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A comprehensive Analysis of Massive Open Online Courses and Learning Analytics in Higher Education

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Abstract - *Higher education in recent times have undergone a tremendous change because of evolution of technology with different types of learning options available. Learning analytics and Massive Open Online Courses (MOOCs) are two of the most relevant emerging topics in this domain. Massive Open Online Courses have become a popular means of providing educational content in higher education globally to learners shifting the trend from traditional classroom setting to an online learning environment. This shift has allowed more people to gain access to education, regardless of their learning background. Despite the ease of accessibility, completion rates of these courses are low. With millions of students enrolled in the courses, large amount of data (Big Data) is generated from the activities of the learners. By using learning analytics on the data generated, it can be used to predict the learners performance thereby improving the quality of MOOCs. This paper aims to provide the reader with a comprehensive review of the existing literature which will currently help us to understand how learning analytics measures can be used to improve the quality, performance and delivery of course content in MOOCs.*

Key Words *:* Massive Open Online Courses (MOOCs), Higher education, Learning Analytics

1. INTRODUCTION

Massive open online courses are one of the most emerging trends in higher education in recent years. The term 'MOOCs' represents open access, global, free, video-based instructional content through an online platform available to huge volume of learners aiming to take a course or to be educated. Because of its ease and accessibility, MOOCs are available to people all over the world without any prerequisites or condition to acquire knowledge or learn a certain skill. In terms of numbers, currently, there are more than 1,60,000 learners enrolled in various kind of courses.

1.1 Massive Open Online Courses (MOOC)

MOOC are online educational courses available to anyone with a computer or any electronic device and an internet connection. It provides students an environment similar to a classroom or an online class setting and it can be accessed from anywhere across the globe. The outstanding feature of MOOC is that there is no limitation of paying tuition fees or committing to an academic course. Selection of MOOCs depends on individual interests and development of their personal or professional goals. At the end of the courses, students can choose to take part in the examinations to finish the course and get the course-completion certificate. Universities in some countries have credit transferring system, i.e., the scores in MOOCs can be converted to the credits in universities. After finishing the required courses, students can get the graduation certificate or vocational certificate in a relevant field which is optional.

The fundamental characteristics of a MOOC is being open, participatory and distributed[1]:

Open - Participation in a MOOC is free and open to anyone who has access to the Internet. A learner might take more than one course and all the content is open to course takers.

Participatory – Active participation in learning is available through discussion forums and assessment and sharing of personal contributions.

Distributed - Based on the connectivist approach any knowledge should be distributed across a network of participants. Since course activity takes place where participants interact such as discussion forum, interpretations of the same based on their learning and thinking can be shared.

MOOCs exceptional quality is that it brings together people who are interested in learning and an expert who seeks to impart this learning to students.

According to Grainger, MOOCs courses uses these areas to achieve student engagement[2]:

• Video lectures: Video lectures with various presentation styles, from in picture educators visuals to voice over are available, availability of Subtitles (primarily English, but other languages are being introduced) are provided by various learning platforms such as coursera, udemy etc. The running time for most of the lecture videos is usually 5-10 minutes each.

• Assessment: Assignments are primarily evaluated through the use of: (a) auto-graded multiple choice questions or

auto-graded programming assignments, (b) peer review assessment where students themselves evaluate and grade assignments.

• Forums: Forums are where students post questions and other students replies. Forums usually consist of general discussion, subject-specific discussion, course feedback, and technical feedback threads.

• Readings: Most MOOCs do not require students to buy books, and most readings are available online or provided by course instructors.

• Activities: A variety of instructional activities are offered, which allows students to further test their understanding of the course concepts.

• Additional video resources: scripted videos to help comprehension of content.

• Social media: Students are encouraged to continue their discussions on dedicated pages on other social media platforms, such as Facebook etc.

1.2 Learning Analytics

Learning analytics has a history of range of definitions. Siemens [3] defined it as "the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning." The Society for Learning Analytics Research (SoLAR) has adopted a final definition of learning analytics - "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" [4]. This definition highlights two interlinked goals of learning analytics: a) from a theoretical perspective, to use the data to increase understanding of learning processes, and b) from the practical perspective, to use the data to act on and intervene in an individual's learning, helping them to achieve defined learning outcomes and improve their overall learning experience. The combination of higher education and learning analytics has proven to be helpful to colleges and universities in strategic areas such as resource allocation, student success, and finance. These institutions are collecting more and more data than ever before in order to maximize strategic outcomes. Based on key questions, data is analysed and predictions are made to gain insights and set actions.

Learning Analytics (LA) is a combination of different disciplines like computer science, statistics, psychology, and education. Learning analytics is based on analysing big data on learning behaviours in MOOCs. It provides a lot of information on the causes of learner success and failure and allows for predicting future learning behaviours. Findings in this analysis are used to fine-tune learning contexts, support students and adapt them to new environments. The core objectives of learning analytics are as follows:

• Measure, collect and present data on learner's behaviour;

• Analyse student performance throughout the course;

• Analyse behavioural patterns using big data;

• Establish cause-effect relationships between performance indicators and learning activities;

• Detect errors and methodological issues in MOOCs;

• Develop recommendations for course content revision;

• Predict student success or failure.

Some of the common methods of LA used are data visualisation, social network analysis, prediction and relationship mining. Even though data tracking, collection and evaluation are some of the challenges associated with LA research, targeted student learning outcomes and behaviour are viewed as potential benefits. Additional sources of information, together with streaming data on user behaviour acquired from MOOC platforms, may include administrative databases of educational institutions, surveys of learners and instructors, pre-test results, etc.

Identifying behavioural patterns at the early stages of learning and classifying students based on their learning activities, helps researchers study the factors that will have the positive impact on student performance and use this to predict course completion.

2. LITERATURE REVIEW

Although MOOCs became popular lately, a number of studies had been done worldwide during last few years. According to Cormier, a MOOC is defined as open, participatory, distributed, and as supporting lifelong network learning [5]. The term 'MOOC' was first coined by Dave Cormier and Bryan Alexander in 2008 in order to introduce the course "Connectivism and Connective Knowledge" which was the first MOOC developed by Stephen Downes and George Siemens [6,7]. With its expansion, various versions of MOOCs emerged, such as cMOOCs and xMOOCs or extended MOOCs which gained popularity in short span of time. One of the most successful xMOOCs offered by Stanford University by Professor Sebastian Thrun in 2011 called "Introduction to Artificial Intelligence" which attracted over 160,000 students (Yuan & Powell, 2013) proved that providing free learning sessions taught by experts from eminent universities can drive large numbers of learners from heterogeneous backgrounds to join MOOCs [8].The success of MOOCs of first and second generation led to the idea of creating a hybrid MOOC delivered by the academics from university of Edinburgh in 2013 [11,12,13,14].

2.1 MOOC Types

On the Web, there are a variety of MOOC types available from different providers. Siemens distinguishes, for example between cMOOCs, xMOOCs and quasi-MOOCs[30]. The cMOOCs concept was developed by George Siemens and Stephan Downes based on the philosophy of connectivism. The idea of cMOOCs concerns itself with knowledge and knowledge construction by self-organized networks [29]. The "c" in the cMOOCs comes from the roots of the underlying learning theory of connectivism(Siemens, 2006). cMOOCs are based on phases of an iterative process "Aggregate, Remix, Repurpose & Feed Forward" [32]. Through this process, the learners in cMOOCs produce and reflect their content and share their new knowledge. Moreover, the learning process is generated with the help of learners themselves.

In contrast, xMOOC is an online mass course with a strongly predetermined learning path, communication tools and assignments [29]. The prefix "x" finds its origin afforded by the famous universities such as Harvard and Stanford and serves as the abbreviation of "extended". Online platform providers started to distribute additional information, learning resources and activities to lectures, which made these courses open and easily accessible by general users. Unlike cMOOCs, which focus on distributing information on networks, xMOOCs are based on the traditional instruction-driven principle. Information is made available via an online learning platform for a large group of students. A study reveals that the main tool for distributing information in xMOOCs is done by video sequences. These often follow the model of traditional lectures. Moreover, xMOOCs offer multiple-choice questions, asynchronous discussion forums and work with essays.

Stacey argued that MOOC pedagogy is boring and not interactive unless the online pedagogies are open, connections between the elements of MOOCs which are learners, instructors and context are open on the web, and online learning happens when students are involved in blogs, discussion forums, and group assignments [33]. xMOOC providers propose badges or certificates to students who successfully complete courses as a type of encouragement or extrinsic motivation. As an example, a team from Harvard and Massachusetts Institute of Technology released their research study on the Harvardx and MITx MOOC platform (edX) in which they examined 1.1 billion logged events of 1.7 million students [34]. It is a logical development for each MOOC platform to seek influence, achieve popularity and also to attract as many participants as possible [35].

On the other hand, quasi-MOOCs are a loose collection of web-based tutorials or Open Educational Resources (OER) elements. These have neither an interaction as in cMOOCs, nor an instruction-driven curriculum as in xMOOCs [30]. There are obvious common areas among the three types of MOOCs.

In a paper titled 'Analysis of MOOCs practices from the perspective of learners experiences and quality culture' by Ossiannilsson, Altinay, and Altinay (2016) [15] identified factors that affected student experience and quality issues in MOOCs. In another paper titled 'Investigating MOOCs through blog mining'by Chen.Y [16], he found 306 blog posts related to MOOCs and analysed all using a text-mining technique. He pinpointed that MOOCs provide several opportunities for learners including faculty members and MOOC providers. On the contrary, he also recognised challenges that need to be overcome such as low course quality, increase in dropout rates, unavailable course credits, ineffectual assessments, complex copyright issues, and the lack of necessary hardware required to join MOOCs.

According to study by Baggaley[17], his research focussed on how MOOCs rise, its characteristics and types and explores the nature of MOOCs and its effects on the future of distance education. In an International conference on Economic, Business Management and Education Innovation, Zimmerman et al (2013) [18] summarized the status quo of MOOCs, evaluated the challenges with respect to online teaching predicted the development of MOOCs in higher education. In the respect of relationship between MOOCs and the reform in higher education V. Subbianin [19] his paper titled 'Role of MOOCs in integrated STEM education: A learning perspective, Integrated STEM Education Conference' evaluated the positive effect of MOOCs on higher education in the five key areas which are computer-aided learning, cross-disciplinary education, non-technology skills, teaching technology and students' evaluation, and explores how MOOCs promote STEM teaching by using the teaching case in Coursera. In several studies, it was found that teachers incorporated both audio + visual learning dynamics and created a virtual as well as interactive learning environment.

Salisbury [20] investigated the impact of MOOCs on higher education institutions such as Stanford University, Hong Kong University, and Davidson College and found that higher education is becoming more digital and despite being criticized, MOOCs are acting as a catalyst in developing education programs. The MOOCs have led people to evaluate, debate, visualize about its impact on future of higher education. MOOCs have upgraded the status of teaching and faculty were appreciated for being equipped with tremendously rich body of research on course design and learning science.

In a study, it was found that providing MOOC accreditation in conventional universities was the solution for issues such as high dropout rates and low course satisfaction. Hollands and Tirthali(2014) [21] argued that providing formal course credit for MOOCs could increase students' motivation to learn and enhance their commitment in completing the courses, thus decreasing high dropout rates.

In [27], the author suggested an inventory of the activities performed by pedagogical actors. In his study, the author displayed that an actor produces knowledge through a number of activities. On the other hand, he noted that knowledge is stored in various locations and in the form of several structures such as videos, images, texts, etc. These data are produced in educational activities including: wiki, forums, lesson, etc.

Techniques and tools integration of learning analytics into MOOCs has been exploited in many studies. For instance, in [28] the authors proposed models and approaches for the analysis and pre-processing of massive data produced by learners, integrating data mining techniques into this domain. In other work, the author has proposed strategies for enhancing the learner experience and quality of MOOCs. Educational data mining offers a range of algorithms for the field of education.

Breslow et al. (2013) have devised a method that uses prior knowledge, skills, and activities such as the use of Virtual Learning Environment (VLE) and activities of the candidate to predict the end-of- MOOC performance of the candidate.

Ashenafi, Riccardi, & Ronchetti (2015) have used data from the forum where students ask questions and rate answers. Data from the peer-assessment system was also used for predicting the result of the student.

MOOCs have seen a dramatic rise in prominence in recent years, and are considered by some as challenging existing pedagogical methods and practices within the education sector, while others are far more skeptical about their impact.

Siemens identified four major challenges of MOOCs: its poor completion rates in comparison with traditional university courses, does not have a sustainable revenue model yet, courses are non-credit which leaves scope or plagiarism and cheating. Furthermore, there is a risk of deskilling the professoriate due to the impact of "super professors" from top universities providing recorded lectures to other universities [23].

Chen. Y points out that lack of interaction between MOOC instructor and learners will definitely damage the course quality. It was also observed that dropout rates are substantially higher that traditional education model. Also only few colleges or universities offer full course credit to students who complete a MOOC. Conducting effective assessment in a MOOC has so far been a major challenge. In addition, many MOOC learners are in developing countries and have limited access to the Internet, meaning they do not have the access needed to watch high- quality video lectures: the main components in MOOCs [16].

North et al. (2014) found that the motivation of students for taking online courses is either to get certificates from elite universities or possibly for enhancing their resumes. Since there is no financial investment by students, it is easy for them to drop a course at any time without any consequences. Students who are taking MOOCs inherently represent wider and larger diversity compared with traditional structured curriculum courses. Almost no one in a MOOC receives individual interaction or feedback from an expert. Even though thousands enroll for MOOCs, the completion rate is extremely low.

A year later, a review of usage and evaluation of MOOCs (Sinclair et al., 2015) showed the next prominent issues: MOOCs' students were found to have difficulties in finding learning paths and understanding the material. MOOC attrition rates are high. Many participants using forums do not act responsibly. Although some researchers suggest that MOOCs provide a flexible and adaptable means of delivering content, in practice the costs of producing good quality recording can be high.

3. CONCLUSIONS

In the era of technological revolution, there is a growing interest to investigate how MOOCs can enhance traditionally taught courses and act as a complementary resource in achieving both teachers' and students' goals. The MOOC phenomenon is still in its evolving stages and the body of literature is growing rapidly making it difficult to definitively evaluate the potential of the massive open online course. It is clear that the impact of MOOC on higher education, in all its manifestations, will be significant. In this study, a comprehensive review of MOOCs and Learning Analytics has been done involving the concepts and methods and how its application in online learning platforms involves interdisciplinary studies of both. Learning Analytics and MOOCs together can enables students to interpret their own results and review their performance, and for instructors to transform the learning of students or student groups in MOOCs according to the need of the hour.

With the analysis of the data, educators can determine renewals in the curriculum and students' weaknesses in learning and understanding thereby improving curriculum quality and learning potential of students and also identify individual errors since there are various variables affecting the individual performance. The rise of MOOCs has forced teachers, administrators, and policy makers to evaluate a range of issues, from definitions of completion and success to pedagogical approaches, delivery methods, and certification. More systematic research and analysis over the next few years will give a clearer picture about the revolution that may happen in the field of online education.

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