MOOCs for Sustainable Development:
SDG Academy Lessons for motivations, learning, completion and impact

Neha Sharma, Chandrika Bahadur
The SDG Academy
neha.sharma@unsdsn.org
475 Riverside Drive, Suite 530, New York 10115, USA

Abstract

MOOCs provide an effective platform for providing access to high quality and wide scale education at a significantly lower cost. However, high dropout rates and lower completion rates of these courses have time and again, raised a question on the effectiveness or success of open online courses. Whether or not completion rates should be used as an indicator for calling a MOOC successful has also been discussed and frequently debated. Learners from diverse environments and backgrounds join the courses with different motivations and hence have different ideas of 'completion' with respect to the MOOC. Learner behavior also varies between technical and non-technical courses. There is a gap in the research literature on why the most popular MOOCs are technical in nature and what motivates learners to opt for online courses in social disciplines. Launched in 2014, the SDG Academy is an online education portal that creates and curates educational content on sustainable development and makes it available as a global public good. Delivered as massive open online courses (MOOCs), mini-series, live webinars, and curated resources, this content is available for a diverse worldwide audience who join the courses with different motivations and personal learning goals. The study intends to address three primary research questions: 1. what are the motivations which drive learners to enroll in courses on sustainable development 2. what is the impact these courses have on learners personal, professional, and academic lives, and 3. what design features and marketing efforts drive the greatest enrollment and completion rates? The study closes with recommendations for a more effective MOOC design for enhanced learner experience and increased access and inclusivity in an online learning environment. While the focus of this research is specifically on MOOCs in the field of Sustainable Development, insights gained from this study may be applicable when considering learners' enrolment, motivation, and completion in other areas of study.

Keywords: MOOCs, Sustainable Development, Enrolment, Completion, Motivations, Impact

1. Introduction

1.1 MOOCs: Promises and Reality

Massive Open Online Courses (MOOCs) are an effective platform for providing access to high quality and wide-scale education at a significantly lower cost. Over the last several years, the promise of MOOCs has mobilized movements to 'democratize' learning and transform global education (de Moura et al, 2017, pp. 139-153). Offered to a large number of participants simultaneously, these courses provide unrestricted access to learners from all socio-economic and academic backgrounds. Some MOOC providers charge a fee for a completion certificate, but a wide majority, if not all, provide open access to all the content resources without any charge.

While classic online courses try, and replicate methodologies employed in a brick and mortar classrooms and are restricted by the predetermined role of the lecturers, duration of the course, curriculum and scale, MOOCs steer away and put a special emphasis on open access

features such as open content and flexibility in structure and learning goals. The focus is on student centered learning, where the pace of learning and content consumed is guided by the motivation and convenience of the learner (Czerniewicz et al, 2015). Massive as they are in their nature, these courses are designed to provide affordable access, accommodate individual learning styles; allow learners a flexibility to pick topics from across domains, interact with peers around the world, or learn by themselves at their own time convenience.

It has almost been a decade since the first ever MOOC was launched by the University of Manitoba in 2008 followed by a radical spike in audience interest in taking these massive online courses in 2011, with over 160,000 learners from 190 countries, enrolling for a course offered by Stanford University and the Massachusetts Institute of Technology (MIT) (Mota and Scott, 2014). MOOCs as discussed before, theoretically, offer a promise of an education biosphere where curriculum is open, and learning is not restricted by geography, gender, learner profile or professional or academic background. This combined with an exponential increase in the online learning platforms in the past decade has consequently led to the explosion of open courses being offered by academic and non-academic institutions alike. In 2012, New York Times also ran a story declaring the year as the 'Year of the MOOCs' (Pappano, 2012). Data from a recent report showed that over 100 million learners from around the world are currently enrolled in the MOOCs across various platforms. It also reported a sustained incremental trend in the number of academic institutions offering MOOCs since 2012, with over 900 institutions announcing or launching 11.4k MOOCs in the year 2018 alone of which 2,000 courses were new and were being offered for the first time (Shah, 2018).

With the interest in MOOCs still on the rise, questions have been raised time and again on the effectiveness or success of these courses. The most widely raised concerns pertain to the relevance and contextualization of content design, high rate of drop- out students and low completion rates (el Emrani, et al, 2017; Barberà, 2017, Zhang et al, 2019, (Werner 2014)). MOOCs promise inclusion beyond barriers, but as studies have revealed, they often struggle with providing language of instruction beyond English and accommodating cultural differences in pedagogy (Fini, 2009, Haggard and Stephen, 2013). While dedicated platforms like MiriadaX, Edraak and XuetangX offer MOOCs in local and regional languages, a majority of the courses offered globally are developed in English and require an understanding of the language as a prerequisite (Baturay and Huri, 2015). MOOCs are also bound by the financial constraints of localizing content and pedagogy and offering translations in multiple languages, and often get restricted to providing a common course for a diverse learner audience. While the flexibility of the MOOC model succeeds in driving enrolments, they struggle with the challenge of retaining learners till the end of the course (Khalil et al, 2014). Data from courses offered on edX, Coursera and Udacity illustrated that the majority of MOOCs have a completion rate of less than 10% with a median average of 6.5% (Jordan, 2014). and these low completion rates have not improved over the past 6 years (Ruipérez-Valiente and Reich, 2019)

This conundrum between the ability of MOOCs to bridge the knowledge gap, offer unrestricted access and garner high enrolments against high dropout rates and low completion rates, highlights the pressing need to explore the factors that affect a learner's behavior in an online learning environment and understand their relevance in teaching complex issues like that of sustainable development.

1.2 Sustainable Development

Sustainable development is the great challenge of our time. In 1987, the Brundtland Commission defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, G.,1987. p35) - a call that remains relevant and still urgent today. Towards this, in September 2015, 193-member states of the United Nations adopted Agenda 2030 and 17 Sustainable Development Goals (SDGs) that provides a broad framework aimed at eradicating poverty

and hunger, reducing inequalities, economic growth, environmental protection and the promotion of peace and good governance universally. The 2030 Agenda is holistic with deep and complex interactions across the SDG domains. The 17 SDGs are integrated and complementary and need to be addressed in unison. Governments and international actors cannot focus on individual or selected SDGs as that could lead to multiple trade-offs across the domains and will result in missing out on synergies and multiple co-benefits.

It requires global cooperation and strong and growing alliances to protect and further develop a rule based global order. To leave no one behind globally, to protect the planet, and to develop multiple sustainable development pathways across scales are key ingredients to shape a peaceful future between our highly interdependent societies. (TWI2050 - e World in 2050, 2018)

A recent study also draws out potential transformation pathways toward attaining the Agenda 2030, by mapping out necessary actions to operationalize the SDGs (Six transformations paper, Sachs, Schmitt-Traub). But these transformations can only be realized by a cadre of practitioners, a workforce, equipped with the skills to achieve an agenda as complex as Agenda 2030. The challenge of Sustainable Development has implications for our economies, consumption habits, health and wellbeing, education, work, and security. Such comprehensive applicability means that sustainable development is everyone's business- but not everyone understands how the agenda applies to them, or they lack the knowledge of how to make sustainable changes to their work and lives.

1.3 SDG Academy- an initiative offering education on Sustainable Development

The SDG Academy is the flagship online education initiative of the United Nations Sustainable Development Network (SDSN), an independent nonprofit created in 2012 under the auspices of the UN Secretary-General to mobilize the global academic community to promote practical solutions for sustainable development.

The SDG Academy leverages SDSN's unique access to the world's leading voices in sustainable development to create and curate the best educational content on sustainable development and make it available as a global public good. Delivered as massive open online courses (MOOCs), mini-series, live webinars, and curated resources, the SDG Academy content is available for a diverse audience worldwide. Since 2014, the initiative has created 26 courses across diverse issues of Sustainable Development such as early childhood development, public health, food and agriculture, and environmental security; featuring renowned experts from premiere academic/ nonacademic institutions globally.

The SDG Academy courses are provided as xMOOCs (Pilli and Admiraal, 2017) and offered on edX, one of the world's largest MOOC platforms, along with regional platforms in China and the Middle East to increase its reach in these key geographies through content translation and regionalization (Chiam, 2016; Pickard and Shah, 2019). The courses have collectively garnered over 200,000 enrolments from over 180 countries.

The courses are modular and don't require prior subject knowledge as a prerequisite, thereby reaching out to a wide base of audience. Each course is 5 to 8 weeks and can be instructor paced; with a fixed offering duration and content release schedule, or self-paced; remains open after release and provides learners the flexibility of moving at their own pace. The video lectures, discussion activities, reading material and assessments are linearly arranged and have graded and ungraded components. Despite the chronological or linear structure of the course material, students are free to navigate back to already published content and repeat or skip lessons. They can also engage in discussions with their peers in the course and interact with the course faculty directly through live webinars hosted periodically. The course material

is provided free of charge and learners can elect to purchase a Verified Certificate, as a proof of course completion.

The SDG Academy courses have an average verified certification rate of 3.25% with an average enrolment of 3,385 learners across all courses. Each course witnesses learners representation from approximately 135 countries with an average of 35% of verified learners coming from middle or low-income economies. An average SDG Academy learner is 32-year-old, has a masters degree and is employed in an industry related to the course topic. Learner demographics represent and overall equal gender representation.

The SDG Academy MOOCs offer comprehensive knowledge on the most pertinent issues in the field of sustainable development. The agenda of sustainable development applies equally to all individuals and all economies and these courses provide inclusive and free access to learners across the barriers of geography, gender and socio-cultural and economic backgrounds. These courses are non-technical in nature and contribute to academic and professional capacity building, unlike courses in the field of technology or business, which till date are the most popular category in the online learning landscape, where the impact reflects tangibly in vocational outcomes. Then why do learners take Sustainable Development courses in such high numbers? It would be interesting to get an insight on the intrinsic motivation which drives learners to enroll in the SDG Academy courses and understand the rationale behind their choices and behavior in the course. This study intends to explore various factors which have an impact on learner enrolment and completion and understand the impact these courses have on learners' personal, professional or academic life.

We begin by reviewing the literature on different variations in learner behavior and motivations in an online learning environment and the initial trends reported in MOOC enrolment and completion across different technology platforms. The main part of this paper includes our study methodology, findings, as well as a discussion of the results from which we infer design implications.

2. Literature Review:

2.1 MOOCs to teach Sustainable Development:

Sustainable development is a wicked problem that poses one of the biggest challenges humanity has ever faced (Pryshlakivsky and Searcy, 2013). The paradox of economic and technological advancements against tremendous inequalities, social exclusion, and environmental destruction led the 193 Member States of the United Nations to come together in 2015 and adopt the Sustainable Development Goals (SDGs), a universal call to action to end poverty, protect the planet, and ensure that people everywhere live in peace and prosper (Sachs, 2014). This ambitious framework calls for a drastic shift in the way that governments and society pursue economic development, while accounting for development's effects on social inclusion and the environment, highlighting the pressing need for a skilled workforce equipped with the understanding of the complex and interlinked nature of the SDGs.

Achieving the SDGs requires the dissemination of evidence-driven, globally-relevant knowledge and training to policymakers, researchers, innovators, and professionals who are on the front lines of this work.

This has long been recognized by the international community--the United Nations declared 2005 to 2014 the Decade of Education for Sustainable Development (ESD), and placed particular emphasis on higher education as a key sector for providing future decision-makers with the knowledge, skills, and values necessary to tackle the world's challenges https://en.unesco.org/themes/education-sustainable-development/what-is-esd/un-decade-of-

esd. UN Academic Impact was formed in 2010 to bring the global academic community in line with United Nations objectives through its teaching and research activities, counting more than 1300 institutions among its ranks to date https://academicimpact.un.org/content/about-unai· Additionally, as of 2013, more than 300 universities and organizations had joined the Higher Education Sustainability Initiative (HESI), another UN platform for sharing best practices and institutional commitments to sustainability (https://sustainabledevelopment.un.org/sdinaction/hesi). The development of these shared platforms and communities demonstrate an increasing awareness of the importance of post-secondary education to the sustainable development agenda, and the need to create capacity-building opportunities for institutions looking to align themselves with these goals.

Yet, while these global partnerships and communities seek to engage institutional actors from across the world, their members and activities are often skewed towards higher-income countries and the Global North. Academic/Research institutions, across economies, suffer from the challenges of complex coordination between different institutional actors; including faculty, administration, finance, and governance, need for innovation in staff training and institutional capacity to accurately present the inherently interdisciplinary topic of sustainable development. What's more, focusing the global conversation around academic institutions relegates the nearly 1 in 5 unemployed young people who are not in education or training to the sidelines of education for sustainable development (International Labor Organization, 2019) and leaves out professionals who are unable or uninclined to seek out professional development in this area.
The imminent need for mass education and trainings on the urgent and complex issues of Sustainable Development, highlights the role Massive Open Online Courses can play in providing flexible, high-quality, affordable and contextualized learning content in the most underserved regions of the world. MOOCs can serve as efficient vehicles to reach out to a diverse audience providing relevant and correct information most suitable to their social, academic or professional context (Wildavsky, 2015; Cutrell et al, 2015)

2.2 Wide variations in learner behavior and motivations in an online learning environment

Technology based learning distinguishes itself from traditional classrooms by offering student-centric learning environments. Along with the freedom to progress at their own pace, the ownership to learn and/or complete the course also resides solely with the learners. A MOOC environment has learners from diverse backgrounds who display unique learning patterns in exploring the course material. Their diverse learning styles guide their behavior, motivation and expectations in an online learning environment.

MOOCs offer learners the freedom of defining their own learning trajectory and create their own learning patterns, but most courses have a linear or chronological organization of course material, guiding the learning sequence. Students have the freedom to break free from the regimented alignment, but it was observed that only learners from high income economies broke away from the set pattern and approached the content non-linearly. Most students follow the predefined patterns of the course design and do not explore much (Pask,1976; Liegle and Janicki 2006). They prefer guided instruction and a predefined learning pathway without becoming the "self-directed autodidacts" as common MOOC environment expects them to be (McLoughlin, 2013, Kizilcec, 2013). Student behavior is also guided by age and geography, with older, more experienced students and those from countries with lower student-teacher ratios (e.g., the US and European countries) covering more material and navigating non-linearly as compared to younger learners and those from countries with higher student-teacher ratios (Guo et al, 2014).

The diversity in learners' profile, socio-economic backgrounds and academic and professional expectations also influences their motivation or objective for joining a MOOC. In a study on

learner motivations by Stanford University (Kizilcec and Schneider, 2015) only about half of the learners reported enrolling with the intention to earn a certificate of completion. A number of learners have been found to take online courses for the opportunity to learn socially, gratify heterogeneous desires such as meeting new people or general curiosity. Another study demonstrated volunteerism along with professional development as one of the primary motivators (Loizzo et al, 2017). Nearly half of the informants in this study reported that they were motivated by their enjoyment of MOOCs, and many identified this as their primary reason for enrolment. Respondents also cited the modular nature of the MOOCs as their motivation, which allowed them to access blocks of information on the topics they wanted to learn about specifically from referring to multiple MOOCs simultaneously and leave the courses as their personal learning goal was reached. Hence, completing the full course sequentially and /or obtaining a completion certificate is reduced to only 'one of the' intended objectives. Learners also cited the 'entertainment' value of the MOOCs, information retrieval and learning with peers as a relevant motivator. Similar motivations were reflected in another study where general interest in learning, receiving a verified certificate, curiosity about the course topic and excitement of taking an online course were reported as the four main reasons for learners to enroll in MOOCs (Hew et al, 2014).
The nature of the course and its real-world relevance also motivates students' decisions for enrolments. Across all technical platforms the highest percentage of MOOCs are offered in the field of technology (20.4%) or business (18.2%) due to their potential of monetization. Learners also gravitate towards technical or skill-based courses as they promise an immediate vocational impact, whereas non-technical MOOCs provide foundational knowledge for future academic or professional capacity building. There is a gap in the research literature on why the most popular MOOCs are the ones technical in nature and what motivates learners to opt for online courses in social disciplines.

Motivations align with personal learning objectives, prior knowledge and skills and are reflected in the learners' expectations and define their level of participation in the course (McAuley et al 2010). A study demonstrated that learners who intended to be active participants in the course from the very beginning had displayed higher chances of MOOC completion (Pursel et al 2016). A positive relationship was also observed between learner motivation, participation, and performance, with learners who stayed till the last few weeks of the course displaying higher odds of completion (de Barba et al, 2016)

2.3 Initial Trends in Enrolment and Completion of Massive Open Online Courses

MOOCs are celebrated due to their open access, reach and flexible affordable nature and their appeal succeeds in drawing large numbers of enrolments. A 2014 study across 90 courses reported a median enrolment of 42,844 learners per course across technology platforms (Jordan, 2014). A recent study from class central reports that the number of students enrolling in MOOCs has gone down marginally with 23 million new learners enrolling in 2016 and 2017 each, down to 20 million new learners in 2018. But despite this decline in enrolments, the number of paying users seems to have increased, encouraging the course providers to offer a high number of courses every year.

However, in spite of promising inclusive access and high heterogeneity, studies reveal that enrolment trends demonstrate a considerable degree of homogeneity in learner background, academic qualification and gender. Most MOOC enrollees are from high income countries, male, college degree holders and, employed full-time or self-employed (Davis et al, 2014). It was also observed that course subject or topic affected gender parity in learner enrolments with an underrepresentation of women in topics pertaining to the field of science, technology, engineering, and math (Macleod, 2015). So, while a large number of students enroll in these courses every year, MOOCs are still struggling to level the playing field in terms of enrolments.

Most MOOCs also fail to accommodate individual motivations and multiplicity of learning goals while offering an open learning environment to students. Course providers often expect all enrolled learners to finish the course or stay engaged till the end in order for the course to be declared successful. Sustained learner attendance and verified certificates have been used as a proxy for MOOC 'success' and 'completion' respectively in a wide majority of studies (Garza and Gomez-Zermeno, 20XX; Hadi and Gagen, 20XX) In a study across 39 courses for their completion, the median completion rate was reported to be 6.5% which has since sparked the debate of considering completion as the appropriate parameter for measuring learning and effectiveness of MOOCs. Considering the variation in learner motivations and expectations quantitative indicators such as completion and dropout rates can be considered as just one measure of a course success. Micro learning within the course and relevant knowledge acquisition should also be factored in while considering factors contributing to the success of a MOOC (Hadi et al, 2016).

3. Motivation of this study and Research Questions to be addressed:

In examining completion and engagement with courses, studies have focused upon characterizing types of learners and ascribing course completion primarily to student demographic and motivation (Morris et al, 2015; Kizilcec, Piech, and Schneider, 2013; Koller, Chuong, and Zhenghao, 2013). There is a gap in the research literature about the potential role of the course characteristics and design on student enrolment along with the marketing and promotional efforts in drawing audiences to participate in the course and their effect upon enrolments and completion rates, which this study intends to explore.
This paper seeks to synthesize the data available from the 22 SDG Academy courses on Sustainable Development, offered on edX and responses collected from 800 SDG Academy course alumni through an online survey, to answer fundamental questions around learner motivations, role of course design, and marketing efforts in driving course enrolments and completions and the impact of these courses on a learner life. For the purpose of this study, course completion was considered as the total number of verified certificates obtained by learners in each course.

The study intends to demystify learner behavior in an online learning environment by answering the following Research Questions:

1. What is the impact of Course Design and Marketing Efforts on learner enrolment and completion rates for Sustainable Development courses in an online learning environment? (RQ 1)
2. What motivates a learner to enroll in courses on Sustainable Development? (RQ 2)
3. What impact do Sustainable Development MOOCs have on a learner's personal, academic or professional life? (RQ 3)

4. Nature of the Study and Rationale Relevance

A mixed method investigation was employed for this study where RQ 1 was analyzed using OLS Multiple Regression and RQ 2 and RQ 3 were explored through a Research Survey administered to participants of the SDG Academy courses.

For answering RQ 1, multiple regression was chosen as the approach for analysis because the study intends to explore various components of course design and marketing efforts for being good predictors of a) enrolments and b) completion in a course instead of explaining the impact of predetermined variables seeking to fit a model. Log data was gathered from edX backend, for 22 SDG Academy courses with 74,462 students enrolled, from September 2018-June 2019 and was synthesized for providing a wide frame to understand the learner behavior behind enrolment and completion.

For answering RQ 2 and RQ 3, an interpretivist methodology is employed, allowing for more nuanced insights into why sustainable development MOOCs are pursued and the impact they have on a learners personal or professional life. This approach allows for a deeper understanding of their motivations, learning goals and their idea of success in a MOOC. 1400 SDG Academy course alumni were randomly recruited from learners who had registered and provided their email addresses voluntarily for future communication, for the MOOCs offered by the SDG Academy on edX in the past 6 months. A short survey was administered to the participants, who had consented to participate in the study, using Internet based Research (IBR) methods and results were coded and analyzed.

5. Methodology

The study was conducted using two distinct analysis methods, in order to answer the respective research questions:

5.1 RQ 1: What is the impact of Course Design and Marketing Efforts on learner enrolment and completion rates for Sustainable Development courses in an online learning environment?

5.1.1 Data Set Description:

Table 1 shows an overview of the indicators whose effect we intend to explore on the course enrolment and completion. We group these under two distinct categories of 'Course Design and Marketing Efforts' and then proceed to a detailed feature space study (independent variables are also referred to as features/dimension of the data, henceforth features wherever mentioned denote an independent variable) of this dataset. The analysis data obtained from three different sources:

1. Course design data was obtained from the 'About' page of each course on edX front end. This page contains introductory details about the course (course overview, course syllabus, lead faculty details, course length, course subject, course language, number of hours required per week, languages the transcript is available in and prerequisites if any), which helps students decide whether or not they want to enroll in the course.
2. Marketing efforts statistics were compiled from Facebook, Twitter, LinkedIn and MailChimp analytics through the administrative access of SDG Academy accounts on these platforms.

	Features explored for predicting Course Enrolment		**Features explored for predicting Course Completion**
Course Design	Course length in weeks		Verified Track Enrolments
	Number of languages the course transcript is available in		Average Length of Videos (min)
	If the course is Self-Paced		Average Video Completion %
	If the partner institute is a university or not		Active Learners/Day
	If the university offering the course is in the top 20 of QS Ranking (QS, 2019)		Total female lead instructors
	If the partner institute is a civil society or an international organization		Total male lead instructors
	If the partner institute is a UN organization		Total number of lead faculty from high income countries
	If the partner institute is a private organization		Total number of lead faculty from upper middle-income countries
	Total female lead instructors		Total number of lead faculty from lower middle-income countries

	Total male lead instructors		Total geographical diversity of the faculty (across continents)
	Total number of lead faculty from high income countries		Required Readings Total
	Total number of lead faculty from upper middle-income countries		Required readings 2-3/week
	Total number of lead faculty from lower middle-income countries		Total number of assessments
	Total SDGs covered in the course		Total Questions for assessment
	Total number of lead faculty from Africa		Total live sessions (webinars)
	Total number of lead faculty from Asia		Total Faculty who took the live webinar sessions
	Total number of lead faculty from North America		Total TA discussion posts
	Total number of lead faculty from Europe		Average weekly TA discussion posts
	Total number of lead faculty from Oceania		Total student discussion posts
	Total number of lead faculty from South America		
	Total number of lead faculty from Middle East		Average weekly student discussion posts
			Total TA emails sent
Marketing Efforts	Total no. of weeks for which the course was promoted		Total no. of weeks for which the course was promoted
	Total mentions in the SDG Academy newsletter		Total mentions in the SDG Academy newsletter
	Total clicks on the news links in the newsletter		Total clicks on the news links in the newsletter
	Total Email Blasts sent out for the course towards targeted community		Total Email Blasts sent out for the course towards targeted community
	Total 'Opens' for the email blasts		Total 'Opens' for the email blasts
	Total clicks on links in the email blasts		Total clicks on links in the email blasts
	Total posts on Facebook promoting the course		Total posts on Facebook promoting the course
	Total paid posts on Facebook		Total paid posts on Facebook
	Total organic reach/views for the course promotions on Facebook		Total organic reach/views for the course promotions on Facebook
	Total paid promotion reach/views for the course on Facebook		Total paid promotion reach/views for the course on Facebook
	Total shares for the course promotion posts on Facebook		Total shares for the course promotion posts on Facebook
	Total tagged posts for a course on Facebook		Total tagged posts for a course on Facebook
	Total Posts on Twitter for promoting the course		Total Posts on Twitter for promoting the course
	Total impressions/views for course tweets		Total impressions/views for course tweets
	Total retweets for course promotions		Total retweets for course promotions
	Total tagged posts/mentions for the course on Twitter		Total tagged posts/mentions for the course on Twitter

	Total posts for course promotion on LinkedIn		Total posts for course promotion on LinkedIn
	Total reach/views for course promotions on LinkedIn		Total reach/views for course promotions on LinkedIn
	Total shares on LinkedIn		Total shares on LinkedIn

Table 1: Features analyzed for predicting Course Enrolment and Completion

5.1.2 Feature Engineering:

We created analysis variables for course design and marketing design parameters for efficient synthesis.

Course Design: Course length, transcript languages, lead faculty gender, and geographical background were considered in count of variables. Data for a) Course nature (Self-Paced or not) and b) Presence of the organizing university in the top 20 of the QS ranking, c) If organizing institute was a civil society/ international organization, a UN organization or a private institute and d) SDGs covered for under each course was transformed through one hot encoding where each data column was split into 2 and a “0” or “1” value was allotted to each of the split columns. The same approach was employed for creating the criteria for the number of readings offered per week.
Averages of individual course data was calculated for identifying length of videos and video completion rates.
Count of variables were considered for analyzing Marketing efforts.

The data in the above-mentioned analyses was standardized before regression, in order to facilitate direct comparison between their coefficients after regression.

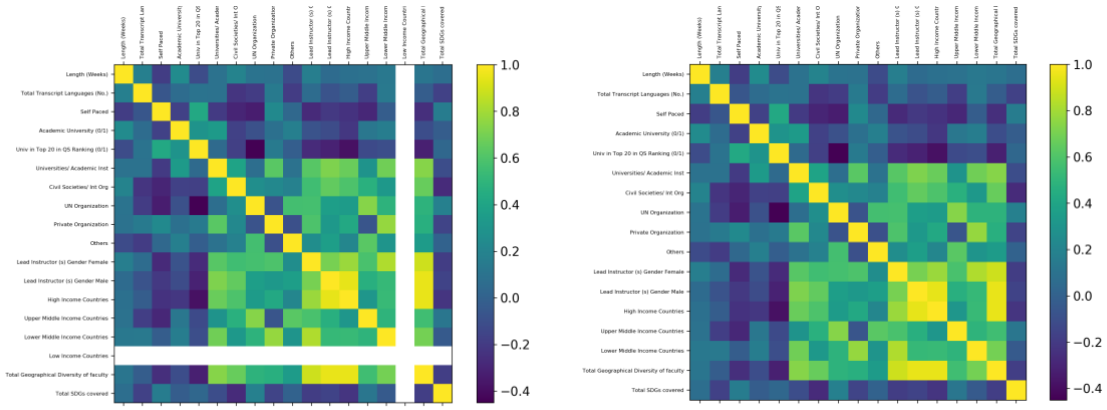
5.1.3 Feature Analysis

This section focuses on the analysis of these features with respect to each other and their relative importance as predictor/regressors. This activity is paramount for this study due to the presence of data-sets where sample size < feature size (i.e. many independent variables). While a large number of features give us more information about the nature of the data and allow for its rich representation, they come with the caveat of increasing sparsity of the data in a higher dimension, an issue known as the ‘Curse of Dimensionality’ which can be an important pitfall for even the most advanced Machine Learning algorithms Venkat, Naveen. (2018). The issue at hand is that with increased sparsity, the measure of geometric similarity of the data between data-points increases, thereby making it difficult for algorithms to capture the patterns inherent in the feature space. We will adopt the following steps in order to analyze the features and select the most relevant from them as the regressors for our next step:

5.1.3.1 Correlation: While doing a correlation study we first tried to ascertain if a linear dependence exists between the variables from the same group, followed by the analysis of correlations between inter-group variables. Analyzing the correlation amongst features as well as between features and the dependent variable is an important first step towards analyzing linear dependence between features and addressing the issue of Multicollinearity.

5.1.3.2 Multicollinearity: We calculated the Pearson correlation equation 1 between each pair of the variables in the dataset and plotted the results as follows:

$$\rho(X,Y) = \frac{cov(X,Y)}{\sigma(X)\sigma(Y)}$$



a) Correlation of all features with each other

b) Correlation matrix after dropping low variance features

Figure 1: Correlation Matrices

5.1.3.3 Variance Threshold: Features with low variance add little information to the data and are poor predictors. Therefore, we tried to eliminate the features with very low or zero variance (we choose 0 as the threshold at the moment) and features with low/0 variances were removed. Figure 1 (b) presents a correlation matrix after removing low variance features.

5.1.3.4 Feature Selection: Small sample size of the dataset (22 courses) coupled with its very high dimensionality, puts a constraint on using all the features for the final regression. Therefore, we adopted a stepwise process of eliminating insignificant features. Following removal of features with low/0 variances, we analyzed correlation matrix for all features and studied the ones which were highly correlated to each other. Variables that were deducible using the other variable(s) that they were highly correlated with, were dropped. The remaining set of variables formed the predictor set that was used for the first regression.

$$y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \ldots\ldots\ldots + \alpha_n x_n$$

The results of the first regression gave an indication towards existing multicollinearity issues in almost all the different cases we are studying and therefore this first regression was almost always followed with subsequent experiments with different combinations of predictors. These combinations of predictors were created using one (or a mix of) the following criteria:

a) Eliminate the predictors with very high p-values.
b) Keep the predictors that were highly correlated with the dependent variable even if their p-value is high.
c) If the removal of a predictor leads to lower r^2 values add that predictor back.

Running several experiments with different combinations of predictors based on the above criteria resulted in several regression models. We finally picked the model that leads to highest r^2 score, lowest error metrics and has a high number of predictors with low p-values. The different experiments we ran per study-case were analyzed and final models were selected (Segment 6) for each based on the values obtained.

5.2 RQ 2: What motivates a learner to enroll in courses on Sustainable Development?

RQ 3: What impact do Sustainable Development MOOCs have on a learners personal, academic or professional life?

5.2.1 Literature Review: We used literature review as a framework for identifying prominent learner motivations across various technical and non-technical MOOCs. Over the last decade, several studies have produced conclusions regarding why learners take MOOCs. Synthesizing this body of work led to identification of 13 most commonly reported motivations which provided the foundation to examine our subset of sustainable development learners.

5.2.2 Designing the survey: A research survey was designed in order to get a deeper understanding of the learner motivations in an SDG Academy MOOC. The purpose of the survey was to collect descriptive feedback from learners to see if their motivations for taking courses in Sustainable Development differ from commonly held assumptions in the field.

The survey had 34 questions and required 10-15 minutes for completion. The survey questions were based on the recommendations of the Kirkpatrick Model with questions formulated to measure learner responses on four levels of Reaction, Learning, Behavior and Result Goh, Wei & Wong, Seng Yue & Ayub, Enna. (2018).. Motivations identified through literature review were mapped to the typical learner behavior and performance in a MOOC and additional questions were framed to understand more about their expectations, performance and impact of the course. The survey employed Likert Scale to measure participants' responses on questions like 'To what extent their expectation from the MOOC was fulfilled', 'How useful were the given course activities during the online course; 'Rate their level of participation in the discussion forum' and ''How likely are they to recommend this course to their peers/coworkers/friends'.
In addition to the Likert items, participants were also given multiple choice questions around motivation, their progress in the course, reasons for finding the MOOC unhelpful (if at all). All multiple-choice questions provided the learners with additional space to submit answers other than the ones given in the list.
Open ended questions were designed to collect learner comments and feedback on questions around their expectations from the course, usefulness, their interactions with the course teams and the impact of the MOOC on their personal, academic or professional life.
Demographics data pertaining to learner age, geography, educational qualification, current employment etc. was collected through dropdown options in the survey.

5.2.3. Administering the Survey: Internet based Research (IBR) methods was used to engage directly with the MOOC learners. Study participants were randomly recruited from learners who had registered for the SDG Academy MOOC(s) on edX in the past 6 months and provided their email addresses voluntarily for future communication. They were given an opportunity to opt into the study and complete informed consent. Online surveys were administered to all learners who agree to participate in the study. Survey remained open and data was collected over a period of 30 days.

5.2.4. Analyzing the final survey results: The collected responses were first transformed through data reduction process to get a clean meaningful data set. For qualitative responses, a thematic analysis was employed through identification of high occurrence words in an iterative process. Data was categorized into common themes, coded, organized and analyzed to connect them back to the research questions.

6. Results and Discussion

6.1 RQ 1: What is the impact of Course Design and Marketing Efforts on learner enrolment and completion rates for Sustainable Development courses in an online learning environment?

We first begin with the results obtained for Course Enrolments when exploring Course Design and Marketing Efforts parameters as relevant predictors. Enrolment numbers for each course for a duration from September 2018-June 2019 are presented in Figure 2.

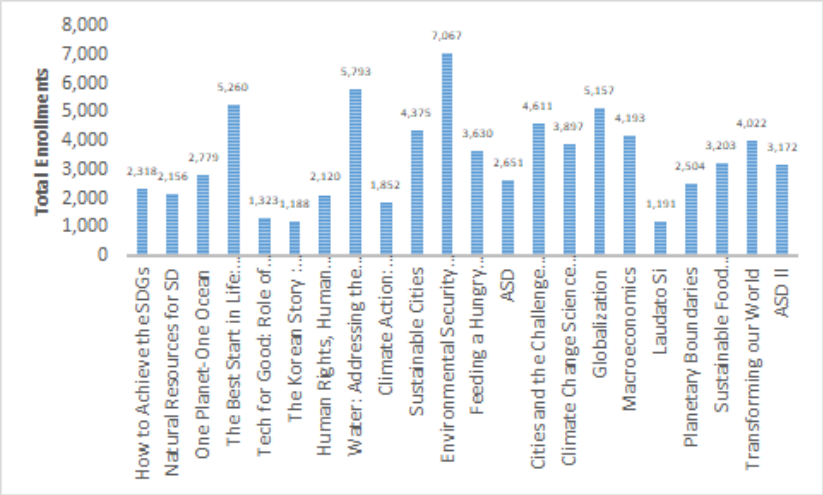


Figure 2: Course wise enrolment numbers for SDG Academy MOOCs from Sept 2018-June 2019

6.1.1: Course Design parameters as predictors of course enrolment:

Table 2 represents the results of the final experiment model (Adjusted r^2=0.887, Prob(F-statistic) = 0.0168) chosen to analyze the impact of course design parameters as predictors of course enrolment. The parameters chosen to define Course Design are described in Table 1.

Course design was analyzed for three critical constituting components of a) course parameters, b) faculty profile and c) profile of the affiliate institute of the lead faculty. SDG Academy rests marked focus on bringing together the world's leading sustainable development experts to teach diverse course topics, when developing a course. The course faculty(s) represents diverse voices and perspectives and are celebrated academics, practitioners, and global leaders in the field, to provide an enriched and interactive learning environment to the students. Most courses are offered in partnerships with premiere universities, academic and research institutions and think-tanks from around the world and the lead faculty(s) represent the global expertise on the content subject. SDG Academy courses are 5-8 weeks long and are either self-paced, where the entire course material is released at once and students can engage with the course at their own pace or they can be instructor paced, where new material is released progressively each week and the course remains open for a pre-defined duration. Learners have the flexibility to pace themselves during the duration of the course but cannot access it once it closes.

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.11e-16	0.073	1.51e-15	1.000	-0.204	0.204
Length (Weeks)	-0.4172	0.150	-2.781	0.050	-0.834	-0.001
Total Transcript Languages (No.)	-0.5636	0.163	-3.465	0.026	-1.015	-0.112
Self Paced	0.7657	0.169	4.524	0.011	0.296	1.236
Academic University (0/1)	0.3458	0.187	1.847	0.138	-0.174	0.866
Univ in Top 20 in QS Ranking (0/1)	0.9214	0.275	3.356	0.028	0.159	1.684
Civil Societies/ Int Org	0.7256	0.401	1.811	0.144	-0.387	1.838
UN Organization	-0.8055	0.692	-1.164	0.309	-2.727	1.116
Private Organization	-1.1737	0.673	-1.744	0.156	-3.042	0.695
Lead Instructor (s) Gender Female	3.9400	0.704	5.597	0.005	1.986	5.894
Lead Instructor (s) Gender Male	-1.8467	0.351	-5.255	0.006	-2.822	-0.871
High Income Countries	0.8407	0.165	5.082	0.007	0.381	1.300
Upper Middle Income Countries	-0.5563	1.482	-0.375	0.726	-4.670	3.558
Lower Middle Income Countries	-0.0823	1.295	-0.064	0.952	-3.677	3.512
Total SDGs covered	0.4384	0.233	1.878	0.134	-0.210	1.087
Africa	6.2275	0.881	7.071	0.002	3.782	8.673
Asia	0.1270	0.194	0.655	0.548	-0.411	0.665
Europe	-0.2367	0.161	-1.467	0.216	-0.685	0.211
North America	-0.3582	0.243	-1.472	0.215	-1.034	0.317
Oceania	-7.6730	1.440	-5.330	0.006	-11.670	-3.676
South America	1.5558	0.550	2.830	0.047	0.029	3.082
Middle East	-1.1737	0.673	-1.744	0.156	-3.042	0.695

Table 2: Summary for results for Course Design parameters as predictors for total enrolment

Upon analysis of course components it was observed that length and nature of the course emerged as two main predictors for the student enrolment. The length of the courses predicted the enrolment numbers strongly (p=0.050, coef= -0.4172). The coefficient was negative indicating that learners prefer courses which are shorter in nature. Self-Paced nature of the course also predicted the enrolments (p=0.011, coef=0.7657) indicating that a higher number of students preferred taking the course at their own pace with complete freedom of access to all course components. Self-paced courses lack the interactive components embedded in the course design of instructor paced courses like moderated discussion forum, multiple faculty webinar sessions and access to the full course cohort in a defined time duration. But they are more learner centric in their approach and open up the curriculum for the students to create their own learning pathways. Since the majority of SDG Academy learners, as reported in the literature review, are working professionals with advanced degrees, the shorter courses and self-paced courses both, give them the flexibility of time and working per their convenience. The learners are free to take the course in its entirety or engage in modular information based on their personal learning goals.

The SDG Academy courses are designed to provide unrestricted access to education to learners without the barriers of geography, economy or learner profile. The courses currently offered in English, provide content transcripts in multiple languages, to reach out to students across language barriers as well. It was also observed that the availability of video transcripts in multiple languages (p value=0.026, coef=-0.5636) significantly predicted the total enrolment numbers. The negative coefficient for total transcript languages however might be an artefact and not representative of the learners' preference for single language courses. Currently, SDG Academy courses with the highest number of transcript languages are long, full length courses which are 8-12 weeks long. And as observed from the data above, learners prefer shorter courses which can be absorbed quickly. Hence, the negative coefficient might reflect their disfavor to longer courses (which have the transcripts in multiple languages) rather than the multilingualism of the MOOC itself.

Learners' decision for course enrolment also takes into consideration the ranking of the university in the international landscape. MOOCs are widely celebrated for bridging the knowledge gap by bringing together the education from the most renowned institutes in the world to the doorsteps of learners across geographical barriers. While a restricted number of students can participate in the on-campus learning programs offered by the topmost universities, learners want to leverage the online medium to access the same high-quality education outside the confines of a classroom. The presence of a university in the top 20 QS ranking of the universities predicted the course enrolments adequately (p=0.028, coef=0.9214) indicating the intent of the learners across economies, geographies and learner profiles to learn about the agenda of sustainable development from the best academic institutions globally.

In addition, the relationship between the geography of the facilitating institute, lead faculty and enrolment figures were also considered. The results demonstrated that the geographical background of the lead faculty(s)'s affiliate institute, significantly predicted total enrolment figures. Higher enrolment trends were observed for the courses where the lead faculty for the course came from institutions or universities from high income countries (p=0.007, coef= 0.8407). As reported before, around 35% of the SDG Academy participants come from middle income and low-income economies and this preferential trend might be indicative of their intent to access resources and education from the topmost academic institutions from the developed world in an affordable and flexible set up. This preference can also be explained through an extension of the user preference for universities in top 20 QS ranking demonstrated above. In the last two years, 19 out of 20 top universities in the world belong to high income economies, hence explaining the user consideration for course enrolments. Courses with lead faculty from Africa (p= 0.002, coeff=6.2275)and South America based institutes (p=0.047, coef=1.5558)

also predicted the total enrolments strongly indicating the students' preference for higher representation and diversity in academic voices and perspectives especially when teaching about the inherently inclusive agenda of sustainable development. Courses with lead faculty from Oceania (p=0.006, coef= -7.6730) inversely predicted the course enrolments.

Report on faculty profile on course enrolments yielded interesting observations with the gender of lead faculty predicting the student enrolments. It was observed that the presence of a female faculty well predicted the enrolment (p=0. 005, coef= 3.9400) positively, as opposed to the presence of a male faculty (0=0.006, coef=-1.8467) demonstrating the gravitation of learners towards courses which are taught by the female experts in the field.

6.1.2: Marketing Efforts parameters as predictors of course enrolment:

With the explosion in the number of MOOCs being made available to the users every year, abundant options are available for learners to pick and choose courses which best suit their requirements. Facilitated by the shrinking of the digital divide, efficient marketing strategy can serve as an effective vehicle to promote these courses to the learners from far and wide corners of the world. At a recent conference organized by Open edX (Class Central, 2019), Ignacio Despujol, of the Universitat Politecnica de Valencia (with 71 courses and more than 1.5 million enrolments, UPV is one of Europe's top MOOC producers) also discussed the critical role digital marketing can play in making the MOOCs reach learners. SDG Academy leverages social media, email blasts and periodical newsletters to promote its courses to alumni from other courses and a wider audience.

	coef	std err	t	P>|t|	[0.025	0.975]
const	0	0.031	0	1.000	-0.099	0.099
No of weeks the promotion ran	0.9793	0.070	14.076	0.001	0.758	1.201
Newletter Mentions	-1.3999	0.159	-8.792	0.003	-1.907	-0.893
Total clicks on the news link	-0.4496	0.112	-4.032	0.027	-0.804	-0.095
Total Email Blasts	3.0184	0.344	8.765	0.003	1.922	4.114
Total 'Opens' for the blasts	5.7446	0.827	6.944	0.006	3.112	8.377
Total clicks	0.0238	0.212	0.112	0.918	-0.651	0.699
Facebook Total Posts	5.1397	0.808	-6.362	0.008	-7.711	-2.569
Facebook Total Posts Paid	1.6755	0.381	4.403	0.022	0.464	2.887
Facebook Total Reach/Views	-2.3750	0.272	-8.736	0.003	-3.240	-1.510
Facebook Total Reach/Views Paid	-4.1747	0.340	-12.280	0.001	-5.257	-3.093
Facebook Total Shares	2.4812	0.479	5.184	0.014	0.958	4.004
Facebook Total tagged posts for this course	-10.4139	1.234	-8.440	0.003	-14.341	-6.487
Twitter Total Posts	5.0605	0.476	10.635	0.002	3.546	6.575
Twitter Total Impressions/Views	-5.8773	0.531	-11.064	0.002	-7.568	-4.187
Total Retweets	9.5334	0.776	12.285	0.001	7.064	12.003
Total Tagged posts/ mentions on Twitter	4.0881	0.497	8.231	0.004	2.507	5.669
LinkedIn Total Posts	-0.3443	0.946	-0.364	0.740	-3.356	2.667
LinkedIn Total Reach/Views	-5.0082	0.952	-5.261	0.013	-8.038	-1.979
LinkedIn Total Shares	-0.1008	0.098	-1.030	0.379	-0.413	0.211

Table 3: Summary for results for Marketing Efforts parameters as predictors for total enrolment

Table 3 represents the results of the final experiment model (Adjusted r^2=0.980, Prob(F-statistic)= 0.00328) chosen to analyze the impact of social media and other digital marketing parameters as predictors of course enrolment. The parameters chosen to define Marketing Parameters are described in Table 1.

An analysis of marketing efforts demonstrated that online promotions have a significant impact on total enrolments across courses. Higher enrolments were observed, for courses which had a longer duration of promotional activities before the course launch (p=0.001, coef= 0.9793). Total number of course promotion weeks strongly predicted the course enrolments indicating the need for longer promotional campaigns before the launch of the courses, to reach out to learners from diverse parts of the world. Sustained long-term campaigns provide users with periodic updates and nudge their behavior towards course consideration, oft leading to conversion.

Course promotion through newsletter (p- 0.003, coef=-1.3999) and the total clicks on various news items (course promotion and non-course promotion news items) (p=0.0027, coef= -0.4496) inversely predicted the course enrolments. The SDG Academy newsletter reaches out to over 100,000 contacts, which are comprised of students, practitioners and experts from

the related fields related or unrelated to the courses. The newsletter community is large, untargeted and includes people with a diverse set of interests and only a subset of them constitutes active MOOC learners. Hence the negative coefficient does not denote an inverse correlation with enrolments as much as it indicates a passive relationship between the smaller number of interested people (a fraction of whom enroll in courses) against the large group the newsletter reaches out to.

This becomes further evident in the analysis of email blasts as predictors of enrolment. In contrast to the newsletter sent to a larger audience database, the email blasts are targeted towards a smaller, highly specific learner or practitioner community or a set of SDG Academy course alumni. Email blasts displayed a significant impact on total enrolments for that course (p=0.003, coeff= 3.0184). Total number of people who opened these targeted emails also strongly predicted enrollment (p-0.006, coef= 5.7446) reinstates the importance of audience analysis for designing effective marketing strategies. The data strongly emphasizes that reaching out to targeted audiences with a displayed interest in the MOOC topic or a related field yields higher dividends in terms of conversion to enrolment as opposed to a larger wider audience.

An analysis of various social media platforms which SDG Academy employs to promote its courses also yielded some interesting observations. Total promotional posts on Facebook (p=0.008, coef=5.1397) and Twitter (p=0.002, coef=5.0605) significantly predicted the enrolment numbers highlighting the importance of leveraging social media as channels to reach out to a wide base of interested audience members increasing the course visibility. Total shared posts on Facebook (p=2.4812, coef=0.014) were also strong positive predictors of enrolment indicating the community of global MOOC learners who get an opportunity to come together through social media platforms. Total tagged posts on Facebook significantly but inversely predicted the enrolments (p=0.003 coef=-10.4139). This might have been due to significantly higher activity in small cohorts of learners for individual courses, who actively engage in course content and its promotions, as opposed to uniform promotional campaign through SDG Academy or partner institutions for across courses.

Paid Facebook promotions are a strong predictor (p=0.022, coef=1.6755) of enrolment for the SDG Academy courses, giving them a greater chance of being noticed. Boosted Posts appear higher in users' news feeds, and target users based on their online behaviors, hence reaching out to a highly specific audience and attracting qualified and relevant traffic. With more than two billion users accessing Facebook and 126 million users on Twitter every month, targeted ad campaigns can help reach out to users based on their interest and build a community of sustainable development advocates (Statista, 2019). Platforms like Twitter also provide users an opportunity to often engage with the course faculty or experts directly (Twitter Retweets: p= 0.001, coef= 9.5334; Twitter tagged posts/mentions: p=0.004, coef=4.0881), get more personalized insights on their views and stay updated and share current information in real time.

A common theme of strong but negative coefficients was observed for the total reach/views (for Facebook (p= 0.003, coef= -2.3750) and LinkedIn (p=0.013, coef=-5.0082)) and impressions (for Twitter (p= 0.013, coef=-5.8773)) for different social media platforms analyzed. Reach refers to the total number of people who see an ad while impressions, in context of Twitter, refer to the number of times a Twitter user sees a tweet—either in their feed, search results, or as part of a conversation. Neither "reach" nor "impressions" indicate that someone has interacted with the ad and hence do not represent actual engagements. These numbers are usually way larger as compared to engagement rates as an ad or promotional activity can show up in feeds for hashtags or keyword search. Hence the disproportionate difference between the large number of appearances/impressions of an ad against the smaller focused number of people who engage in (and a further subset of those who enroll in the courses), can explain the negative coefficient for the feature for course enrolment.

We now analyze the results obtained for Course Completion (verified certificates issued) when exploring Course Design and Marketing Efforts as relevant predictors.

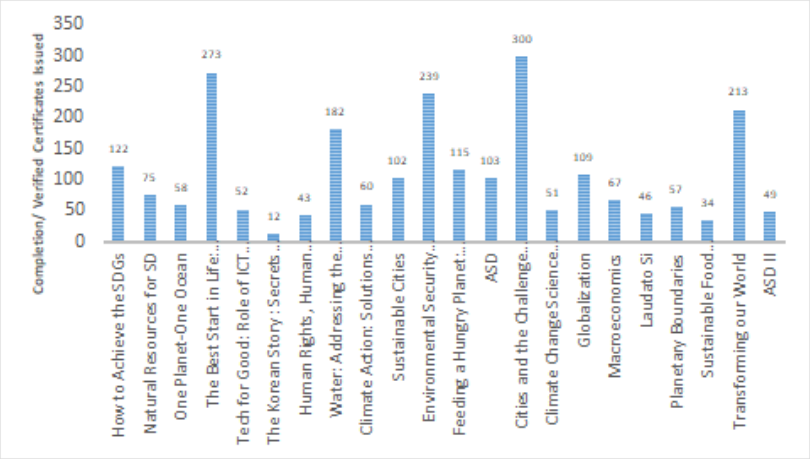


Figure 3: Course wise completion numbers for SDG Academy MOOCs from Sept 2018-June 2019

6.1.4: Course Design parameters as predictors of course completion:

With learners coming to the online learning environment with varied motivations, course completion becomes irrelevant as an overarching indicator for success. It can certainly be considered as one of the factors contributing to the effectiveness of a course. For SDG Academy courses, we consider dissemination of verified certificates as the marker for course 'completion' due to the limitations of the available data. Verified certificates act as a proof of course completion, irrespective of the motivation; they can be used as an evidence for professional/academic reasons or personal encouragement for further learning.

This study intends to explore three principal components of course design, (a) course components, b) faculty profile, c) in-course interactions, to understand if it has an influence on the students' decision for opting for the edX verified certificate. Table 6 represents the results of the final experiment model (Adjusted r^2=0.989, Prob(F-statistic)= 0.00969) chosen to analyze the impact of course design parameters as predictors of course completion. The parameters chosen to define Course Design are described in Table 1.

	coef	std err	t	P>|t|	[0.025	0.975]
const	4.857e-17	0.023	2.15e-15	1.000	-0.097	0.097
Verfied Track Enrollments	0.9140	0.111	8.251	0.014	0.437	1.391
Average Length of Videos (min)	-0.9746	0.153	-6.388	0.024	-1.631	-0.318
Average Video Completion %	-0.7532	0.156	-4.829	0.040	-1.424	-0.082
Active Learners/Day	-0.3509	0.088	-3.968	0.058	-0.731	0.030
Lead Instructor (s) Gender Female	-1.3682	0.249	-5.498	0.032	-2.439	-0.297
Lead Instructor (s) Gender Male	0.5737	0.142	4.046	0.056	-0.036	1.184
High Income Countries	-0.3469	0.059	-5.852	0.028	-0.602	-0.092
Upper Middle Income Countries	-0.0121	0.075	-0.160	0.887	-0.336	0.312
Lower Middle Income Countries	0.2074	0.142	1.463	0.281	-0.403	0.817
Total Geographical Diversity of faculty	-0.2288	0.034	-6.675	0.062	-0.376	-0.081
Required Readings Total	-0.4377	0.088	-5.002	0.038	-0.814	-0.061
Required Readings 2-3/week (0 or 1)	-0.1529	0.040	-3.834	0.062	-0.324	0.019
Total Number of Assessments	-0.0363	0.100	-0.362	0.752	-0.468	0.395
Total Questions	-0.1989	0.057	-3.460	0.054	-0.446	0.048
Number of sessions	0.2902	0.200	1.449	0.284	-0.571	1.152
Total Faculty who took the sessions	2.0538	0.253	8.133	0.015	0.967	3.140
Total TA Discussion Posts	4.1754	1.952	2.139	0.166	-4.222	12.572
Average weekly TA Discussion Posts	-5.4501	1.964	-2.776	0.109	-13.899	2.999
Total Student Discussion Posts	0.4464	0.729	0.612	0.603	-2.691	3.584
Average Weekly Student Discussion Posts	0.0407	0.689	0.059	0.958	-2.922	3.003
Number of TA Emails Sent	-1.2613	0.272	-4.642	0.043	-2.430	-0.092

Table 4: Summary for results for Course Design parameters as predictors for total completion

Table 4 presents some interesting findings for the course design features predicting completion.

In Course Components, verified track enrolments, i.e. learners who enrolled in the course with an intention to obtain a verified certificate, positively predict course completion (p=0.014, coef= 0.9140). SDG Academy trends demonstrate that over 85% of learners who enroll in the verified track, successfully complete the course requirements for passing the course and obtain the certificates. The same trend is reflected in this study indicating that the learners who enroll in the course with the motivation to earn the certificate and pay the fees associated with the same upfront, put in the required time and effort towards taking the course in its entirety and successfully receive the certificates.

As expected, average video length in a course predicts the course completion successfully, with a negative coefficient (p=0.024, coef= -0.9746). The evidence for the attention span of users in an online learning environment is varied, however increasingly large data evidence points towards the low time spans for which learners can focus their attention. Shorter videos also support the open online environments where learners, a majority of which are employed professionals with a paucity of time, can absorb shorter modular information, based on their learning goals. SDG Academy analytics also reflect that the courses which perform well and are most popular with users, have 9-10-minute videos amongst several other course design factors.

The evidence of this further lies in average video completion negatively but successfully predicting the completion (p= 0.040, coef= -0.7532). Not all users who complete the course watch full videos. Video watch rates are generally higher for the first few modules of SDG Academy courses and start declining over the weeks. Once learners get familiar with the course material they start skipping or forwarding through the videos or skimming through transcripts to understand the course material.

Total number of readings mandatory for course completion (p= 0.038, coef=-0.4377) and total assessment questions (p=0.054, p=-0.1989) for a course well predicted the course completion with inverse coefficients indicating the preference of learners for courses with lighter workload. While intense course loads are accepted norms and managed by learners in offline classrooms, they seem to adversely impact a students' learning journey in an online environment. Since MOOCs are driven by self-motivation, excessive readings and assessments might act as a deterrent in faster completion of a course and motivate a learner to drop out.

When analyzing in-course interaction and its potential impact on course completion, it was observed that the number of faculty taking live webinars during the course duration (p=0.015, coef= 2.0538) strongly predict completion rates. Learners appreciate the opportunity to interact with the faculty directly and it provides them with additional encouragement or push to finish the entire course. Courses with higher numbers of faculty engaging in the live sessions see an increased level of engagement from students, which in turn is reflected in the higher completion rates. The number of reminder emails sent by the teaching assistant (TA) managing the instructor paced courses negatively predicted the course completions (p= 0.043, coef=-1.2613). While TA emails play an important role in reminding learners of the key deadlines, important updates etc, a threshold effect seems to be at play with courses with 3 or more emails sent out by the TA per week have displayed lower completion rates. This however is a correlation and might not be the explanatory cause for the inverse prediction.

Results of analyzing faculty profiles for their potential impact on completion demonstrated a strong prediction albeit with negative coefficients for female faculty (p=0.032, coef=-1.3682) and faculty affiliate institutes from high income countries (p=0.028, coef= -0.3469). We find these results challenging to explain and would encourage more data collection from a higher number of courses in order to make a conclusive statement.

An analysis of marketing parameters demonstrated that promotional efforts did not seem to predict the completion rates for a course in an online environment.

6.2 RQ 2: Why do learners enroll in courses on Sustainable Development?

The analysis of the survey led to identification of the chief motivation factors which encourage learners to enroll in courses on Sustainable Development.

Figure 4: Learner motivations

68% of learners who responded to the survey question regarding their motivation, selected more than one reason as their motivating factor for enrolling in the course. Most MOOCs environments focus on completion and receiving verified certificates as success indicators for the course, however the results of the survey indicated that the learner decision is influenced to a large extent, by personal and academic factors along with professional motivations.

The highest number of choices (62%) were made for ‘personal growth/enrichment’ indicating that unlike technical courses which lead to direct vocational impact and are driven by professional intent, courses on sustainable development appeal to learners on a personal level and they enroll to enhance their own understanding of their imminent worlds and its challenges. 41.40% of all people who chose “Personal growth/enrichment’ came from high income economies and 48% were women.

Learners might not be motivated by professional gains as their primary factor of choice, however it certainly can be one of the reasons for enrolling in the courses as is demonstrated by the second most preferred selection ‘hope it could advance my career’ (38%). 37% of people who chose ‘advance my career” were from lower middle-income economies and 44% respondents were women.

Students’ preference for learning for self-motivation, capacity building and growth, is further highlighted by the next most preferred choice of the learners for taking the courses ‘found the topic interesting and joined out of general curiosity’ (37%) which was selected by 51% women from high income economies.

Motivations reflecting academic outcomes or ambitions were also highly reported with 21% selections for ‘topic relevant to academic/school curriculum’ and 20% choices for ‘topic relevant for research’. A large number of learners also reported leveraging these courses to

gain information which could provide foundational knowledge for the career transitions they planned to make.

Interestingly 17% selections were made for ‘wanted to experience online learning’, 12% for ‘wanted to meet new people working in the same sector’ and 8% for ‘want to improve my English’ highlighting the social aspirations which MOOCs offer to fulfill.

Only around 25% choices were made for ‘Wanted a verified certificate’ as the guiding motivation for enrolling in the course and 88% of these learners who had chosen receiving the verified certificate as their primary motivation finally ended up receiving a verified certificate. 40% of these learners were women and 36% came from high income economies. 32% of these people who reported Verified Certificate as their primary motivation felt that the certificate would be useful for their current/ future jobs while 47% wanted to add it to their resumes or professional profiles as a proof of completion.

Learners were also given the option of providing an open-ended response if their motivation was different from the ones which were provided in the options. Over 2% learners (all from high income economies, 20% women) who reported ‘other’ motivation, cited that the learnings from the MOOC will help them understand the challenges faced by people due to exclusion and inequality and provide them with a knowledge base for their volunteer work, or the work they are doing at the community level in personal capacity or in association with a nonprofit organization. This motivation is unique to the MOOCs in the field of development and demonstrates the need for dissemination of knowledge at scale to mobilize communities and work at ground level.

Motivations also differed by geographies with over 70% of people from high income economies citing ‘personal growth/enrichment’ as one of their principal motivations followed by ‘found the topic interesting’. Obtaining a verified certificate was one of the top 5 reasons (Figure 5). The results differed for learners from Lower middle-income countries (Figure 6) who chose ‘found the topic interesting’ as their most chosen motivation followed by ‘enrich my career’ and ‘found the topic fun’. Prestigious professor/institutions were one of the top 5 reasons. Obtaining a verified certificate was not a priority.

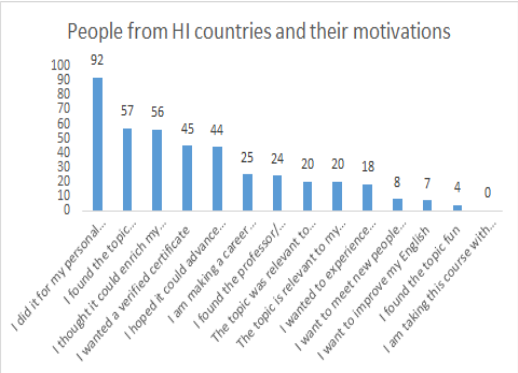


Figure 5: Motivations of learners from High income countries

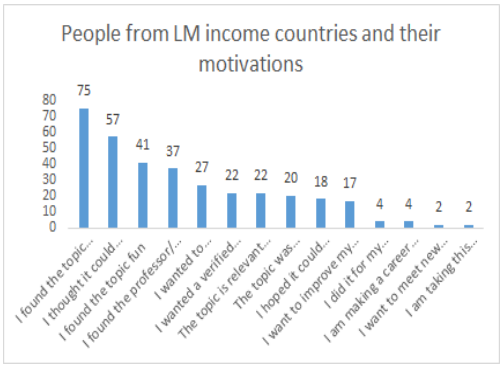


Figure 6: Motivations of learners from Lower middle income countries

25% of learners from Low income economies cited ‘personal growth and enrichment’ as their primary motivation followed by 25% opting for enriching current job, 17% for advancing career and17% for getting a verified certificate.

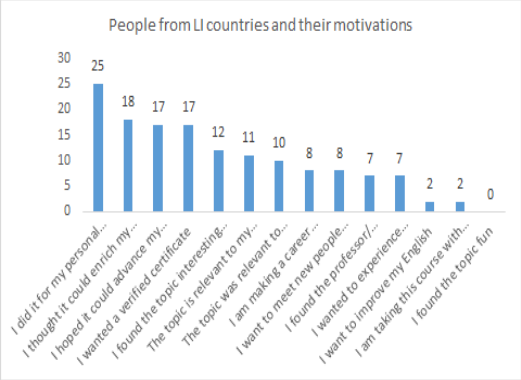


Figure 7: Motivations of learners from Low income countries

The geographical variations in the results demonstrate that Learners from lower middle- and low-income countries see online courses as an avenue for future career growth while learners from high income economies prefer taking these courses for personal enrichment or growth.

RQ 3: What impact do Sustainable Development MOOCs have on a learners personal, academic or professional life?

34% of the survey participants reported that their expectations from the MOOC they participated in was completely fulfilled, while 53% reported it to be very fulfilled. 11% reported that their expectation was somewhat fulfilled with less than 1% reporting it to be little or least fulfilled (Figure 8).

90% of the respondents reported that the knowledge gained from the MOOC helped in their personal, professional or academic lives (Figure 9).

Figure 8: Extent of fulfillment of learner expectations from the course

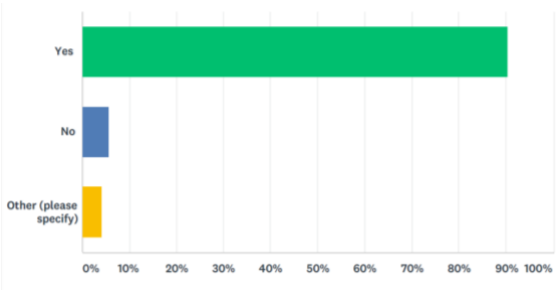


Figure 9: Did the MOOC have an effect on the learner's personal, professional or academic life?

Thematic analysis of the user responses describing the impact of SDG Academy MOOCs on their personal, professional and academic life demonstrated that 40% of the learners found that these courses provided them with fundamental knowledge about the issue of sustainable development (Figure 10). It was new information that enriched their minds and opened their

perspective towards the current state of the world and the challenges and opportunities for attaining Agenda 2030. These learners did not report if this information would help them in their professional or academic lives but reported that the course added to their knowledge base and increased their awareness of the world. 17% of learners reported that the course added to their existing understanding of the SDGs and helped them deep dive into the subject matter. They reported understanding several specific topics in depth and becoming more well versed with the issues of sustainable development after taking the course.

9% of learners said that the course helped them in their professional lives, either by helping them with the project they were working on or building their capacity in the field of their work. They also reported that the knowledge obtained would support their job applications for new positions and make them stronger candidates for opportunities in the field of sustainable development. 7% of learners were academic researchers who found the course material to be a useful resource and added to their repository of information.

Around 4% of learners reported that the course has helped them grow in their personal lives. They have been able to become more aware and implement changes towards a sustainable living in their everyday lives owing to the knowledge received from the courses. Similar percentage of learners reported that the MOOC learnings have helped them become better negotiators for the SDGs in their discussions with their peers and friends, has supported them as an efficient resource in their school/university curriculum. Around 4% of respondents were academic professionals who reported that they have been leveraging these courses as a teaching aid for their in-classroom teaching sessions.

A small percentage of learners also reported that the course has increased their socio-political awareness, has supported them with their advocacy work with the government and other non-government organizations at local and national level and has helped them understand the depth of issues at local level for their work with the community. The knowledge provided them with confidence, supported their small-scale industry innovation projects, helped them build capacity for their teams and was an achievement to add to their professional profiles.

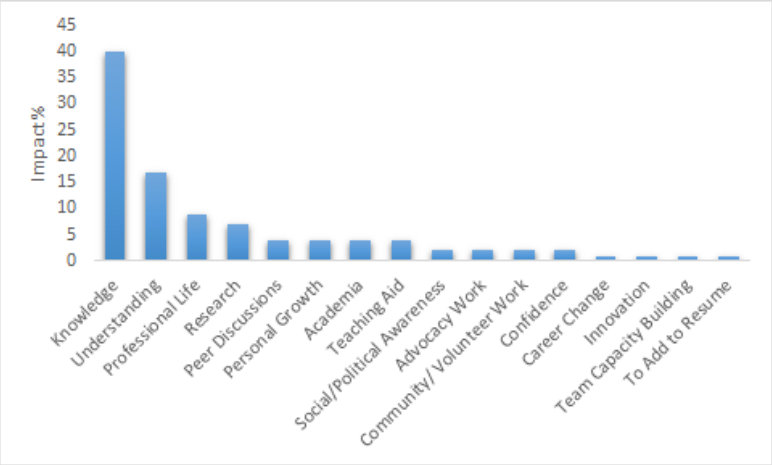


Figure 10: Impact percentages on learners' life

7. Conclusion and Recommendations

The current work offers an insight into the factors which drive enrolments and influence course completion rates in an online learning environment. We also investigated the various motivational factors which impact a learner's decisions to enroll in a course on Sustainable Development and the impact these courses have on their personal, professional and academic lives. The analysis of quantitative data gathered from the edX backend from 20 courses on sustainable development offered by the SDG academy highlighted the importance of a

strategic course design and the impact of the presence of reputed faculty and a renowned academic institution offering the course, in students' decision to enroll in the course. The study also emphasizes on the need of efficient marketing plans to reach out to learners from far and wide corners of the world, thereby increasing the course visibility and giving students an opportunity to enroll in the course. MOOC completion (students receiving a verified certificate) are predominantly driven by the course components, with learners demonstrating a preference for shorter self-paced courses, and the level of interaction between the course teams and the students within the course.

The study also provided a lens into student motivations and their variations, indicating that learners' decision to take MOOCs on Sustainable Development is primarily driven by personal motivators like increasing knowledge base and understanding, interest in the topic and their interest in exploring the online learning environment or social factors like meeting new people from the same field or motivation to improve their English through peer interaction. Professional development also appeared as one of the key motivations, with students taking these MOOCs to gain knowledge which could help improve their current or future vocational avenues. Obtaining a verified certificate was not one of the most commonly selected motivations, and most of the learners who opted for a certificate came from high income economies, indicating the role the price associated with the certificates might have to play in a learners' s motivation behind opting for a certificate.

An analysis of the learner responses for the impact of MOOCs on Sustainable development offered by the SDG Academy, indicated that these courses provided learners with knowledge and understanding about the current state of the world and the challenges and opportunities for achieving Agenda 2030. Learners reported that they learned about new information and strengthened old concepts. The courses also gave them a new perspective on sustainable living to apply on their everyday lives, equipped them with knowledge and gave them the confidence to engage in discussions with their peers, friends and in their advocacy work. These courses also built their professional capacity and provided effective resources for their academic and research work.

The study provides recommendations for a more effective MOOC design for teaching the complex issue of Sustainable Development, to enhance learner experience and provide enhanced access and inclusivity in an online learning environment. While the focus of this research is specifically on MOOCs in the field of Sustainable Development, insights gained from this study may be applicable when considering learners' enrolment, motivation, and completion in other areas of study.

Recommendations for creating engaging course components:

1. Typical SDG Academy learners are early or mid-level professionals, men or women, employed in related fields with advanced degrees. This is very similar to the profile of the overall MOOC learners as reported in the literature review. The courses should be designed keeping in mind the profile, motivations and time commitments of the targeted user base. Since learners are employed professionals and are driven by their motivation to learn for personal growth and enrichment, courses should be self-paced, short and provide a flexibility in learning structure. Courses with 6-8 weeks of content worth seem to be most popular with the students. The course design should consider the paucity of time which the learner base struggles with, and modular components should be developed, allowing learners to either follow the predefined order of the course design or formulate their own learning pathway by selecting modules of their preference in an order they deem best aligns with their learning goals.
2. Course videos should be short and paced out through the course design. An inverse correlation with the average video completion and course completion rates indicates that not all the videos are watched in their entirety and for the full duration of the course. The video watching rates decline over time, allowing for the need of providing shorter (9-10 minute) videos as core course components and distributing them through the

weeks to not burden the learners. Additional audio-visual material can be provided as an optional learning segment allowing for learner driven choices of course components.

3. Readings, assessment and activities should be optimally designed to provide a seamless learning experience. Learning in a MOOC environment is driven primarily by a learner's personal motivation and excessive workload should not dissuade them from moving ahead or staying engaged with the course. One recommendation would be to find a balance between mandatory and optional components of course work, which will allow different users to engage with the reading material and take assessments guided by their own learning goals and level of engagement.
4. Multilingualism in a course can increase access and facilitate for inclusion of students from non-English speaking parts of the world. But as was observed in their report on motivation, students also enroll in MOOCs to improve their English by interacting with their peers in the course. One recommendation to allow for this balance would be to provide multilingual video transcripts and translated assessment material. In addition to the core readings provided with the courses, additional regionally relevant documents in the local language can be provided as reading material, allowing for higher contextualization and providing the learners with a flexibility to take the course in English or the translated language.
5. In-course interaction is extremely important for student engagement and motivation. Opportunities like webinars, Facebook live, hangout events etc. provide the learners an opportunity to interact with their course faculty directly. This simulates an offline learning environment and helps breaks the geographical barrier between the learner and the teacher. These interactions are highly encouraging and lead to increased engagement of students and encourage more and more students to complete the full course. An optimal level of engagement from the course team, in the form of reminder emails and updates, is also helpful in keeping learners engaged. However excessive communication (more than 2 emails/week) can be counterproductive and lead to students ignoring the emails.

MOOC organizing institute, faculty profiles and their influence on learners:

1. MOOCs bridge the education gap by allowing learners to access high quality education from the most renowned institutes in the world by overcoming the geographical and financial barriers. Not all learners can participate in the on-campus learning programs but are highly motivated by the opportunity to access that same level of quality course material through online learning. The reputation of the course offering institute in the academic world is one of the biggest draws for the learners before enrolling in the courses. Since over 35% of learners in a MOOC environment came from low- and middle-income economies, their intent to access education from the topmost academic institutes at an affordable cost, reflects in higher enrolment numbers for courses offered by these institutes.
2. The profile of the lead faculty also drives the enrolment rates in an online course environment. Students gravitate towards courses offered by experts with reputed academic credentials. Courses should also ensure higher representation in faculty selection, as is evident by the student preference for courses taught by female faculty and diversity in academic voices demonstrated by higher enrolments for courses with female experts and faculty from Africa, and South America.

Marketing as an effective tool for increasing course visibility:

1. With increasingly large number of institutes offering MOOCs every year, learners have a plethora of choice when looking for a course on a specific topic. Efficient marketing strategy can serve as a vehicle to increase the visibility of the courses. Social media platforms can be leveraged for their potential of large audience reach. A

recommendation would be to design promotions for a targeted user base. For MOOCs on issues like Sustainable Development, which unlike technical MOOCs driven by vocational impact, are more foundational and provide a knowledge base, the strategy should be to focus on engagement and not on reach or impressions. While reaching out to a wider audience base increases brand recognition, targeting a niche audience group based on their interest groups, would provide higher engagement leading to higher chances of conversion. Paid advertisements can prove as effective tools in identifying and reaching out to these selected audience along with email blasts shared with a smaller practitioner/learner cohort.

Role of Verified Certificate in MOOCs:

1. Most MOOC creators and providers put a lot of focus on verified certificates as an indicator for MOOC success. However, as this study reveals, obtaining a verified certificate is only one of the many motivations which drive a learner to enroll in a MOOC. Not all learners who complete the full courses, opt for verified certificates, as learners are mostly driven by personal growth, professional capacity building and social factors to engage in the MOOC. Hence the recommendation would be to shift the focus from completion and certification to creating efficient course designs which would facilitate inclusive learning for students from different backgrounds and profiles. Offering modular learning in multiple languages, giving students an opportunity to engage with peers and faculty in the course, move at their pace and get required support when needed, should be the areas of work the course teams should focus on.
2. Learners who want Verified Certificates should also be provided with the opportunity to apply for scholarships and course subsidies, to overcome the financial barrier which the certificate cost poses. As seen from the study, most of the learners who receive a verified certificate currently, come from high income economies. Providing alternate financing options like geo pricing, scholarships and bringing down the cost associated with the certificates will encourage learners from all parts of the world equally to complete the course and apply for a verified certificate as a proof of completion and ensure that the MOOCs are open and inclusive for learners across geographical, demographics and financial barriers.

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