



Massive Open Online Courses(MOOCs) – A Comprehensive study and its Application to Green Computing in Higher Education Institution

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ABSTRACT

Massive Open Online Courses (MOOCs) was first introduced in 2008 by Dave Cormier to describe “Connectivism and Connective Knowledge” course. In 2011, Sebastian Thrun and his colleagues at Stanford University designed an open access course on Artificial Intelligence. It was a tremendous success of MOOC. Since then, MOOCs have become a label for many recent online course initiatives from institutions. In the present paper the authors have made a comprehensive study on application of Green Computing in Higher education using MOOCs. A study is made on MOOCs in the wider context of open education, online learning and the changes that are currently taking place in higher education at a time of globalization of education within constrained budgets. The present study will help decision makers in Higher Education Institutions(HEIs) to have a better understanding of the phenomenon of Massive Online Open Courses (MOOCs) and trends towards green computing. The authors made a thorough study on MOOCs and application in future higher education and at large it will to introduce green education in HEIs.

Key words : MOOCs, Artificial Intelligence, Green Computing, Globalization, HEI

1. INTRODUCTION

Agarwal et al.[1-11] published several papers on green computing and its implication in higher education. It has been already established that e-learning is one alternative for green computing. E-learning not only reduces the production of carbon footprint but it saves energy, resources and money. Initially e-learning was used as a supplementary education system. But in the last one decade there has been a massive change in the school level and in higher education level also. E-learning is generally asynchronous. On the other hand the traditional teaching learning process is synchronous and the learner and the teacher must be present at particular moment in a particular place which is essentially a class room. In traditional teaching learning system there are both positive as well as negative side. The positive effect is very much clear such as there is face to face interaction of the teacher with the students and the students can also interact among themselves. The negative points of traditional teaching learning process is that if a student can not attend a particular class for some

unavoidable reason then there is no recovery option of the same class. The traditional teaching learning system is very much teacher centric. The learners don't have any other option but to listen the entire lecture even though he could not understand or not getting interest in that subject. Moreover the learners don't have any freedom for taking break or to think something independently within the class. To get rid of all these problems initially e-learning system was introduced. e-learning may drastically change learning and teaching methodology and it will save power, energy and will decrease carbon footprint. Recently e-learning methodology has been drastically changed. Initially e-learning was based on study materials uploaded in various websites and the user can download those study materials instead of buying books and study when they are free. So it was purely asynchronous mode of study. In 2011, the University of Pennsylvania, Princeton University, Stanford University, and the University of Michigan joined forces to offer free courses online. The Massachusetts Institute of Technology and Harvard University came together to do the same in 2012. The partnership has expanded to include a number of other institutions, including the University of California at Berkeley and Wellesley College. The collaboration of such name-brand institutions has sparked increasingly greater interest among higher education leaders and the public in such massive open online courses or MOOCs[13-14].

MOOCs can be seen as an extension of existing online learning approaches, in terms of open access to courses and scalability, they also offer an opportunity to think afresh about new business models that include elements of open education. The opportunity that MOOCs offer for massification of courses has generated significant interest from governments, institutions and commercial organizations. MOOCs reduces not only cost of study but it helps to save environment by introducing paperless study. The MOOCs drastically reduces the carbon footprint in higher education. The impacts of MOOCs on colleges and universities may be considered as follows:

(i) While information technology (IT) is the medium through which disruption of the academic enterprise is taking place, that disruption is not about IT. IT is an enabler of almost every aspect of life in the 21st century—on our campuses, in our workplaces, and in our homes. But what is most important for higher education is the transformation of teaching and learning. The learners are indeed backstage, making things happen and the faculty members and the instructors are the “stars”. This revolution is not about IT. It is about teaching and learning.

(ii) Although MOOCs have grabbed the headlines and rightfully become the focal point of the disruption under way in higher education, we should not think MOOCs is only online education methodology in colleges and universities but definitely MOOCs may be one important issue to implement higher education in colleges and universities.

One of the key differences between MOOCs and the previous online approaches is that MOOCs are free. Students can take the courses at no charge. The pedagogy that MOOCs employ also differs significantly from “traditional online learning.” Learning is accomplished via a “flipped classroom” model, whereby the instructor employs the Internet and other technologies to allow students to gain knowledge that used to be delivered via a lecture format and then use time in the classroom to work on problems together. A number of custom-made MOOC platforms have been developed and started to deliver courses independently or sometimes in collaboration with some reputed universities. An increasing number of institutions are now engaged with MOOCs for the purpose of expanding its access, its marketing and for proper branding and developing new revenue streams. It is now high time to motivate the learners to participate in MOOCs in the context of an online learning environment. The time has come to verify what is the real market value of certification of MOOCs. Till 2012 the MOOCs were run by few reputed Universities of US and UK those universities were offering those course totally free of cost to anybody. But from mid of 2012 and till now there are quite a number of private institutions have come up to offer MOOCs and they want to attach with Universities and want to run it in commercial basis. In the present paper the authors have given complete survey report on MOOCs and its application in Higher Education institution.

2. SOME IMPORTANT QUERIES AND ISSUES FOR MOOCs

The last one decade there has been a considerable change in common adoption of Internet technologies with extensive explosion and use in more economically developed countries. However, in terms of the explosion of MOOCs as an educational approach, there is a risk that the current interest is being driven by a self selecting group of qualified and IT literate individuals who are able to navigate the sometimes complex, confusing and unapproachable nature of online learning. In general, there are concerns about the pedagogy and quality of current MOOC courses, with a clear distinction between process and content-based approaches. The motivation for some MOOCs is a charitable one and for others a new business with MOOCs in Open Education and its implications for Higher Education Institution. However, in both cases, there is the challenge of finding a viable model that allows for sustainability of MOOC provision.

A. Is MOOCs are disruptive innovations?

The theory of disruptive innovations defined by Bower and Christensen[15] gave us an explanation how some innovations disrupt existing markets at the expense of present players. In case of MOOCs there is a fundamental question for higher education institutions to address: “are online teaching innovations, such as MOOCs, made a change in the business scenery that poses a threat to their existing models of provision of degree courses?” We do not know yet whether this is true or false. So therefore, the theory of disruptive innovation suggests that there is a strong argument for establishing an autonomous business unit in order to make an appropriate response to these potentially disruptive innovations.

B. Who can access education and opportunities globally?

For past few centuries, higher education institutions’ mission has started with a set of students who are really interested to take higher education. Can these institutions revisit the mission now, to consider it as the search for talents around the world who should apply? The impact of this question is the introduction of enterprise and vocational training and all the way to lifelong learning. With the initiation of high quality of education being made widely accessible through new technology democratizes the higher education.

C. What is the role the classroom and Faculty?

Should the class be reserved only for two-way interactions and the answer is yes. Now the lecturing is converted to YouTube and MOOC. In fact we have to pay more incentives to those teachers who are preparing the materials for online teaching.

D. Is there a sustainable revenue model for MOOCs?

The platforms like Coursera, Udacity and Code Academy are profit-seeking companies seeking returns on their investment on the other hand like EdX, Class2Go, Semester online, Open Yale are non-profit and financed by university resources. But in both the cases the financial sustainability of some amount is needed. However, there is no business model to generate non-trivial amounts of revenue for profit-seeking platforms.

E. How can MOOCs authenticate and assess the learners?

There are four(4) types student assessment : (i) self-grading, (ii)machine-grading,(iii)peer-grading,(iv)professional-grading. Out of four type assessment the first three(3) are most appropriate for MOOCs assessment. Regarding student authentication there are already profitable companies selling Coursera certificates at some cost. Not only that they have the solutions to defeat the recently announced biometric authentication tests. MOOCs may be free but the authentication of the student should be done with tests centres and ground staff with some reasonable fees. Now the next important question is that what type of certificate should be given to the student? Depending on the confidence levels of

authentication the following type of certificates may be given (i) a diploma, (ii) letter grades, (iii) pass/fail, (iv) a course completion certificate from the instructor with no institutional logo.

F. How can MOOCs scale up, scale down and engage students?

We have to find the answer to the question “are students actually paying enough attention in asynchronized learning?” We have to also find answer to the following questions:
Can we create personalized instruction?
Can the textbooks of the future be made from the learning style of the current learners and adapt the content and layout of the text chapters?

G. How might we make it easier for students to finish a course?

The completion rates for MOOCs to-day are typically of the order of 3%(maximum). This statistical data is quite surprising. We can get the answer to it very easily. Suppose a learner wants to join MOOCs and so he has to spend 20 hours per week on difficult homework about differential equations which may not be so easy for that learner at that age. More than just boosting the impressive enrolment numbers further, how can we significantly increase the completion rate? For example we can give certificate of completion to the participants after completion of the duration of the course. This may help to get better percentage of completion of the MOOCs.

There are many such queries or challenges are there in MOOCs as MOOCs is intrinsically asynchronous and heterogeneous. In MOOCs there is no common timetable, there is no daily schedule of the course, there is no common education goals and there is no common background among the diverse demographics.

3. IMPLICATIONS OF MOOCs IN HIGHER EDUCATION

Massive Open Online Courses (MOOCs) have recently received a great deal of attention from the media, professionals from educational institute, technology and corporate people. The idea of MOOCs is that they will provide free to access, advanced courses that could drive down the cost of university-level education and potentially disrupt the existing models of higher education (HE). This has encouraged elite universities to put their courses online by setting up open learning platforms. At the same time a parallel new commercial start-ups such as Coursera and Udacity have also been launched in collaboration with prestigious universities, offering free online courses but charging a small fee for awarding certificate for the course. Big companies like Pearson and Google are also planning to move into the HE sector as global players and are likely to adopt a MOOC-based approach as a part of their plans. The Open University of UK has launched a new company called Futurelearn[22] to bring together a range of free, open, online

courses from leading UK universities for learners around the world. From open access to open educational resources, and more recently, open online courses, there is growing impetus among HEIs to participate in this MOOCs. The UK Open Educational Resources programmes launched 2009 a new teaching and learning resources freely available worldwide with copyright licenses that promote their use[2013].The original objective of MOOCs was to open up education and provide free access to university level education for as many students as possible. In contrast to traditional university online courses, MOOCs have two important features :

1. Open access - anyone can participate in an online course for free of cost.
2. Scalability – the courses are designed to support an infinite number of participants

Again these features may be interpreted differently by different MOOCs providers:

Some MOOCs are massive but not open and some are open but not massive. The ambiguities in the concept of MOOCs may create a problem to the future development of open educational resources and open courses where the general learner will recognize this as ‘free’ is good enough and they will not bother about ‘open’.The development of MOOCs is rooted within the ideals of openness in education, that knowledge should be shared freely, and the desire to learn should be met without demographic, economic, and geographical constraints. Since 2000 the concept of openness in education has been evolving rapidly, although it has its origins in the early 20th century[36] Massachusetts Institute of Technology (MIT) established OpenCourseWare in 2002 and the Open University set up OpenLearn in 2006, representing an ongoing development of the open education movement. A key message that emerges is that the evolution of MOOCs is leading to more players in the market as HEI and private organizations seek to take advantage of these innovations in online learning.

A. cMOOCs Vs. xMOOCs

The MOOCs again classified into two distinct categories : (i) cMOOCs and (ii) xMOOCs

The cMOOCs are based on a connectivity theory of learning with networks developed informally. The xMOOCs are content based and which follow a more behaviorist approach. Essentially it is the same learning process versus learning content debate that the educationalists have for many decades and failed to resolve. cMOOCs emphasise connected, collaborative learning and the courses are built around a group of like-minded persons who are relatively mentally free from institutional constraints. cMOOCs provide a platform to explore new method beyond traditional classroom settings and, as such, tend to exist on the fundamental edging of HE.

The instructional model or xMOOCs is essentially an extension of the instructive models practiced within the institutions themselves, which are instructional methods with video presentations, short quizzes and assessments. xMOOCs can be again divided into two categories and can be identified as profit and non-profit to serve different purposes. xMOOCs can be seen as part of MITs continued development

of their Open Courseware initiative offering the opportunity to learners from different parts of the world to access high quality teaching and learning for free. However, the opportunity for branding and marketing for institutions is also recognised and seen to be valuable. However, there are few commercial companies like Coursera and Udacity had set up to help the universities to run xMOOCs at profit. Now the sustainability issues were a key concern of this type of programme. The identification of a sustainable approach for the development of Open Educational Resources(OERs) in institutions has proved intangible. With the backdrop of significant amounts of money invested, a criticism of OERs is that they have not yet affect traditional business models or daily teaching practices at most institutions. The rapid growth of MOOCs has initiated commercial interest from major corporations who want to enter the HE market using a MOOC approach. It has opened up strategic discussions about the disruptive potential of MOOCs in HE and forced established providers to re-visit online learning and open education as strategic choices for the future. In order to raise awareness of MOOCs and their implications for HE, the present study will give comprehensive idea about MOOCs and its implications in HEI.

4.MOOC-STYLE OPEN EDUCATION INITIATIVES TAKEN BY SOME UNIVERSITIES

edX (<https://www.edX.org/>) is a non-profit MOOCs platform founded by Massachusetts Institute of Technology and Harvard University with \$60 million of resources contributed by the two institutions to support this project. Currently, there is a total of eight courses including chemistry, computer science, electronics and public health. By the end of 2013 it is anticipated that there will be about 30 courses in subjects. MITx and Harvardx courses will not be offered for credit at either university but online learners who demonstrate mastery of subjects can pay a modest fee for a certificate of completion. Coursera (<https://www.coursera.org/>) is a profit making company, which started with \$22 million total investment including New Enterprise Associates and Kleiner, Perkins, Caufield & Byers Education. There are four university partners, namely Stanford University, Princeton University and the Universities of Michigan and Pennsylvania. Coursera currently has 197 courses in 18 subjects, including computer science, mathematics, business, humanities, social science, medicine, engineering and education. Some partner universities offer credit for their Coursera classes to those who want to pay a fee to have some extra assignments and work with an instructor and be assessed. UDACITY (<https://www.udacity.com/>) is another profit making company start-up founded by Sebastian Thrun, David Stavens and Mike Sokolsky with \$21.1 million investment including Charles iver Ventures and Andreessen Horowitz. Udacity currently offers 18 online courses in computer science, mathematics, general sciences, programming and entrepreneurship. When students complete a course, they receive a certificate of completion indicating their level of

achievement, signed by the instructors, at no cost. Some universities began offering transfer credit for Udacity students who then take the final examination at a Pearson centre. Udemy (<https://www.udemy.com/>) founded in 2010, with a total \$16 million investment from Insight Venture Partners, Lightbank, MHS Capital, 500 start-ups and other investors provides a learning platform, which allows anyone to teach and participate in online video classes. Udemy currently offers over 5,000 courses, 1,500 of which require payment, with the average price for classes falling between \$20 and \$200. Khan Academy (<https://www.khanacademy.org/>), another well-known free online learning platform, is a not-for-profit educational organization with significant backing from the Bill & Melinda Gates Foundation and Google. The Khan Academy, started by Salman Khan in 2008, offers over 3,600 video lectures in academic subjects with automated exercises and continuous assessment. Whereas edX offer only Harvard and MIT's courses, Coursera focuses on providing a platform that any university can use and Udacity only offers its own curriculum with specialised areas. Other open education initiatives, such as Udemy, Khan Academy have been around for a while and provide opportunities for anyone to learn with experts, peers and others outside traditional universities.

A. Motivations for MOOC providers for implementing green computing:

The scale and open nature of MOOCs provides opportunities for expanding access to HE to all and creates a space for experimentation with online teaching and learning. This exploration of new approaches for HE provision has generated significant interest from governments, institutions and commercial organisations. The current value propositions for institutions to engage with MOOCs are identified as “education access, experimentation and brand extension” [21]. MOOCs can expand access to education, for those who are interested and extend institutions’ reach and reputation internationally. The ‘digital footprint’ of learners using the technology is captured in large data sets that can, potentially, provide useful insights into online teaching and learning with very large numbers of students at low or minimal cost. For example, edX institutions such as MIT and Harvard use MOOCs to understand “how students learn” and “improve innovations in teaching and learning on campus”. The MOOCs is considered as a disruptive innovation that will transform higher education [36]. MOOCs provide a powerful tool to make fundamental changes in the organisation and delivery of HE over the next decade. Those who are politicians, MOOCs help address the problem of HE budget constraints and help to lower the cost of degree courses by enabling inexpensive, low-risk experiments in different forms of HE provision [16]. The commercial organisations see MOOCs as a way to enter the HE market by providing a MOOC platform and developing partnerships with existing institutions and to explore new delivery models in HE. It is less expensive, less power consuming and produces almost no carbon foot print and implementing green computing.

B. Learners attitude towards Green MOOCs :

Learners' motivation to participate in MOOCs is a significant area of interest to many HE stakeholders. There are many factors that influence students' motivation to learn; these include future economic benefit, development of personal and professional identity, challenge and achievement, enjoyment and fun. The question is how green MOOCs learning system motivates the MOOC learner? Surveys conducted by researchers at Duke University show that student motivations can be categorized into four different categories [14]:

- (i) To support Lifetime learning or to understand of the subject matter, with no particular expectations after completion of the course.
- (ii) For doing fun and entertainment.
- (iii) more advantage over traditional education system.
- (iv) To experience or explore online education.

In the pre-course survey in different Higher Education Institutions in US it was found that fun and enjoyment were selected as important reasons for enrolling by a large majority of students (95%) and on the post-course survey, most reported that they have a general interest in the topic (87%). It was found from the same survey that 15% students used the online course to help them decide if they want to take college/university classes and about 10% of students claimed that they could not afford to pursue a formal education. But more research work is to be carried out to understand the learners are really motivated towards MOOCs education system or the traditional educational system which is against green computing.

5. SOME IMPORTANT ISSUES OF MOOCs IN IMPLEMENTING GREEN EDUCATION METHODOLOGY IN HIGHER EDUCATION INSTITUTION

Due to many advantages in MOOCs It has created many criticisms and concern in Educational forum. In this section the authors have investigate the issues relating to sustainability, pedagogy and quality of competition of MOOCs in spreading green education in higher education institution.

5.1 : Sustainability

According to Global Industry Analysts [26], the global e-learning market will reach \$107 billion by 2015. But it is not very clear how the MOOC approach to online higher education institution will generate money. Most MOOC start-ups do not appear to have clear business models and are following the common approach of Silicon Valley start-ups by building fast and worrying about revenue streams later. Some common approaches to generate revenue are considered by Coursera and other start-ups working in partnership with HEI which include fee for certificate for participation of a student of participation in MOOCs. However, it is a significant challenge for partner universities to generate income to make the whole system sustainable. In established business models, universities have control of the customer value proposition in

that they provide any recognition of learning and set tuition fees. For MOOCs, most participating institutions have decided that they will not offer credits as part of traditional awards for these courses. It would be also against the initial ideals of MOOCs if universities started to charge tuition fees for their courses. Therefore, many institutions participating in MOOCs consider the courses they offer to be a branding and marketing activity at present.

A. Quality of green MOOCs education and the Completion rate:

The issue of quality assurance of MOOCs is a big concern for HEIs. In most cases, compared to other online courses, MOOCs lack structure, and rarely include the central role of the instructor or teacher. They are largely self-directed learning, which is a very different experience to formal education. The open nature of MOOCs creates a population that is self selected to be engaged and passionate about this approach to learning. MOOCs demand a certain level of digital literacy from the participants. It has been suggested that one approach could be for them to be evaluated by learners and educators, leading to group tables that rank the courses by the quality of the offering [20]. In this way, it is possible that courses from institutions and individuals that rate poorly will either disappear due to lack of demand or will survive by improving course quality in response to poor ratings. Whether the dropout rates and progression should be a concern for MOOCs is a common debate. Meyer [29] reported that the dropout rates of MOOCs offered by Stanford, MIT and UC Berkley were 80-95%. For example, only 7% of the 50,000 students who took the Coursera-UC Berkeley course in Software Engineering completed. There is a similar reported dropout rate in Coursera's Social Network Analysis class where only 2% of participants earned a basic certificate and 0.17% earned the higher level programming with distinction certificate. If the aim is to give the opportunity of access to free and high-quality courses from elite universities and professors, then high dropout rates may not be a primary concern [25]. But the researchers have already started to do research work for finding out why and at what stage students drop out of courses.

B. Assessment and credit system in MOOCs

Most MOOCs use quizzes as their main instrument of assessment – short multiple choice questions with automated answers for feedback. Some may offer other types of assessment that require open responses. Some MOOCs rely heavily on peer engagement and assessment to support the individual student's learning process. Coursera, for example, includes submission of essay style answers, graded through peer assessment, to balance the scale with the available resource. Measures taken by MOOCs to avoid the issue include Coursera teaming up with Pearson test centres to provide in person examinations. MOOCs often give participants opportunities to earn badges or a certificate of completion. In some cases, they may even be able to gain credits towards a degree qualification. However, it has been observed that most learners using MOOCs are people who

already have a degree. In this case, whether the course carries credit seems less important compared to whether they have evidence through certification that they have participated in a programme of learning and that they can present to an employers as evidence of professional development

6. MOOCs AND OPEN EDUCATION : TO ESTABLISHING GREEN TECHNOLOGY IN HIGHER EDUCATION INSTITUTION

The Online University scenario represents a future of openness in higher education. In this scenario, competition between universities, with increasingly differentiated and innovative use of technologies, creates a wide variety of open education provision. In this model, students undertake largely independent study with free courses, and paid-for external examinations for degrees awarded when they feel ready to take them.

Within the movement towards open education, this new paradigm opens up opportunities for sharing ideas, collaborating between institutions, educators and learners locally and internationally, and for facilitating more meaningful engagement in teaching and learning. A number of related aspects of openness are emerging in different areas, such as those illustrated in Figure 1.

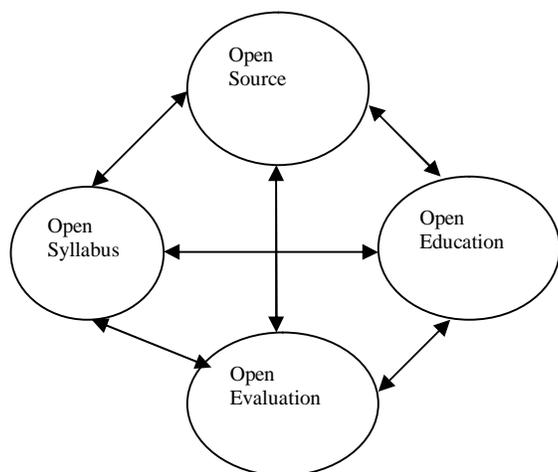


Figure-1 Open learning Process

Open Source: supports a dynamic and interactive open education community by creating and maintaining an engaging, intuitive and stable user interface for educators and learners. Cloud-based provision and the use of open standards makes it easier for different sources and services to exchange information and data. Open education brings new opportunities for innovation in HEI that will not only support institutions to implement the fundamental values of university based education but it will also shift the focus from traditional lecturing to more towards learner centric education in open platform and using paperless virtual higher education centre.

Open Syllabus: learners mix educational resources, activities, and/or packages for different disciplines to meet their needs. This places learners in charge of their own learning and

ensures that they will learn what they need to meet their personal desires and requirements.

Open education: Instructors, subject specialists and/or peers will, through various activities, generate and share new ideas and new understanding during the learning process. This provides learners with opportunities for self-determined, independent and interest-guided learning.

Open Evaluation: In open evaluation system instead of depending on the “monopoly” on formal evaluation of learning results led by accredited education providers now the assessment is carried out by their instructors, others and peers during the learning process via peer to peer or crowd-sourced assessment with “on-demand accreditation” for learners.

All the above methods used in MOOCs are in favor of green computing or green technology. MOOCs are saving paper, carbon footprint, traveling costs, recurring expenses for arranging classes of the teachers. Or in other words we can say that MOOCs will come in a very big way in green computing in HEI to save power, resources, recycling MOOCs material, saving traveling cost and reducing use of unnecessary papers and generating less carbon footprint.

7. CONCLUSION AND FUTURE SCOPE

Green Computing is now a well known concept in Higher Education Institution(HEI). Many renowned Universities across the globe are doing extensive research work to get guidelines for all HEI to introduce green computing as a subject in their Graduation as well as Post graduation studies. Almost all developed countries like US, UK, Australia have already implemented green computing in HEI. The emergence of MOOCs and on-line education could be one good instrument to implement green computing in HEI. There is the potential for green e-learning and open learning to play an important role in ensuring access to education for all at a minimal cost and to save energy and to save environment by producing minimum carbon foot print. In HEI the following are the changes are inevitable: (i) Globalization and the increased momentum for internationalization in higher education, (ii) Worldwide growth and increasing demand for access to higher education, with the projection that there will be 120 million students worldwide by 2020 which means MOOCs will be one alternative to cater these needs, (iii) Changing learner demographics, experience and demands of the dramatically increasing numbers of lifelong adult learners, (iv) Highly increased access to personal technology and social media. The time not very far when MOOCs will be one alternative method for implementing green computing in HEI and giving degrees, diplomas to any learner who may be situated at a very remote place. In future there is a lot of scope for the betterment of MOOCs and to make it more sustainable and financially viable and to open some new horizon in green computation.

REFERENCES

1. Green Computing Endeavor in Higher Educational Institutes – a noble initiative towards Sustainable IT Infrastructure, Shalabh Agarwal, Archana Vimal, Saima Ghosh, Asoke Nath, Journal of Computing(USA), Vol 4, issues 5, May, ISSN- 9617, Page-217-222, 2012
2. “Green Computing - a new Horizon of Energy Efficiency and Electronic waste minimization”: a Global Perspective, Shalabh Agarwal and Asoke Nath : Proceedings of IEEE CSNT-2011 held at SMVDU(Jammu) 03-06 June 2011, Page 688-693(2011).
3. Desktop Virtualization and Green Computing Solutions, Shalabh Agarwal and Asoke Nath, The Second International Conference on "Soft Computing for Problem Solving (SocProS 2012)" published in the proceedings of the conference SocPros 2012 held in December 28 - 30, 2012 and will be published in Conference proceedings in AISC series of Springer.
4. A Study on implementing Green IT in Enterprise 2.0, Shalabh Agarwal, Asoke Nath, International Journal of Advanced Computer Research, Vol-3, No.1, Issue-3(march),pp. 43-49(2013).
5. A Comprehensive study on Cloud Green Computing : To Reduce Carbon Footprints Using Clouds,Chiranjeeb Roy Chowdhury, Arindam Chatterjee, Alap Sardar, Shalabh Agarwal, Asoke Nath, International Journal of Advanced Computer Research, Vol-3, No.1, Issue-3(march),pp. 78-85(2013).
6. Application of Green computing in Framing Energy Efficient Software Engineering, Aritra Mitra, Riya Basu, Avik Guha, Shalabh Agarwal,Asoke Nath, International Journal of Advanced Computer Research, Vol-3, No.1, Issue-3(march),pp. 117-121(2013).
7. Green Software Engineering Process : Moving Towards Sustainable Software Product Design, Shantanu Ray, Nabaraj Sengupta, Koustav Maitra, Kaushik Goswami, Shalabh Agarwal, Asoke Nath, Journal of Global Research in Computer Science(ISSN-2229- 371X), Vol-4, No.1, pp.25-29(2013).
8. Green Computing and Green Technology in e-Learning, Corporate, Business and IT Sectors, Shalabh Agarwal, Shreya Goswami, Asoke Nath, International Journal of Computer Applications(IJCA), Vol 76, No.7, (August), Pp. 35-41(2013).
9. Green Computing and Green Technology based teaching learning and administration in Higher Education Institutions: Shalabh Agarwal, Kaustuvi Basu, Asoke Nath Asoke Nath, Bidhusundar Samanta, International Journal of Advanced Computer Research, Vol-2, Number-3, issue-11, Sept, pp 295-303(2013).
10. “Green Computing - a new Horizon of Energy Efficiency and Electronic waste minimization”: a Global Perspective, Shalabh Agarwal and Asoke Nath : Proceedings of IEEE CSNT-2011 held at SMVDU(Jammu) 03-06 June 2011, Page 688-693.
11. Cloud Computing is an application of Green Computing – a new horizon of Energy Efficiency and its beyond—Shalabh Agarwal, Asoke Nath proceedings of International conference ICCA 2012 held at Pondichery Jan 27-31, 2012.
12. "Thin Clients 2011 - Ecological and economical aspects of virtual desktops", a study conducted by Fraunhofer Institute of Environmental, Safety and Energy Technology UMSICHT
13. Bates, T. (2013) Harvard’s current thinking on MOOCs, <http://tinyurl.com/a2uh86zBBC>, (2012), UK university applications down as fees rise, <http://www.bbc.co.uk/news/education-16787948>
14. Belanger, V., Thornton, J. (2013), Bioelectricity: A Quantitative Approach - Duke University’s First MOOC
15. Bower, J., Christensen, C., (1995). Disruptive technologies: catching the wave. Harvard Business Review, pp.41–53. <https://cbred.uwf.edu/sahls/medicalinformatics/docfiles/DisruptiveTechnologies.pdf>
16. Carey, K., (2013), Obama, Rubio Agree on One Thing: Technology Could Fix the Higher Ed Mess, <http://tinyurl.com/cogw2kh>
17. Casey, J. (2012), Taking Care of Business? The political economy of MOOCs and Open Education, <http://tinyurl.com/ao2agyc>
18. Christensen, C., Johnson, C.,W, Horn, M.,B (2008), Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns, <http://tinyurl.com/apnfhls>
19. Christensen, C., M. (2003). The innovator's solution: creating and sustaining successful growth. Harvard Business Press.
20. Daniel, J. (2012), Making Sense of MOOCs: Musings in a Maze of Myth, Paradox and Possibility, <http://tinyurl.com/ak8qvdv>
21. Educause, (2012), What Campus Leaders Need to Know About MOOCs, <http://tinyurl.com/c7gqj65>
22. Futurelearn (2013), Futurelearn launches, <http://futurelearn.com/feature/futurelearn-launches/>
23. Jarrett, J (2012), What Are 'MOOC's and Why Are Education Leaders Interested in Them?, http://www.huffingtonpost.com/impatient-optimists/what-a-re-moocs-and-why-ar_b_2123399.html
24. JISC, (2013), Open educational resources programme, <http://www.jisc.ac.uk/whatwedo/programmes/elearning/offer.aspx>
25. Gee, S. (2012), MITx - the Fallout Rate, <http://www.i-programmer.info/news/150-training-a-education/4372-mitx-the-fallout-rate.html>
26. Global Industry Analysts, (2010), ELearning: A Global Strategic Business Report , http://www.strategy.com/eLEARNING_Market_Report.asp
27. Larry, C. (2012) MOOCs and Pedagogy: Teacher-Centered, Student-Centered, and Hybrids (Part 1) <http://larrycuban.wordpress.com/2013/02/13/moocs-and-pedagogy-part-2/>
28. Hill, P (2012), Online Educational Delivery Models: A Descriptive View, <http://www.educause.edu/ero/article/online-educationaldelivery-models-descriptive-view>
29. Meyer, R. (2012). What it’s like to teach a MOOC (and what the heck’s a MOOC?), <http://tinyurl.com/cdfvqvq>
30. Soulsby, J., (2013), Adult learning in the UK is in a policy vacuum, <http://www.infonet-ae.eu/en/background-reports/adultlearning-in-the-uk-is-in-a-policy-vacuum-1273>

31. Watters, A. (2012), Top Ed-Tech Trends of 2012: MOOCs, <http://hackededucation.com/2012/12/03/top-ed-tech-trends-of-2012-moocs/>
32. White, D., Warren, N., Faughnan, S., and Manton, M., (2010), Study of UK Online Learning, <http://tinyurl.com/chpx9za>
33. Wiley, D. (2012), The MOOC Misnomer, <http://opencontent.org/blog/archives/2436>.
34. Willetts, D., (2011), Speech to the Universities UK Spring Conference, <http://goo.gl/PdF8y>.
35. Yuan, L., MacNeill S., & Kraan W. (2008), Open Educational Resources – Opportunities and challenges for higher education, http://wiki.cetis.ac.uk/images/0/0b/OER_Briefing_Paper.pdf 1-34.
36. Peters, M., (2008) Paper presented at Economic and Social Research Council (ERSC, UK) Seminar Series on 'Education and the Knowledge Economy', University of Bath. Shirky, C., (2012), Napster, Udacity, and the Academy, <http://www.shirky.com/weblog/2012/11/napster-udacity-and-the-academy/>