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Learning in MOOCs: Motivations and self-regulated learning in MOOCs

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ABSTRACT

Massive open online courses (MOOCs) require individual learners to be able to self-regulate their learning, determining when and how they engage. However, MOOCs attract a diverse range of learners, each with different motivations and prior experience. This study investigates the self-regulated learning (SRL) learners apply in a MOOC, in particular focusing on how learners' motivations for taking a MOOC influence their behaviour and employment of SRL strategies. Following a quantitative investigation of the learning behaviours of 788 MOOC participants, follow-up interviews were conducted with 32 learners. The study compares the narrative descriptions of behaviour between learners with self-reported high and low SRL scores. Substantial differences were detected between the self-described learning behaviours of these two groups in five of the sub-processes examined. Learners' motivations and goals were found to shape how they conceptualised the purpose of the MOOC, which in turn affected their perception of the learning process.

1. Introduction

Massive Open Online Courses (MOOCs) have received much attention from academics and the media for their potential to reshape learning opportunities and to transform higher education. Proponents of MOOCs emphasise their openness and scale, which allow learners, regardless of location or previous experience and qualification, to engage at no (or minimal) cost in learning opportunities, which often are curated by leading universities. However, there is growing concern that MOOCs have not had as profound or as immediate an impact on education as initially anticipated (Gillani & Eynon, 2014).

Research has not adequately addressed the unique nature of learning and learners in MOOCs or examined the new methods of knowledge production and learning that MOOCs can support (Gillani & Eynon, 2014; Milligan, Littlejohn, & Margaryan, 2013). A number of studies have focused on what can easily be measured at scale, such as progression, retention and completion rates (Breslow et al., 2013; Guo & Reinecke, 2014; Kizilcec, Piech, & Schneider, 2013; Liyanagunawardena, Adams, & Williams, 2013). The employment of these measures as proxies of learning does not adequately take into account the unique structure of MOOCs, the new forms of learning opportunities they promote or the diversity of learners participating in MOOCs. More research is required, which focuses on the unique nature of learning and learners in MOOCs and examines the new methods of knowledge production and learning that they can support.

The open nature of MOOCs, which allow anyone to enrol, leads to diversity in motivations and expectations among learners (Kizilcec et al., 2013). This diversity in expectations, coupled with the variety of backgrounds and previous experiences of learners, results in a wide range of learning behaviours, skills and abilities among MOOC participants. MOOCs are now dominated by platform-based approaches to learning (often referred to as xMOOCs), which typically involve minimal direct interaction between the instructor and learners. This places the onus on individual learners to create and navigate their own learning journey. In order to do so individuals must self-regulate their learning, which requires them to monitor and adjust their behaviour and actions in relation to their specific learning context (Zimmerman, 2000a). In a MOOC, individuals must determine when, how and with what content and activities they engage (Milligan & Littlejohn, 2014). Studies suggest that learners who are better able to self-regulate their learning, in either formal or informal settings, employ more effective learning approaches in online settings (for a review of this research see Bernacki, Aguilar, & Byrnes, 2011). Initial research into the role that self-regulated learning (SRL) plays in supporting learning in MOOCs has identified a range of cognitive, affective and behavioural factors that impact learning in a MOOC (Hood, Littlejohn, & Milligan, 2015). Research has further suggested that learners' context and current roles influence their ability to self-regulate their learning in a MOOC (Hood et al., 2015).

This study explores in detail how learners self-regulate their learning in the 'Introduction to Data Science' MOOC offered by the University of Washington through Coursera MOOC platform. The MOOC attracted 50,000 participants from 197 countries. The study is framed by the research question 'What self-regulated learning strategies do learners apply in a MOOC?' and explores how self-regulated learning (SRL)

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strategies vary between learners who score low and high on a measure of SRL. The study is focused particularly on the variation in motivations for taking the MOOC between these two groups of learners and how this shapes their behaviour and employment of SRL strategies. The paper begins with a review of the literature on SRL in the online setting and how this literature relates specifically to MOOCs. The literature review is followed by a discussion of the methods employed to investigate the research question. The data analysis process and findings are then presented and discussed. The paper concludes by summarising the key findings and reflecting on the limitations of the study as well as potential directions for future research.

2. Background

Questions have been raised about how the unique characteristics of MOOCs – including free registration, open access to learning (regardless of prior qualifications), a large and diverse learner body who not only have different backgrounds but also wide ranging motivations for enrolling in a course, and the absence of a single, linear learning progression followed by all students on a course – are shaping the learning process. Breslow et al. (2013) urged researchers to take advantage of the huge quantity of data MOOCs generate to identify in greater detail what contributes to and constrains students' learning. The ability to track how often and with what aspects of the MOOC individuals engage has enabled studies to classify learners based on their patterns of interaction with MOOC features (Kizilcec et al., 2013). Much of the research on learner behaviour has focused on trying to understand the low completion rates (Jordan, 2014), which current estimates place at less than ten percent (Breslow et al., 2013; Jordan, 2014). Studies have examined the role that participants' educational backgrounds, gender and geographic location (Breslow et al., 2013; Guo & Reinecke, 2014; Kizilcec et al., 2013) have on their continued engagement in a MOOC, while further research has investigated the connection between the nature of learners' participation in the online discussion forums and completion rates (Gillani & Eynon, 2014).

The focus in these studies on progression, retention and MOOC completion rates as indicators of learning have enabled an understanding of the whole MOOC cohort but provide little insight into the behaviour and learning of the individual. Furthermore, the use of completion rates as a proxy for learning success is problematic in the MOOC context. Unlike in traditional HE courses where learner expectations are largely standardised (successful completion of a course or degree programme is a marker of success), the diversity of learners in a MOOC results in a range of motivations for participation (Kizilcec et al., 2013) and potentially leads to different levels of engagement (DeBoer, Ho, Stump, & Breslow, 2014). To understand learning in MOOCs, it is necessary to move beyond the artificial binary distinction between completers, representing those who have learned, and non-completers, those who have not learned, to more fully investigate the motivations and drivers, including contextual, cognitive and behavioural factors, that are influencing learners' behaviour and actions.

Investigations of learning in MOOCs must also take into account the non-formal nature of MOOCs, which allows learners to engage in non-linear learning trajectories that do not follow a pre-established, sequential progression (Guo & Reinecke, 2014). Analysis of learner behaviour in four MOOCs determined that certificate earners viewed on average only 78% of learning sequences, completely skipping 22%, and navigation backjumps from assessments to lectures were more common than lecture-to-lecture backjumps (Guo & Reinecke, 2014). This self-determined navigation combined with the absence of interaction between the instructor and learners requires that individuals self-regulate their own learning, determining when, how and with what content and activities they engage (Milligan & Littlejohn, 2014).

Self-regulated learning, which was first studied in formal, offline education contexts, refers to 'self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals' (Zimmerman, 2000a p. 14). Zimmerman identified three phases of self-regulated learning – forethought, performance and self-reflection – and a number of sub-processes associated with each phase. Self-regulation is not fixed. The ability to self-regulate one's learning is mediated by both personal–psychological factors (cognitive and affective) and contextual–environmental factors (Pintrich, 2000). Self-regulation has been positively associated with academic outcomes in formal, offline learning contexts (Pintrich & de Groot, 1990; Zimmerman & Schunk, 2001) and an increasing number of studies have investigated the role that SRL plays in online learning environments (for a comprehensive overview, see Bernacki et al., 2011).

Studies examining learning in online settings have determined positive correlations between self-regulated learning behaviour and academic achievement (Azevedo & Cromley, 2004; Barnark-Brak, Lan, & Paton, 2010). Further research has focused on mapping SRL sub-processes in online learning environments. Cheng and Chau (2013), in their study of e-portfolios, identified five sub-processes that were associated with higher achievement — elaboration, organisation, critical thinking, metacognitive self-regulation, and peer learning. Another study, focused on self-regulated learning in a MOOC, identified four SRL sub-processes where differences were noted between people exhibiting high and low self-regulation — goal setting, self-efficacy, learning and task strategies, and help-seeking strategies (Milligan & Littlejohn, in press). Further research on self-regulated learning in a MOOC identified significant differences in self-regulated learning behaviour between learners from different contexts and professional roles (Hood et al., 2015).

This study builds on previous research into self-regulated learning in non-formal and online contexts to investigate the SRL sub-processes learners employ in MOOCs and to probe how different learning motivations influence self-regulated learning behaviours. The self-regulated learning framework facilitates the creation of context-rich accounts of the learning actions and behaviours of individuals in a MOOC. It provides insight into the nature of the learning occurring in MOOCs as well as evidence of how individuals are interpreting their learning in relation to their 'real-life' or offline contexts (Selwyn, 2010).

3. Methodology

This study formed part of a larger study examining the learning behaviours and actions of 788 participants in the 'Introduction to Data Science' MOOC (https://www.coursera.org/course/datasci) from the University of Washington and offered on the Coursera platform. Quantitative data was collected through a survey posted on the course message board. The survey was a slightly modified version of a published, validated instrument designed to measure SRL and SRL sub-processes of adult learners in informal learning contexts (Fontana, Milligan, Littlejohn, & Margaryan, 2015). The survey instrument is available at http://dx.doi.org/10.6084/m9.figshare.866774. The data generated from the survey enabled a SRL profile to be developed for each participant. The profile included an overall SRL score as well as a separate score for eight SRL sub-process. The factor structure and descriptive statistics are summarised in Table 1.

Participants who completed the survey and identified as data professionals (n = 362) were invited to participate in a semi-structured interview. A semi-structured interview instrument was designed to probe the full range of SRL sub-processes identified by Zimmerman (2000a) with questions developed iteratively over a number of studies (Fontana et al., 2015; Milligan & Littlejohn, in press). The questions were adapted to fit the context of this study and to ensure that they were directly relevant to participants' experience of the MOOC. Relevant questions are included in the results section below, with the whole interview script available at http://dx.doi.org/10.6084/m9.figshare.1300050. Interviews were conducted via Skype with 32 participants from 16 countries. All interviews were recorded and transcribed verbatim.

Table 1
Factor structure and descriptive statistics for SRLMQ instrument. F = forethought, P = performance, SR = self-reflection.

Factor	No. of items	Mean	SD	Example item	Cronbach's alpha	% of explained variance	Total explained variance
F1: Goal-setting	7	3.27	.84	I set short-term (daily or weekly) goals as well as long-term goals (for the whole course).	.85	22.79	56.94
F2: Self-efficacy	7	3.76	.70	I feel that whatever I am asked to learn, I can handle it.	.83	20.42	
F3: Task interest/value	3	4.21	.70	The learning that I undertake is very important to me.	.76	13.74	
P1: Learning/task strategies	11	3.47	.73	When I am learning, I combine different sources of information (people, web sites, printed information).	.89	30.30	57.33
P2: Interest enhancement	2	3.92	.	I like opportunities to engage in tasks that I can learn from.	.72	14.83	
P3: Help-seeking	3	2.67	761.1	When I do not understand something, I ask others for help.	.86	12.21	
SR1: Self-satisfaction	3	3.46	.92	I try to understand how what I have learned impacts my work/practice.	.77	36.08	68.17
SR2: Self-evaluation	3	3.46	.85	I know how well I have learned once I have finished a task.	.74	32.09	

The interview transcripts were analysed in conjunction with the quantitative data in order to probe how participants' self-regulate their behaviour in relation to each of the sub-processes. Data were analysed in three successive rounds, with the eight SRL sub-processes operating as the initial coding framework. First, each of the 32 transcripts was coded independently by two researchers. Discrepancies in the coding between the two researchers were minor and were resolved prior to the commencement of the second round of analysis. Second, participants were each assigned a rank (1 to 32) corresponding to their overall SRL score, which was calculated by adding the responses for each of the 39 items, with a minimum possible score of 39 and a maximum score of 195. In order to develop a more robust understanding of self-regulated learning behaviour, alongside their overall rank position, participants were also ranked for each of the eight SRL sub-processes reported in Table 1. The overall SRL scores were used as a guide (Barnard, Lan, To, Paton, & Lai, 2009; McManus, 2000). The Pearson correlation analysis conducted between the eight factors determined strong correlation between each of the eight sub-factors and the overall score (Table 2), indicating that the constructs formed a coherent group.

In the third round of analysis, transcripts were analysed in relation to participants' SRL scores, in order to see whether there were any discernible differences in the interviews of participants with higher and lower SRL scores. Analysis determined differences in the learning behaviour and actions in a number of sub-processes between participants with high overall SRL scores (a score of over 146, n = 16) and participants with low overall SRL scores (a score of below 146, n = 16), with 146 representing the median score for the sample participants. The fourth round of analysis examined separately the data of the high SRL group and the low SRL group for each of the 8 sub-processes in order to identify emergent patterns of behaviour in each group. The analysis determined discernible differences in behaviour in five sub-processes — motivation and goal setting, self-efficacy, task strategies, task interest and value, self-satisfaction and evaluation.

3.1. Construct definitions

Analysis of the interview data uncovered clear patterns between those learners with high overall SRL scores and those learners with low overall SRL scores in five sub-processes — motivation and goal setting, self-efficacy, task strategies, task interest and value, and the combined self-satisfaction and evaluation. The data were analysed to identify the key themes relating to learners' actions and behaviours for each of the five sub-processes. Data were then further analysed in order to identify whether there were discernible differences in the number or behaviour of participants in each theme based on their overall SRL scores and their scores for each specific sub-process. The five sub-factors and the emergent themes in each are discussed below.

Motivation and goal setting refers to learners' motivations and reasons for taking the course as well as the aims for learning and performance outcomes they established at the start of the MOOC. Zimmerman (1990) suggests that motivation and learning are interdependent processes and that individuals exhibiting higher self-regulation are more proactive in their approach to learning. The primary motivations for participants in this study were: relevance to work; for professional development and to expand their skill set; an enjoyment for learning; to support career development. Four categories of goals emerged: general learning and development; development of specific know how; to achieve certification; and to complete all of the assignments.

Self-efficacy refers to the extent to which an individual feels confident in their ability to engage with and complete the learning activities offered on the MOOC and their ability to persevere when learning becomes challenging. A learner's self-efficacy shapes their motivation

Table 2
Factor correlations.

Correlations									
	SRLMQ	F1	F2	F3	P1	P2	P3	SR1	SR2
SRLMQ	1	.77**	.79**	.58**	.87**	.72**	.40**	.69**	.78**
F1: Goal-setting		1	.56**	.37**	.53**	.45**	.28**	.46**	.52**
F2: Self-efficacy			1	.48**	.59**	.59**	.19**	.42**	.53**
F3: Task interest/value				1	.41**	.49**	.15**	.41**	.38**
P1: Learning/task strategies					1	.56**	.30**	.55**	.68**
P2: Interest enhancement						1	.22**	.45**	.59**
P3: Help seeking							1	.25**	.25**
SR1: Self-satisfaction								1	.59**
SR2: Self-evaluation									1

** $p < 0.01$.

and the particular learning strategies they employ in relation to a specific learning context or activity, meaning that self-efficacy incorporates both individual and socio-cognitive components (Bandura, 1986; Zimmerman, Bandura, & Martinez-Pons, 1992). Self-efficacy in this study was connected to individuals' confidence in their ability to learn, confidence in their existing knowledge of the subject matter, and learners' determination and discipline when undertaking learning activities.

Task strategies encompass the ability of the learner to plan their learning and to identify and employ learning approaches that will enable them to learn. It also incorporates the ability of learners to adjust their strategies and plans throughout their learning journey. A large number of themes related to task-strategies emerged from the data: selective learning; undertaking background reading; engaging with additional material to supplement the MOOC; note-taking and creating personal records of content from the MOOC (and making no notes or records); watching lectures and undertaking the quizzes and assignments; undertaking practical activities to consolidate learning; and working backwards from the assignments.

Task interest value refers to learners' perceptions of how valuable the MOOC is to them. While closely connected to learners' motivations for participating in a learning task, and often following the same distinctions between intrinsic value and extrinsic purpose that are associated with goal orientation, Pintrich, Smith, Garcia, and McKeachie (1991) argue that unlike goal orientation, task value refers to individuals' evaluation of how important and interesting a task is. Learners perceived the task interest value of the MOOC in relation to how well it related to their job, its potential to support their career development, general interest in the subject, the provision for practical learning and incorporation of real world examples, certification it provided, and for general knowledge enhancement.

Self-satisfaction and evaluation combine two of Zimmerman's SRL sub-processes, from the self-reflection phase. Evaluation refers to an individual's awareness of their learning behaviour and the manner in which they compare their self-observed performance against some standard, such as their prior performance, another person's performance or an absolute standard of performance (Zimmerman, 2002). Self-satisfaction encompasses how satisfied learners are with their performance and progression towards their objectives. Participants employed a number of self-evaluation strategies: assessing their own knowledge; assessing knowledge by completion of exercises and assignments; ability to apply knowledge and skills in their work; recognising how they learn best; evaluating themselves against others in the course; evaluating their ability to persist; and uncertain of how to gauge their own learning.

A summary of the participants, their roles, and the ranks assigned for overall SRL and individual sub-processes is provided in Table 3.

4. Findings and discussion

This section presents analysis of data from interviews with participants in the *Introduction to Data Science* MOOC. The data relating to these five sub-processes is presented and discussed below, with particular attention given to exploring the differences between learners with high SRL scores and learners with low SRL scores.

4.1. Motivation and goal setting

In this study, twelve participants with higher SRL scores discussed their motivation in relation to their professional development and how the MOOC would contribute to their professional roles and work context. Their goals were focused primarily around improving their skillset and gaining general content knowledge of data science that

Table 3
Participants' overall SRL score and overall rank position and rank position for five SRL sub-processes.

Participant ID	Location	Professional role	High or low (rank)	Motivation and goal setting	Self-efficacy	Task strategies	Task interest and value	Self satisfaction and evaluation
534	Greece	Data professional	High (1)	1	1	1	1	1
239	Poland	Analyst	High (2)	1	1	3	1	1
685	Chile	Development Engineer	High (3)	3	5	1	17	1
336	Russia	Team lead	High (4)	3	5	4	1	8
673	USA	Data analyst	High (5)	8	5	5	8	5
22	Belarus	Software programmer	High (6)	12	8	7	17	13
493	USA	Special Project organiser	High (6)	9	5	6	17	11
543	UK	Non-professional	High (8)	12	9	9	12	11
428	New Zealand	Scientist	High (9)	3	17	22	17	1
492	USA	Senior data analyst	High (10)	6	4	27	1	13
247	Russia	Programmer	High (11)	14	17	7	1	5
119	Netherlands	Scientific programmer	High (12)	9	14	24	17	24
370	Brazil	Programmer	High (12)	24	23	24	1	18
505	New Zealand	Computing advisor	High (14)	16	10	13	32	13
461	UK	Database administrator	High (15)	16	24	20	12	24
670	Germany	Consultant	High (16)	25	14	9	1	13
396	Netherlands	Consultant decision support	Low (17)	22	28	13	26	18
215	Spain	Project manager	Low (18)	14	10	13	28	5
448	Canada	Software designer	Low (19)	19	14	16	26	8
767	Ireland	Business analyst	Low (20)	6	20	32	8	26
640	UK	Operational researcher	Low (21)	19	10	24	8	26
135	UK	Quantitative analyst	Low (22)	9	3	29	17	18
783	USA	IT Specialist	Low (23)	16	31	20	17	18
42	India	Senior software engineer	Low (24)	25	20	9	28	13
291	USA	Programmer	Low (25)	30	10	16	17	26
603	Poland	Lead ETL developer	Low (25)	25	20	16	17	18
236	UK	Software engineer	Low (27)	22	25	16	30	8
495	USA	Software developer	Low (28)	28	25	9	12	26
129	UK	Development manager	Low (29)	21	29	27	8	18
635	South Africa	Tech leader	Low (30)	28	25	29	12	32
222	India	Consultant	Low (31)	32	29	22	12	30
787	USA	Non-professional	Low (32)	30	32	31	30	31

would support them in their current and future practice. In contrast only two learners with high SRL scores set goals around completion of the course or achievement in the assignments. As one participant (Number 673, ranked 5 for SRL; 8 for motivation) explained:

> *'The main aim is to become a better data analyst and get my introduction and get the concepts I need for data science, especially data science that revolves around building MapReduce programmes and Python programmes.'*

The specificity of learning objectives and goals highlighted in this quote was a common feature among high self-regulators. Ten of these learners, compared with four participants with low SRL scores, discussed their motivation in relation to the learning of specific skills and content knowledge, connecting gaining expertise with particular programmes with their professional roles and contexts.

In contrast, low self-regulators tended to discuss their learning in more abstract terms.

Seven of these learners, compared with only one high SRL learner, discussed their motivation in relation to their love of learning and curiosity to learn new things, and their desire to broaden their knowledge more generally. While their motivations were less specific, their goals were tied to concrete and extrinsic measures. Six participants with low SRL scores, compared with two high SRL participants, had goals around the completion of all the assignments and earning a certificate of completion. One participant (Number 495, ranked 28 for SRL, 28 for motivation) described their goals:

> *'I'm aiming to get a certificate of completion. I am aiming to get a passing grade and get a passing distinction grade out of the class … I took the course very seriously from the beginning and I planned to watch all the videos and go through all the assignments and at least I have all the compulsory assignments'.*

This difference in motivation and goal-orientation between high and low self-regulators is supported by the literature. Zimmerman (2000a) suggests that high self-regulators are more likely to adopt a 'mastery goal orientation', structuring their learning around the development of content knowledge and expertise. Pintrich and de Groot (1990) further suggest that intrinsic motivation is linked to self-regulation. Learners who believed their learning to be interesting and important are more cognitively engaged than those learners who are motivated by grades. The difference in motivation and goals between the two groups of learners in this study aligns with Pintrich and de Groot's (1990) distinction between learning versus performance goals. While many learners with low SRL scores did mention they were motivated by a love of learning, their goals were focused around traditional measures of performance (i.e. passing assignments, and course completion) whereas high self-regulators were less concerned about outward measures of performance than developing knowledge and expertise that was relevant to their professional needs. These findings also align Dweck's (2000, 2008) work on the distinction between growth and fixed mindsets. Learners with high SRL scores appear to possess growth mindsets, approaching learning as a challenging activity, which will foster growth in understanding and expertise.

4.2. Self-efficacy

The majority of participants, both high and low self-regulators, exhibited high self-efficacy scores. Despite these overall high scores, common themes emerged linking the accounts of learners with the highest self-efficacy scores. Furthermore, similarities were detected in the accounts of the five participants who had high overall SRL scores but scored in the bottom half of learners for self-efficacy.

The interview data suggests that high self-efficacy scores were particularly associated with two factors. First, higher self-efficacy was evident among twelve learners who were familiar with and had previous exposure to the content knowledge and data science skills and concepts that they were encountering in the MOOC. Learners who believed that they had a good basic understanding of data science were more confident in their ability to learn and engage in the MOOC. As one participant (Number 215, ranked 18 for SRL, 10 = for self-efficacy), reflected:

> *'I mean I had exposure to some of the content and I had some programming exposure before. So I thought, I mean I could grasp the contents easily and I was able to attempt all the assignment problems and do it without very much effort.'*

The second factor affecting self-efficacy was whether participants had previously participated in a MOOC (Number 505, ranked 15 for SRL, 10 = for self-efficacy):

> *'I would say I'm at the point now where I am very familiar with the platform and how to learn on a MOOC, at least in terms of what works for me. So I can tackle courses very efficiently when I'm doing them as a student.'*

This participant exhibits strong self-awareness of how he learns best. He attributes his ability to structure his learning to best suit his personal learning needs to his previous engagement in a MOOC. A similar finding was determined among the eight other participants who discussed their previous experience of taking a MOOC.

Being able to connect their learning experiences in a MOOC either to their existing knowledge or to previous learning experiences appears to increase learners' self-efficacy. This corresponds to theories of knowledge construction, which suggests that learning is easier when learners are able to connect new knowledge with existing knowledge, embedding it within existing cognitive schema (Anderson, 1982). Furthermore, the higher self-efficacy scores among participants who had previously engaged in a MOOC aligns with Zimmerman's (2000b) contention that self-efficacy is correlated with task familiarity and is sensitive to variations in performance context. Previous participation on a MOOC influences learners' perception and understanding of potential impediments to and opportunities for learning, which in turn influences their goals and outcome expectations, and which together shape their perceived efficacy (Bandura, 2000).

Five participants who had high overall SRL scores scored in the bottom half of learners for self-efficacy. These participants were not as confident in their existing content knowledge; however, they considered themselves to be effective learners and had confidence in their ability to engage with the course material. As one participant (Number 428, ranked 9 overall, 17 for self-efficacy) commented:

> *'No I've got immense faith in my ability to pick up new programming languages … So I know that the next assignment is using R, which I've never used before, but shouldn't be too difficult.'*

This suggests that learners' reports of self-efficacy may be more strongly influenced by their familiarity with the content with which they are engaging than their confidence in their ability to learn more generally.

4.3. Task interest value

The data revealed marked differences in how learners with high and low SRL conceptualised and understood the task interest value of participating in the MOOC. High SRL participants placed greater value on acquiring skills and content knowledge than those with low SRL scores. Twelve out of fifteen of these learners, compared with five low SRL participants, evaluated their engagement, both with the content and the specific activities and assignments, in relation to the skills they developed rather than the completion of formal learning tasks. The value of the MOOC lay in the provision of new knowledge and

expertise to support them in their current and ongoing professional roles. As one learner (Number 336, ranked 4 for SRL, 1 for task interest value) reflected:

> *'This course provides very practical information, they provide practical examples of how to use this knowledge in practice and I think it's very relevant.'*

Learners with high SRL scores were more likely to evaluate their learning in relation their professional roles, where the value of the learning process is inseparable from its application in their workplace context. The opportunity to utilise datasets drawn from their own contexts of practice in the MOOC was of particular value to these learners. Task interest value was connected to the real world applicability of the content and activities. The real world applicability of the learning activities, and the autonomy individual learners possess to determine how they engage with the activities, appears to enhance or facilitate the intrinsic motivation of these learners, catalysing their continued engagement in the MOOC (Ryan & Deci, 2000).

High SRL participants not only evaluated their learning in relation to their current professional context and needs but also were more likely to connect their learning to their future needs, with twice as many high SRL participants as low SRL participants discussing how their learning might support them in the future. One participant (Number 336, ranked 4 for SRL, 1 for task interest value) reflected:

> *'I think in future it will be related with my profession and so I want to go to a more sophisticated tool and I think that big data is the future, it's the profession of 21st century.'*

In contrast, while five low SRL participants mentioned the importance of real-world applicability, task interest value was more readily associated with performative outcomes by these learners. Nine out of fifteen of these participants discussed the importance of completing assessments and earning a certificate of completion. One participant (Number 448, ranked 19 for SRL, 26 for task interest value) commented:

> "*I hope by going through this with my time and efforts that I will get a certificate … I do like to see the reward by getting a certificate.*"

Value was measured extrinsically, with the certificate functioning as a signal of their learning. Seven low SRL learners, compared with only one high SRL learner, discussed the importance of the certificate for demonstrating to their employers what they had learned. As one participant (Number 783, ranked 23 for SRL, 17 for task interest value) explained:

> '*But for some reason this class motivated me to do whatever was required to get the certificate and it was just a psychological thing to satisfy myself.*'

The certificate becomes a symbol of learning and a physical object representing their achievement.

4.4. Task strategies

A wide range of task strategies were identified with little observable pattern between participants overall SRL score and the specific task strategies they employed. Fifteen participants emphasised the importance of familiarising themselves with the theories and literature behind the concepts they were engaging within the MOOC, with twenty learners indicating that they went beyond the material provided in the MOOC in order to supplement and enrich their learning.

While the specific task strategies being employed were evenly distributed among participants, differences were detected in the overall learning approaches between learners with high and low self-regulated learning scores. Highly self-regulated learners tended to be more flexible in their approach to learning. They were less likely to follow a linear progression through the MOOC, instead determining their own trajectory based on their individual needs. They also were more likely to adapt their approach to learning over time in order to best suit their needs. As one participant (Number 239, ranked 2 for SRL, 3 for task strategies) reflected:

> *'I think my knowledge and my background and my work experience was very, very helpful because whenever I (saw)-something I understood I just ditched it and went to another part of the course because I don't really see the point in repeating everything all the time.'*

This quote illustrates the learner's ability to modify and adjust their approach and the strategies they employed based on their unique situation. Zimmerman (2000a) suggests that higher levels of self-regulation are related both to a wide range of strategies and the ability to rethink the strategies employed throughout the learning process.

In contrast, learners with low SRL scores tended to be more structured and linear in their approach to learning. They were more likely to follow the course in a structured way, scheduling specific times each week to engage with the MOOC and pre-determining the activities and tasks they wanted to complete. Ten participants with low SRL scores compared with only five participants with a high overall SRL score, consistently set aside time each week for the MOOC. In contrast, six learners with high SRL scores engaged with the MOOC in a random and unscheduled way, compared with only two low SRL learners.

As many of the low SRL learners had the goal of completing all of the assessments and earning the certificate of completion, they not only engaged with more of the material but were also more likely to dedicate greater amounts of time to the MOOC. One learner (Number 135, ranked 22 for SRL, 29 for task strategies) described how they structured their engagement:

> *'I made a little Excel spreadsheet where the key dates, the sort of hard dates, were. So for example I knew an assignment had to be handed in on a certain day or I knew a quiz had to be handed in on a certain day or I knew a course project had to be handed in on a certain date and then I guess I sort of kept track of what lectures I'd need to have covered before I could answer those questions and I kept that in mind, so I kind of planned my way through it so I didn't miss any of the hard deadlines.'*

This learner employed a structured approach to their learning, establishing the strategies that they will utilise prior to engaging.

The variation in task strategies between high and low self-regulators corresponds to the motivations and goals structuring their learning. Those learners who were looking to build their knowledge of and skills in data science adopted more fluid task strategies and were less linear and more flexible in how they structured their learning. Learners who were aiming to gain a certificate of completion and to complete all of the assignments were much stricter in their time management and more structured in their approach. These learners approached the MOOC as a more formal learning opportunity, similar to a traditional HE course. In contrast, learners (generally those with higher self-regulated learning scores) who conceptualised the MOOC as a non-formal learning opportunity that supported their professional learning and development were less structured in how they approached the MOOC.

4.5. Self-satisfaction and evaluation

Both high SRL and low SRL participants used the exercises and assignments in the MOOC as a benchmark to evaluate their performance. However, differences were detected in their evaluative strategies. High SRL participants used the activities as an opportunity to monitor their progression. Seven high SRL participants discussed how they primarily saw the assessments as being formative, providing them with a means to track their progress and understanding throughout their learning

journey. The assignments provided a means to self-assess their learning, with knowledge and expertise development rather than achievement on the assignment signalling learning for them. The assignments further provided a way for learners to question how they could improve or have done things differently. As one participant (Number 239, ranked 2 for SRL, 1 for self-satisfaction and evaluation) reflected:

> '*The most interesting part was just to try and do it and check if I understood it correctly and then going into the forums and looking at what other people thought about and how did they approach it and maybe if my approach was good enough or if there were other better approaches that I could use.*'

The assignments are used as a tool to test and evaluate learning and understanding and to compare working processes in relation to other learners. Importantly, however, these types of learners are not attempting to measure their performance against others but rather are using other people to question how they can improve their own approach.

In contrast, the low SRL participants were more likely to conceptualise the assignments as being summative, functioning as the end point of their learning. Only three low SRL participants discussed the formative role the assignment played. They completed the assignments in order to learn rather than using them as a self-evaluation tool. As one learner (Number 396, ranked 17 for SRL, 18 for self-satisfaction and evaluation) commented:

> *'I wanted to get this statement of accomplishment. It's kind of a mixed thing, I wanted to learn and I wanted to do the assignments to prove that I've learnt them and the lectures you can watch anytime, they are not really on a time schedule.'* [396]

Five low SRL participants acknowledged that it was often difficult to perceive and measure their own learning '*Yeah that's a difficult question because I don't perceive my own learning*' (Number 396, ranked 17 for SRL, 18 for self-satisfaction and evaluation). The three participants with low overall SRL scores but who scored highly for self-evaluation discussed their persistence when they struggled with an assignment, associating learning with their determination when encountering challenging activities. These three learners exhibited growth mindsets (Dweck, 2008), seeing the challenge as an opportunity to foster growth and deeper learner.

Self-satisfaction was strongly connected to learners' initial expectations and goals for the MOOC. Those participants (six low SRL and two high SRL) who wanted to complete all the assignments and receive a certificate of completion and approached the MOOC as a formal learning opportunity tended to be less satisfied with their learning. They were more likely to identify the ways in which they could have participated more and were more likely to express disappointment in their performance. As one learner (Number 448, ranked 19 for SRL, 8 for self-satisfaction and evaluation) explained:

> *'I have learned a lot, but I'm not really satisfied with the quality I have learned, as myself, I say I should have done better. But that's, well unfortunately that's a misestimating at the beginning from my side, it's more demanding than I had planned to engage in.'*

Among the high SRL participants, there was a consistent pattern of being highly satisfied with their participation and learning. These learners were more motivated by a desire to enhance their expertise than to achieve certification. They tended to be more informal and less structured in their learning approach, engaging with the content and activities that they determined would support their individual needs. Seven of these learners compared with only two low SRL learners discussed being satisfied with the range of content and skills that they had learned. Three high SRL learners mentioned that while being satisfied with what they had learned, they believed that they could have learned more, while five low SRL participants expressed dissatisfaction with the amount they had learned during the MOOC.

This connection between the forethought phase (motivation and goal setting) and the self-reflection phase (evaluation and self-satisfaction) aligns with Zimmerman's (2008) suggestion that learners who set specific goals were more likely to adopt mastery criteria to self-evaluate rather than normative criteria. Other research (Zimmerman & Kitsantas, 1999) has identified that learners' feelings of satisfaction with their performance were predictive of forethought-phase sources of motivation. It appears that in a MOOC setting, learners are evaluating their learning performance and determining their satisfaction in relation to their goals for learning and participation. Those with more formal-style learning goals, associated with achievement in assessments and completion were more likely to be less satisfied than those learners who were approaching the MOOC as a non-formal learning opportunity and were interested in developing expertise and knowledge to support them in their professional contexts.

5. Conclusions

The findings of this study have identified differences in behaviour associated with five SRL sub-processes – motivation and goals setting, self-efficacy, task interest value, task strategies, and self-satisfaction and evaluation – between MOOC participants classified as having high overall SRL scores and those with low overall SRL scores. All three of Zimmerman's (2000a) SRL phases – forethought, performance, self-reflection – are represented by these sub-processes. Zimmerman suggests the phases and sub-processes of SRL occur cyclically, with significant correlations between variables within SRL phases and potential causal influence of SRL processes across phases. The findings of this study support this theory with motivation and goal setting particularly strong drivers of learners' perception of the other four sub-processes. Marked differences were determined between the motivations and goals of learners with high SRL scores and low SRL scores. These differences in turn shaped how these two groups of learners were conceptualising the purpose of the MOOC, which in turn affected their perception of the learning process.

Individuals with high SRL scores engaged with the MOOC primarily as a professional learning opportunity. Their motivation and goals for participation centred around the development of knowledge and expertise that was tied specifically to their workplace context rather than more extrinsic motivations such as passing the assignments and receiving the certificate of completion. This led to their conceptualisation of the MOOC as a non-formal learning opportunity, enabling each learner to independently determine activities and material they would engage with based on their individual needs, rather than the more formal course requirements. By centring their engagement around their specific needs, they adopted more flexible task strategies, which enabled them to readily adapt their approach as and when they needed to. The close connection between their participation in the MOOC and their workplace needs (both present and future) led these learners to score highly for task interest value, as they could apply their learning directly to their professional roles and workplace tasks. This focus on expertise development for their professional roles rather than formal achievement translated into higher overall satisfaction.

It is possible that the more open and flexible approach adopted by these learners, required them to be more self-regulated in their learning. Because they were not conceptualising the MOOC as a traditional HE course, with a linear progression towards pre-established performative goals (assessments and completion), these learners had to determine independently with what content and how often they would engage. These participants evaluated their learning in relation to how well it related to their professional roles and continually adjusted their engagement in order to ensure that they were gaining maximum learning outcomes (as determined by themselves, rather than in relation to formal assessments or external markers). This finding has

important implications for how MOOCs are evaluated. The binary division between completers and non-completers is not an adequate measure of quality or of learning in MOOCs. It fails to take into account the varied goals of learners or the ability of individual learners to determine personal markers of success.

In contrast, those learners with low overall SRL scores tended to be more concerned with gaining a certificate of completion and consequently were more focused on completing all of the activities and assessments. While also engaging in the course to support their professional development, these learners were more likely to be driven by extrinsic motivation factors, and used external markers as evidence of their learning. These learners were less likely to connect their learning to specific workplace tasks or to discuss how they were actively applying the knowledge and expertise they were developing in their work context. They tended to conceptualise the MOOC as a formal learning activity, adopting a more uniform and linear approach to their engagement. Their learning was centred primarily on the MOOC itself, rather than being distributed between the MOOC and the offline setting of their workplace. This led to lower levels of task interest value, as learners were less consciously connecting their learning to their wider settings. This influenced the ways in which these learners assessed their learning, with most learners using extrinsic measures, such as achievement in the assessments or completion of the course, to evaluate their learning. It is possible that the higher levels of extrinsic motivation and the conceptualisation of the MOOC as a formal learning activity among these low SRL learners meant that they had less need to self-regulate their learning compared with participants who adopted a less linear and more flexible approach to their learning.

Self-regulation is not fixed and previous studies have identified the role that context places in determining an individual's self-regulated learning (Pintrich, 2000). In this study, there appears to be a difference between how learners with high overall SRL scores and low overall SRL scores conceptualised the learning environment of the MOOC. Distinctions were detected between formal, certification-oriented participation where learning was primarily centred on the MOOC versus non-formal, professional-development oriented participation where learning was centred on the utilisation of knowledge in real-world contexts. While a connection between a learner's motivations and goals and their conceptualisation of learning in MOOCs is apparent in this study, it is not possible to determine which is the driving factor. Does a learner's motivation and goals for a MOOC influence the learning approach they adopt and consequently their overall self-regulated learning? Or, does a learner's self-regulated learning influence the approach that they adopt and shape their motivations and goals for the MOOC?

As with any study, there are a number of limitations influencing the findings and conclusions that can be drawn. The data reported derives from participants in a single MOOC and as such without further studies there is no way of knowing whether the findings identified here would also be evident in other MOOCs. Interviews were only conducted with a specific group of learners within the MOOC: those participants who were working as data professionals. Undertaking further research to investigate the perceptions of learners from other contexts and roles could provide deeper insight. The study only sampled participants who were still participating in the MOOC after several weeks. MOOCs suffer from high attrition rates, particularly in the first few weeks. Capturing data from these learners could provide valuable insight into the reasons for their dropping out and how their learning behaviours influenced this decision.

The interview schedule utilised by this study was designed to elicit narrative descriptions of self-regulated learning that could be analysed in relation to eight pre-identified SRL sub-factors. The interview data did not yield sufficient evidence to allow extensive analysis of learners' perceptions of all of the SRL sub-processes. Furthermore the interrelated nature of the sub-processes makes it difficult to separate out the individual sub-factors from each other. Refining the interview instrument to better target all of the sub-processes could yield more robust data.

Despite these limitations the study does provide clear evidence of the variety of learning behaviours of participants in a MOOC and that some of this variation is related to learners' ability to self-regulate their learning. This finding has important implications for MOOC designers. Given the diverse backgrounds of learners and the egalitarian mission of MOOCs to open up education to all, understanding how to support learners with different dispositions and abilities is critical. The association between learners' motivations and goals in a MOOC and their subsequent perceptions of their learning behaviour determined in this study has significant implications for future research in MOOCs.

While most previous research into learning in MOOCs has focused on completion and retention rates as proxies for learning, this study suggests that these may not be the most appropriate measures to employ. While accountability in education is frequently measured in terms of qualifications, this study suggests that in the MOOC context, learning is more nuanced. The diversity of learners participating in MOOCs leads to a range of learning motivations and goals, not all of which are focused on traditional measures of educational success. Given the current "knowledge economy", and the growing importance of lifelong learning and "knowing how to learn", it is necessary to question whether we should focus on certificates at all. Measurement of learning in a MOOC must move beyond extrinsic or performative measures to also examine the intrinsic motivations and personal outcomes by which learners measure their learning. Therefore, gathering empirical evidence on new forms of capturing, measuring and assessing learning that are specific to the MOOC context is critical.

By virtue of the unique characteristics indicative in their name – namely their massive scale, their openness and their online setting – MOOCs challenge many of the traditional modes of education. In doing so, they question traditional pathways, purposes and outcomes in education. Research must engage deeply with these differences in order to enhance the learning opportunities that MOOCs, and future forms of open learning, provide for all learners.

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