

Massive Open Online Courses: Concept and Implications

RAJIV MAHAJAN¹, PIYUSH GUPTA² AND TEJINDER SINGH³

From Department of¹Pharmacology, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, ²Department of Pediatrics, University College of Medical Sciences, New Delhi; and ³Department of Pediatrics and Medical Education, SGRD Institute of Medical Sciences and Research, Amritsar, Punjab, India.

Correspondence to: Dr Tejinder Singh, Professor, Departments of Pediatrics and Medical Education, SGRD Institute of Medical Sciences and Research, Amritsar, Punjab, India. drtejinder22@gmail.com

Massive open online courses (MOOCs) are currently the buzz word in the field of e-learning. By definition, MOOCs are massive courses considering the number of participants enrolled across the globe per course, are open accessed, and are available online. MOOCs have evolved along the trajectory of correspondence courses, radio- and television-broadcasts, and e-learning. Though various taxonomies to classify MOOCs exist, two types – Connectivist Massive Open Online Course (cMOOC) and Extended Massive Open Online Course (xMOOC) have distinctly emerged. cMOOC promotes creativity and interaction among participants, while xMOOC is used merely for knowledge dispersion. With increased and unrestricted use of internet, and with ease of developing new online platforms, MOOCs are proving to be an evolutionary phenomenon. Many universities and institutes of higher learning are using MOOCs for knowledge dispersion and skill development. Their role in faculty development, capacity and capability building in medical education arena is unequivocal. Potential of MOOCs can be well-tapped for conduct of continuing medical education programs, and programs for improving soft-skills and research skills in medical field for faculty development. This review details the concepts of MOOCs and their application in education field, particularly in medical education, and feasibility of developing MOOCs in India.

Keywords: *E-learning, Life-long learner, Open courses, Ubiquitous learning.*

Human race is in the midst of a knowledge explosion [1]. Is our conventional educational set-up equipped enough to deal with this enormous magnitude of knowledge and information explosion, so that the knowledge reaches the intended end-user? The working capacity of traditional system is limited by time, space, cost, infrastructure, manpower, structured curriculum, assessments and certifications. Institutes of higher education world-wide deliver a structured program in some conventional and specific domains with restrictions of number of entrants per year per course and at a very high cost. Increasing cost of education under traditional set-up is already a catchphrase in higher education circuit. As per rough estimates, the cost of running a college in the US has increased by 439% compared to 1982, and this is being projected as the 'higher education bubble'; which is about to burst [2].

Do we have a solution? Distance learning in its various incarnations has always been promoted as a supplement to traditional learning in dispersing vast quantity of knowledge and information to the learners. With the growing use of internet, online-learning has taken the centre-stage and that makes a perfect case for introduction of Massive open online course (MOOCs).

EVOLUTION OF MOOCs

The term Massive open online course was framed by Dave Cormier, while christening a course developed by Siemens and Downes at the University of Manitoba [3]. More than 2,000 students enrolled for the course (massive), and it was delivered using various open and free to use educational resources (open) such as wikis, online forums, Google Docs, YouTube, and Facebook groups [3]. As the name suggests, these courses are massive in terms of number and distribution of participants across globe per course, are open access, and available online. The four basic elements of MOOC are defined below [4]:

- *Massive:* MOOCs are designed for enrollment of unlimited number of participants; and if number of participants increases, no additional efforts are needed to conduct the course.
- *Open:* Courses under MOOCs are delivered free of cost, and participants do not require any predefined and specific enrolment qualifications.
- *Online:* The course is delivered through online resources *via* the Internet.
- *Course:* A full course is offered including designing of

learning goals; availability of course content; and assessment of learners through quizzes, formative assessment, and summative examination for certification purposes.

The origin of MOOCs was possibly a bottom-up approach, characterized by development and promotion of MOOCs by educationists working with the students' learning, for promoting open and flexible educational practices and approaches through use of social media. However the latest surfacing of many start-ups with commercial interests suggests a shift to a more top down structured approach.

Along the evolutionary path, the earliest documented predecessor of MOOC is distance learning, which started in the form of correspondence courses delivered *via* posts in early part of last century, and is still prevalent in many parts of the world. Indira Gandhi National Open University is one such example in India. Later, the courses were delivered *via* radio and television broadcasts, in isolation or in conjunction with both classroom and distance education [5]. With the advent of Internet, online or e-learning provided added advantage of synchronous interactions between students and faculty. Advancements in online accessibility has revolutionized the open learning opportunities and promoted acceptance of MOOC. The scope and spectrum of MOOC has been further broadened by the introduction of peer review, peer assessment, and self-assessment in-built in to its scheme.

TAXONOMY OF MOOC

The main focus of the Connectivist Massive Open Online Courses (cMOOCs) is on creation and generation of knowledge, whereas Extended Massive Open Online Courses (xMOOCs) merely focus on knowledge duplication [6]. More simply, xMOOC can be compared to watching videos while cMOOC is like making a video [7]. cMOOCs are based on the principles of aggregating and remixing study materials with re-purposable and feed-forward intent of use. They try to promote interaction among learners to answer questions or work jointly on projects. xMOOCs work more like a traditional course structure where syllabus is specifically defined in the form of recorded lectures and assessment focuses on self-test problems. They, in effect, provide content distribution partnerships to institutions and promote individual learning on a single platform [8].

With extended use of MOOCs, other taxonomies of MOOCs have emerged. MOOC have been appended to twelve different dimensions - the degree of openness, the scale of participation, the amount of use of multimedia,

the amount of communication, the extent to which collaboration is included, the type of learner pathway, the level of quality assurance, the extent to which reflection is encouraged, the level of assessment, how informal or formal it is, autonomy, and diversity [9]. Any MOOC can be designed and evaluated against these 12 dimensions and criteria for ensuring quality assurance.

Clark detailed taxonomy of MOOCs from a pedagogical perspective, based on their learning functionality, and not on their origin [7]. He proposed eight categories (**Fig. 1**). Though the categories are not mutually exclusive, but they provide functional base. He categorized 'transferMOOCs,' as the one which repurpose existing course content in a MOOC platform and mainly rely on a name of the institution or academic to attract learners; 'madeMOOCs' which rely on creativity and designing of new material and tend to have more innovative use of videos; 'synchMOOCs,' which have well defined timelines to submit assignments and finish the course work, 'asynchMOOCs,' which are self-paced having an open timeline for course completion, 'adaptiveMOOCs' use adaptive process to present personalized learning experiences, 'groupMOOCs' as the one which start with small number of students in a cohesive group with an intent to improve student retention, 'connectivistMOOCs' rely on the connections across a network rather than pre-defined content and tend to create their own trajectory rather than following any linear path, and 'miniMOOCs' with courses of shorter duration lasting for few days [7].

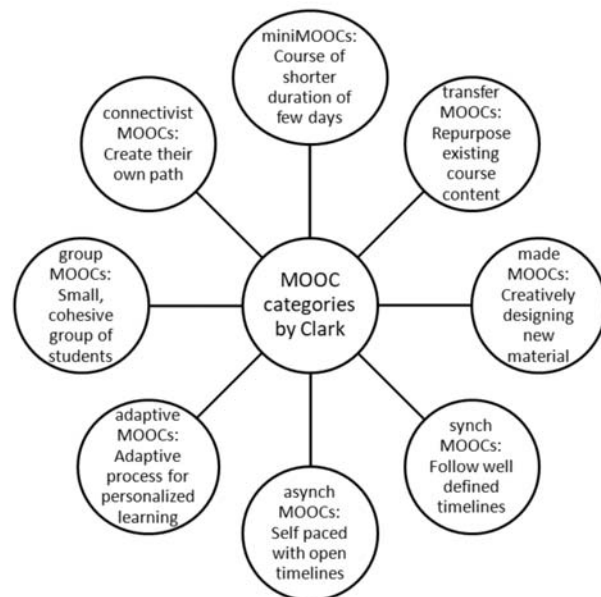


FIG. 1 Clark taxonomy of Massive Open Online Courses.

All India Council for Technical Education (AICTE) under Ministry of Human Resource Development of Government of India (GOI) has started MOOCs under ‘Study Webs of Active-Learning for Young Aspiring Minds’ (SWAYAM) portal (<https://swayam.gov.in/>), providing hundreds of open courses to students, with an option of transferring the credits earned by students through these courses into their academic record [10]. This portal incorporates many courses, ranging from engineering to social sciences to medical sciences structured by different Indian Universities and has option of both ‘scheduled courses’ and ‘self-paced courses’.

ROLE OF MOOCs IN MEDICAL EDUCATION

Though not suitable for traditional medical courses requiring face-to-face practical and skill training with live interaction with patients, MOOCs can play a supporting role by supplementing these traditional courses through information propagation to many participants at the same time. The role of MOOCs in conduct of continuing medical education (CME) programs, programs for improving soft-skills and research skills, faculty development, and capacity building may prove unequivocal (**Box 1**).

MOOCs FOR CONTINUING PROFESSIONAL DEVELOPMENT

As per General Medical Council, UK – “continuing professional development (CPD) is any learning outside of undergraduate education or postgraduate training that helps to maintain and improve performance. It covers the development of knowledge, skills, attitudes and behaviors across all areas of professional practice” [11]. CPD helps the healthcare professionals to update their learning of the medical school and postgraduate training so as to adjust to the emergent innovations in the practice, changing needs of patients, and changing

expectations of the society from their work. In short, CPD programs serve the purpose of maintaining and improving the health care professionals’ competency and performance required for patient care in order to improve health outcomes and thus features as an important part of healthcare professional’s training [12].

It is pertinent to mention that the MCI Competency-based UG Curriculum 2018 mentions ‘lifelong learner’ as one of the five main roles of Indian Medical Graduates (IMG); necessitating them to continuously improve skills and training [13]. CPD is the core idea of being lifelong learner. One of the core competencies as mentioned in guidelines is – “the IMG demonstrate ability to search (including through electronic means), and critically evaluate the medical literature and apply the information in the care of the patient [13].” MOOCs are wonderful online tools for IMG to fulfill the role of lifelong learner.

Besides providing learning opportunities to acquire or refresh knowledge, MOOCs provide an arena for interaction amongst a mixed population of learners, facilitating the exchange of ideas and experiences, development of new innovative study materials and development of ideas beyond the course material [14]. The potential for this interactive team efforts within MOOCs is highly relevant to health care professional workforce due to their regular need of developing and conquering new knowledge.

MOOCs FOR SKILL DEVELOPMENT

In the healthcare system, the health issues of the patients are largely affected by skilled health care professional resources. The World Bank status report of skill development in India identified several lacuna in skill development and highlighted the relevance, potential and efficacy of vocational training in the country. Eleventh Five Year Plan (2007-12) of GOI included skill development programs in the policy agenda; leading to National Policy on Skill Development and Entrepreneurship-2015 [15]. Currently, India is having a separate Ministry of Skill Development and Entrepreneurship, working with the motto of ‘Skill India’ [16].

MOOCs are particularly helping participants develop skills across marketing, engineering and computer programming. Participants are working over social media communities also, for better interaction and collaboration [17]. Some MOOCs for skill development in health care and life science field has also been created like ‘An Introduction to Global Health’ (Coursera), and ‘Behavioral Medicine: A Key to Better Health’ (EdX) [18]. More specific like ‘Exploring Anatomy: The Human Abdomen’ (Futurelearn) has also been functional since

BOX 1 ROLE OF MOOCs IN MEDICAL EDUCATION

For Continuing Medical Education

- Online CMEs
- Webinars/Podcasts for structured courses

For Faculty Development

- For fostering soft skills
- For inculcating research skills

For Skill Enhancement

- Development of psychomotor skills through online programs
- Blended programs (Online combined with onsite)

2014 [19]. A meta-analysis provided a list of 98 health and medicine related MOOCs running across the globe in the year 2013 [20]. The areas where MOOCs can be used for skill development in medical sciences is limited, as skill development in medical sciences require actual performance and learning by doing on human beings under close supervision. Still, the full potential of MOOCs for skill development in medical sciences has not been tapped yet.

MOOCs FOR TEACHERS' PROFESSIONAL DEVELOPMENT

The teacher is a key element in every educational set up. The National Knowledge Commission of India recognized the teacher as the single most important element of the education system [21]. A report by an international organization also mentions that the quality of an education system cannot exceed the quality of its teachers [22]. It is an undisputed fact that teachers' professional development (TPD) is required for continuous evolution of the educational system.

As noted by Quattlebaum - "teacher development has moved beyond simple in-service workshops and has expanded into a more robust system of continuing education. In order to advance in their careers, teachers should seek out professional development opportunities which are ongoing and aligned with standards and assessments" [23]. In this changing paradigm, TPD cannot be equated to attending a few day workshop programs, on and off. Rather that will require continuous efforts. MOOCs not only can help in development and sharpening of health professional skills and professional development, but can also play a role in medical teachers' professional development. With easy accessibility, low cost and interactive nature, MOOCs provide immense learning opportunities to the teachers for professional development. Experts opine that the most natural and immediate service MOOCs can provide to teachers is the professional development of the teachers [24]. Though MOOCs are available for TPD for medical teachers [25]; a large number of teachers are still unaware about MOOC and the opportunities for TPD provided therein [26].

MOOCs FOR MEDICAL STUDENTS' EDUCATION

Current undergraduate and postgraduate medical students, who are going to be health care professionals, can also be benefitted from MOOCs. Some courses are supplementing traditional medical education in a flipped-classroom experience [20]. MOOCs are also providing platform for blended curricula for campus-based training [19]. E-learning technology in itself can be used for supplementing and augmenting training in all domains *viz.*, cognitive, psychomotor and affective through use of

smartphones and skill laboratories [27]. Besides their use as flipped classroom tool, they have the potential to be used as alternative platform for interprofessional education (IPE) [12] with its immense potential of heterogeneous participants and opportunities for interactions, which are the two core features and requirements of IPE [28].

In-built tools of peer-review and assessment and self-assessment in MOOCs help medical students to inculcate the skills of self-directed learners. But due to lack of highly structured curriculum, self-pacing and only a suggested course pathway to guide learners, learning under MOOCs require high degree of self-motivation.

POTENTIAL AND FEASIBILITY OF MOOCs IN INDIA

India has the most number of medical colleges in world with an astounding figure of 497 with 60680 seats for Bachelor of Medicine and Bachelor of Surgery (MBBS) course (MCI website, January 2019). Such an extensive network of medical colleges, coupled with enormous learning opportunities due to introduction of Competency-based medical curriculum (CBMC) from 2019 session across all medical colleges in India is a fertile ground to tap the potential of MOOC for both – students' learning and faculty development. MOOC can be suitably planned for formal and non-formal, curricular and beyond-curricular learning of undergraduate and postgraduate students under CBMC. Some the curricular related areas where MOOC can be of much benefit are: training about professionalism and ethics, training about research methodology, training about good clinical practice guidelines, training about adverse drug reaction monitoring, and skill development through virtual patients.

Many initiatives as MOOCs have started in India now. SWAYAM portal is one effort by GOI to implement massive online courses and almost all of them are free of cost. As government has huge infrastructure and resources, so implementation is not an issue. The courses for SWAYAM are produced and delivered by AICTE for self-paced courses, University Grants Commission for post-graduation education, Consortium for Educational Communication for under-graduate education, National Council for Educational Research and Training for school education, Indira Gandhi National Open University for out of the school students and, Indian Institute of Management, Bengaluru for management studies; thus giving a wider range, openness, and self-pacing as its key attributes [20].

National Program on Technology Enhanced Learning (NPTEL) is another joint venture started by consortium of

Indian Institute of Technology and Indian Institute of Science. Through this portal, online courses and certification in various engineering and technology related topic is provided. These are all structured and scheduled courses. Many faculty development programs are also conducted through NPTEL portal [29].

Under project ECHO, National Institute of Mental Health and Neurosciences is providing training in many courses in blended form. The centre is providing certification with a mission, so that the cost of training and geographical distance does not act as a barrier for quality care [30]. Though the target participants are specific and mode is blended; none the less openness and online availability are its key features.

With increasing use of cheaper internet in India, availability of gadgets like tablets and smart phones at affordable prize and digitalization of resource libraries, learning now days is becoming ubiquitous, thus paving the way for introducing more MOOCs. Only feasibility issue is identification of areas to be taught through MOOCs and development of such courses. With more and more collaborative efforts and guidance from Universities already working in the field, the same can be overcome easily. MOOC handbook of university of Edinburgh [31], which gives instructions for designing MOOC once your bid for course development has been accepted, can be of great help and guiding document for developing courses for MOOCs. Another guiding document is ‘Guidelines for developing online courses for SWAYAM’ by GOI [32].

PROS AND CONS OF MOOCs

The advocacy of MOOCs lies in its in-built attributes of

massiveness, openness, and ubiquitous presence; and same may turn out to be the Waterloo of MOOCs if we flip to the other side of the coin with unstructured and short courses and high attrition rate. At the same time MOOCs pose challenges to both students and faculty – uncontrolled, uninhibited and unrestricted use of MOOCs by the students can lead to access to unnecessary courses, acquisition of unsubstantial degrees and wastage of time at the expense of time for regular course-work. Regular students of any institute have to be extra-cautious before joining any MOOC and must ascertain, if their institute’s rules permit them to join any online course for acquiring a dual-degree.

Internet connectivity and hardware problems will always be there, for the delivery of the MOOCs. MOOCs may prove challenging for persons not accustomed to the use of computers and internet. Various pros and cons of MOOCs have been compared in **Table I**.

CONCLUSION

MOOCs have huge potential which can be tapped in medical sciences both for faculty development and for teaching learners. However, at the same time one must bear in mind that MOOCs are neither a panacea for all the problems being faced in medical education nor they can replace traditional education system, as far as the medical sciences are concerned. None the less, they can supplement the traditional set-up for delivery of knowledge and psychomotor skills in medical students, for inculcating self-directed learning skills, and for making health professionals lifelong learners.

Contributors: TS,PG: conceptualize the paper; RM: wrote the paper; TS, PG: critically reviewed the paper; RM: revised the paper.

Funding: None; *Competing interest:* None stated.

TABLE I PROS AND CONS OF MASSIVE OPEN ONLINE COURSES

<i>Pros</i>	<i>Cons</i>
<ul style="list-style-type: none"> • Large number of participants can enroll simultaneously. • Online delivery, easy accessibility • Free of cost • Heterogeneous participants – promote interaction and sharing of ideas • Promotes learning in an inter-professional educational environment • Self-pacing • Promotes creativity • Inculcates self-directed learning skills • Same module can be used time and again – low cost of delivery 	<ul style="list-style-type: none"> • Unspecific short courses • High drop-out rate • Course development is resource- intensive • No clear-cut assessment criteria • Certification is dubious • Appraisal and recognition of such certificates by employers not clear, leading to hurdles in career progression • Little financial incentives to course content developers

REFERENCES

1. Grabbe OJ. The knowledge explosion. *Tomorrow's World Magazine* 1971;3(3). Available from: <https://www.hwalibrary.com/cgi-bin/get/hwa.cgi?action=getmagazine&InfoID=1334072546>. Accessed July 10, 2018.
2. Daly J. The higher education bubble is about to burst. EdTech [article on internet]. Available from: <https://edtechmagazine.com/higher/article/2012/07/higher-education-bubble-about-burst-infographic>. Accessed July 10, 2018.
3. López-Sieben M, Peris-Ortiz M, Gómez JA. Lessons learned through massive open online courses. In: Peris-Ortiz M, Garrigós-Simón FJ, Pechuán IG (editors). *Innovation and Teaching Technologies: New Directions in Research, Practice and Policy*. Berlin: Springer; 2014. p. 11-21.
4. Patru M, Balaji V. Making sense of MOOCs: A guide for policy-makers in developing countries. Paris: United Nations Educational, Scientific and Cultural Organization; 2016. p. 17.
5. Department of School Education. Punjab Edusat Society. Available from: <http://ssapunjab.org/edusat/index.html>. Accessed July 11, 2018.
6. Stathakarou N, Zary N, Kononowicz AA. Beyond xMOOCs in healthcare education: study of the feasibility in integrating virtual patient systems and MOOC platforms. *Peer J*. 2014; 2: e672. [Last accessed May 22, 2019]. doi: 10.7717/peerj.672
7. Clark D. MOOCs: Taxonomy of 8 types of MOOC. *Donald Clark Plan B*. [online] 16 April, 2013. Available from: <http://donaldclarkplanb.blogspot.co.uk/search?q=MOOCs:+taxonomy>. Accessed July 26, 2018.
8. Prpiæ J, Melton J, Taihigh A, Anderson T. MOOCs and crowdsourcing: Massive courses and massive resources. *First Monday* 2015;20(12). Available from: <http://journals.uic.edu/ojs/index.php/fm/article/view/6143/5170>. Accessed July 25, 2018.
9. Conole G. MOOCs as disruptive technologies: Strategies for enhancing the learner experience and quality of MOOCs. *Revista de Educación a Distancia (RED)*. 2013;39. Available from: <http://www.um.es/ead/red/39/conole.pdf>. Accessed July 25, 2018.
10. Swayam – Free online education. Available from: <https://swayam.gov.in/>. Accessed July 28, 2018.
11. General Medical Council. Continuing professional development: Guidance for all doctors. Available from: https://www.gmc-uk.org/-/media/documents/cpd-guidance-for-all-doctors-0316_pdf-56438625.pdf. Accessed August 3, 2018.
12. Pickering JD, Swinnerton BJ. An Anatomy massive open online course as a continuing professional development tool for healthcare professionals. *Medical Science Educator*. 2017;27:243-52.
13. Medical Council of India. Competency Based Undergraduate Curriculum for the Indian Medical Graduate. MCI:2018; p.20.
14. Glass CR, Shiokawa-Baklan MS, Saltarelli AJ. Who takes MOOCs? *New Directions for Institutional Research*. 2016;167:41-55.
15. Gaba AK, Mishra S. Skill Development through MOOC for inclusive and sustainable development: A Review of Policies in the Asian Commonwealth Countries. Available from: [https://oerknowledgecloud.org/sites/oerknowledgecloud.org/files/PDF%20\(1\)_0.pdf](https://oerknowledgecloud.org/sites/oerknowledgecloud.org/files/PDF%20(1)_0.pdf). Accessed August 4, 2018.
16. Ministry of Skill Development and Entrepreneurship. Available from: <https://www.msde.gov.in/#>. Accessed August 4, 2018.
17. Rayan AP. Skill-building, the MOOC way. *The Hindu*, Dec 7th, 2014. Available from: <https://www.thehindu.com/features/education/skillbuilding-the-mooc-way/article6668073.ece>. Accessed August 4, 2018.
18. Sarkar S, Bharadwaj B. Adapting massive open online courses for medical education. *International Journal of Advanced Medical and Health Research*. 2015;2:68-71.
19. Swinnerton BJ, Morris NP, Hotchkiss S, Pickering JD. The integration of an anatomy massive open online course (MOOC) into a medical anatomy curriculum. *Anat Sci Edu*. 2017;10:53-67.
20. Liyanagunawardena TR, Williams SA. Massive open online courses on health and medicine: Review. *J Med Internet Res*. 2014;16:e191.
21. Mishra PK. MOOC for teacher professional development: Reflections and suggested actions. *Open Praxis*. 2018;10:67-77.
22. OECD. PISA 2009 Results: What Makes a School Successful? – Resources, Policies and Practices (Volume IV); 2010. Available from: <https://www.oecd.org/pisa/pisaproducts/48852721.pdf>. Accessed August 4, 2018.
23. Quattlebaum S. Why professional development for teachers is critical. *The Evollution*; 2012. Available from: <https://evollution.com/opinions/why-professional-development-for-teachers-is-critical/>. Accessed August 4, 2018.
24. Palmer M. Are we missing opportunities to engage teachers with MOOCs? EDX BLOG; 2015. Available from: <https://blog.edx.org/are-we-missing-opportunities-engage>. Accessed August 4, 2018.
25. edX. Medicine Courses. Available from: <https://www.edx.org/course/subject/medicine>. Accessed August 4, 2018.
26. Malita L, Tiru LG, Grosseck G. MOOCs for Teachers Professional Development - A University Challenge. *International Journal of Information and Education Technology*. 2018;8:235-9.
27. Dhir SK, Verma D, Batta M, Mishra D. E-learning in medical education in India. *Indian Pediatr*. 2017;54:871-7.
28. Mahajan R, Mohammed CA, Sharma M, Gupta P, Singh T. Interprofessional Education: An Approach to Improve Healthcare Outcomes. *Indian Pediatr*. 2018;55:241-9.
29. NPTEL: Online Courses. Available from: <https://onlinecourses.nptel.ac.in/>. Accessed July 30, 2018.
30. NIMHANS-ECHO.: Virtual Knowledge Network, Centre for addiction medicine. Digital courses. Available from: http://vlc.nimhans.ac.in/?page_id=3008. Accessed August 2, 2018.
31. Scott I, Kendra L, Woodgate A. *Edinburgh MOOCs handbook: How to grow your own MOOC with Coursera, version 1.2*. Edinburgh: The University of Edinburgh. Available from: <https://moocs.unige.ch/files/3414/2503/>

- 3908/Growing_an_Edinburgh_MOOC.pdf*. Accessed August 2, 2018.
32. Ministry of Human Resource Development – Government of India. Revised Guidelines for Development of Online Courses for SWAYAM; 2017. Available from: [http://ugcmoocs.inflibnet.ac.in/download/course/notice/3885329_MOOCs-Guideline-\(Development—Funding\).pdf](http://ugcmoocs.inflibnet.ac.in/download/course/notice/3885329_MOOCs-Guideline-(Development—Funding).pdf). Accessed August 4, 2018.
-