation). The results are shown in Fig 4.
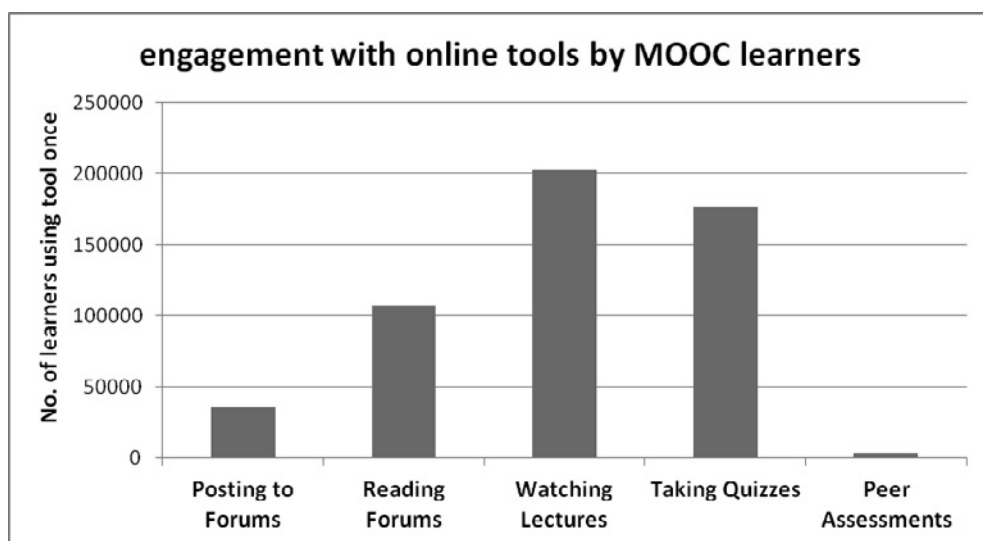
Figure 4. *The total number of MOOC learners who engaged with each tool type within the Coursera platform, combined across 001 and 002 iterations of wave one Edinburgh courses*

In numerical terms, most learners watched videos, followed closely by taking quizzes and then at much lower levels, reading and posting to forums and finally engagement in peer assessments. These results are unsurprising, as this is the order of «complexity» or «cognitive demand» of each of these tools. However, hidden in these aggregate numbers from our six MOOCs were marked differences in choice of tools to deploy. EDC 001 had no videos or quizzes; Critical Thinking, Astrobiology, AI planning and Equine Nutrition had no peer assessments. The last group clearly contributed to the low level of engagement with peer assessments, although where peer assessments were used, very low percentages of learners engaged with them ('1% when optional, 6% when part of SoA requirement). It may be that the «double load» of peer assessment (having to prepare one's own assignment and also review that of others) militates against engagement and where peer assessment is key to gaining a SoA (e.g. in EDC), it may lower SoA numbers.

However, we know that most learners on MOOCs are not deeply committed to completion of the course, and even fewer obtain SoAs. It was therefore of interest to explore if there were differences in behaviours of SoA-achieving learners to non-SoA achievers. The results of this analysis are shown in Fig 5, in which we have calculated the value of each type of learner (SoA, non-SoA) using each tool in the total population as a percentage of the total number of learners of that type, so as to normalise the data for the different sizes of the two populations.
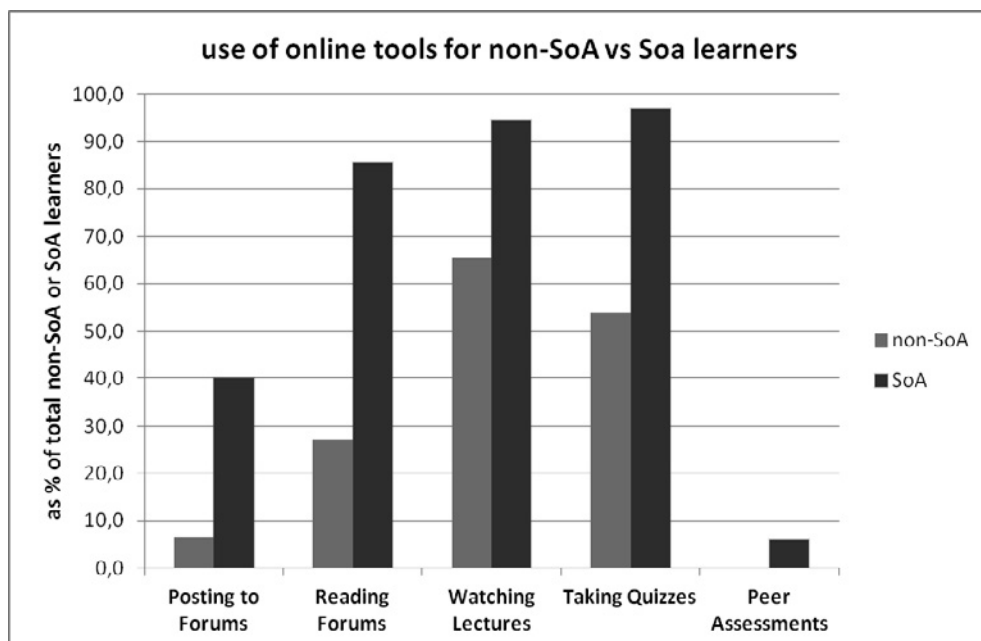
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Figure 5. *Comparison of online tool engagement by SoA achievement status, shown as a %
of learners in each achievement type and combined across all 001 and 002 courses*

There was a striking difference between the two groups of learners in how they engaged with the tools on offer. The smallest difference was in watching video lectures and the largest in posting to forums and doing peer assessments. Even in the relatively passive activity of reading forums there was a large difference between the SoA and non-SoA learners. Over 70% of the non-SoA learners never read posts on the forums even once, whereas 85% of the SoA learners did so.

From a preliminary analysis we can see that SoA learners not only engaged once only with tools much more did non-SoA learners, but they also engaged many more times with each.

CONCLUSIONS

Some clear conclusions can be drawn from our data about learners on our first six Coursera MOOCs. One is that, at least for our survey respondents (who are 17% of the learner population), younger learners had stronger initial intentions to gain some formal recognition of their study outcomes, as Statements of Accomplishment, than did older learners. The

SoA bears no university credit and nor is it robustly verified as to the authenticity of the learner's assessment results, but despite that the SoA may have value to the learner. At the least it is a «memento» of the study experience, a reminder of a particular course, instructor, university or the platform. The university and platform credits are on the SoA partly for that reason. It is possible that, for some learners and especially perhaps the younger ones, the SoA may be viewed as a badge as these gain acceptance and recognition in some online communities [http://openbadges.org/]. Learners can list their SoAs alongside their badges in their profiles on their favourite social networking sites. This finding aligns with our earlier analysis which showed that there was a strong age-related correlation for career enhancement as a reason for taking a MOOC; more young learners gave this as their reason for study than did older learners (Macleod *et al., 2015*).

However, there was a big gap between their intentions and the eventual outcomes for younger learners, which may reflect counter-pressures of time for study, or it may merely reflect a higher propensity to indicate SoA as their intention than did older learners.

Those learners who did achieve SoAs engaged with the online tools provided differently to learners who did not. Their behaviour corresponded more closely to the faculty «ideal student», an autonomous learner who takes advantage of all educational opportunities. Learners who did not achieve SoAs browsed content rather than participated in the course; they watched videos and did some quizzes where these existed, but were much lower users of forums and peer assessments. This was observed even at the minimal level of one single interaction with these tools, that is, many non-SoA learners never even read one post on the forums. It may be that they gained enough from the video content to satisfy their intentions. As we only analysed for one interaction with each tool, it may be that many of the non-SoA learners became inactive very early in the course and so the forums etc were not relevant to them. Interestingly, even with dedicated learners who achieved SoAs, less than half posted even once to the forums, although did read them. They may therefore fall into a learning style which prefers solo study over social constructivist engagement with peers. This has to be viewed with the caveat that only online activities are being observed; activities, alone or with others, offline cannot be viewed.

Finally, from the data we have gathered we can draw some conclusions about learners who return to re-take the same MOOC. Learners who had never been active first time around (i.e. just enrolled but never studied) mostly did little more than re-enrol but never became active. It seems unlikely that they re-enrolled on a MOOC they felt was «not for them», so perhaps we can conclude that, for some reason, they would like to study but

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the barriers to that are too high for them. Those who completed a MOOC first time around (i.e. gained an SoA) are very unlikely to re-take the same MOOC, but of the few who do, in some MOOCs many of them gain a second SoA (e.g. 31% in Equine Nutrition), whereas in others none do so, e.g. AI Planning. The social and affiliative is almost certainly at play here. As one is given an SoA if one completes all the assessments to the required standard, they may not have an intention to gain a second SoA but because they studied the course thoroughly they are awarded one.

The largest numbers of returners are drawn from those who had been active in their first study of that particular MOOC. Between 50% and 66% of the returners were in this group, across the six MOOCs. However, their success rate was fairly low in terms of SoA awards; Astrobiology had the most at 12% of this group reaching SoA. There are several reasons why this might be the case. These learners may just enjoy learning with others in their chosen subject; they may find the same pressures that resulted in non-completion first time around still apply, or they may be studying a different section of the course the second time (i.e. taking the course in segments). Further analysis of this group's reasons and behaviours might help us to support them better, as returners are clearly committed in some way to these MOOCs.

The percentage of learners who completed the entry surveys was quite small, and may be decreasing over time. The entry survey response to the 001 MOOCs averaged 21% whereas that for the 002 MOOCs was 17%. We consider that this trend might continue as more learners have prior MOOC experiences, and survey fatigue may set in. For our 002 MOOCs, 58% of the learners had taken a MOOC from somewhere previously and MOOC surveys are very common. A counter-trend may arise if more brand new learners enrol on the MOOC platforms. Either way, analyses need to be done with due caution, as the learner populations are changing in complex ways, and the numbers of respondents are very small in some small categories (e.g. SoA achievers from minority age groups or from developing countries). We recognise the need to re-think and re-design the way we gather data about learners on our MOOCs in future. For example we might use learner panels as are common for on-campus courses, possibly rewarded, or like others we could take an ethnographic approach (Adams, Yin & Madriz, 2014).

The patterns of behaviour of learners on MOOCs are of interest to all organisations that offer MOOCs as they give some data to guide course design and to predict likely enrolments. Where paid-for options, such as verified certificates, are on offer, income streams might be more predictable. Longitudinal data are most valuable for indicating where trends are

beginning to emerge; even if no trends are apparent, at least that lack of trends is explicit, and we can reflect on what it means for our future plans. Where specific actions have been put in place to target countries or particular learner audiences, these longitudinal surveys offer some pointers to progress.

MOOCs present particular challenges for educational research, and some of these come from their changing nature and form. Unlike traditional university courses which generally evolve relatively slowly, there is a great deal of change and innovation taking place within MOOCs and on the platforms themselves. Trialling is taking place to find formats that can circumvent the limitations of irregular timing of most MOOC sessions due to limited faculty availability, and to seek more effective software features to support teaching at scale with very small numbers of teaching assistants. Thus «on-demand» MOOCs, more automated MOOCs, and a wider range of software tools will make the task of analysing the data about learning online in MOOCs increasingly complex over the coming years.

NOTAS

1   http://www.urbandictionary.com/define.php?term=frainger

2   http://moocs.is.ed.ac.uk/edinburgh-report-2/course-summary-details/learner-participation-overview/

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