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Maurice Dawson
Sharon Burton
Dustin Bessette
Jorja Wright

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Maurice Dawson  
*University of Missouri – St. Louis, USA*

Sharon Burton  
*Grand Canyon University, USA*

Dustin Bessette  
*National Graduate School of Quality Management, USA*

Jorja Wright  
*University of Charleston, USA*

**INTRODUCTION**

The purpose of this chapter is to (1) understand MOOCS, massive online open courses, and differentiate MOOCS from other like learning and training methodologies, (2) comprehend the manner in that MOOCS can be utilized, as well as the (3) lasting impacts of MOOCS on learning whether in academics or the corporate environment. MOOCs are aimed at large scale participation in online education (Bud, Smith, & Reisman, 2015). This chapter will identify for educators, administrators, and practitioners the staggering awareness of the outcomes of this learning modality. MOOCs are continuing to change the way individuals receive education and learn. One idea of MOOCs is that learners may learn through collective education using what is believed to be a form of experimentation wrapped in andragogy, adult learning, andragogy. Education through Knowles’ adult learning, offers the notion of learners gaining knowledge and understanding through (a) self-directedness, (b) need to know, (c) use of experience in learning, (d) readiness to learn, (e) orientation to learning, and (f) internal motivation (Knowles, 1979; Taylor & Kroth, 2009). Another view is that MOOCs could be the answer to the economic concerns faced by institutions of higher learning, the push to increase learner enrollment, and the drive to enhance graduation completion rates (Ng’ambi & Bozalek, 2015). Administrators, educators, and practitioners are faced with the increased popularity of MOOCs. The popularities of MOOCs include the positives as well as the concerns: their impersonal nature, numerous students enrolled into an individual section of a MOOC course, instructors serving as facilitators, as well as there being no instructors assigned to courses. MOOCs, post-date open courseware which was on the increase in 1990s and the sharing of courseware online. Specifically, open courseware stems from face-to-face instructions wherein instructors share aspects of their courses on the Internet which may be reading lists, assignments, recorded videos, audio lectures, or syllabi. One of the understood top aspects regarding MOOCs is that these courses fulfill knowledge gaps for learners. MOOCs propose for the learners the alternative of completing quality courses without a financial obligation. Some MOOCs

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courses, like Cousera, offer certificates. With this said MOOCS offer inexpensive avenues to add certificates to learners’ resumes and therefore ways to drive personal accomplishments. MOOCs have maintained a large following of users. They draw attention and remain the element learners need to study and become educated outside of the traditional classroom.

This chapter will delve into key significant areas. First, the researchers will gain understanding regarding the development of a method in which Open Source Software (OSS), open source technologies, and open access literature can be incorporated to strengthen the MOOC environment. Second, readers will garner comprehension of how to strengthen the MOOC environment and therefore increase retention in addition to increasing enrollment in higher education. Third, the lasting impacts of MOOCs will be described, mainly as the impacts relate to STEM, Science, Technology, Engineering, and Mathematics and how such programs are entering the online space. Through this chapter, educators and administrators will grasp an increased interpretation of the technologies that have influenced learning and development. Administrators and Practitioners will learn meaningful solutions about open technology solutions so that as-is and to-be MOOCs can be improved with minimal cost. Further readers, researchers, administrators, and practitioners will learn how to infuse MOOCs learning and training initiatives to ensure best outcomes in the academic and e business world.

BACKGROUND

MOOCs is another form of distance education and learning community; the term originated in 2008 by David Cornier and senior research fellow Bryan Alexander (Martin, 2010). At that time, MOOCs described a course entitled Connectivism and Connective Knowledge (Pence, 2012). According to Caulfield, Collier, and Halawa (2013), MOOCs stem from the category of online connected learning communities. MOOCs are representative of Siemens’ and Downes’ connectivist learning theory, which provides that learning occur through connections within networks (Pence, 2012). The model uses a network with nodes and associations to explain learning (Siemens, 2013). The name MOOC was derived because (a.) MOOCs are collaborative with the appearance of experimentation, (b.) the courses move along numerous paths, and (c.) MOOCs necessitate participation in “Massively Multiplayer Online Game (MMOG)” (Pence, 2012, p. 27).

MOOCs, a recent innovation in the distance education field, were labeled as disruptive innovation (Christensen, 1997). According to Flynn (2013), MOOCs describe the varied kinds of changes in an evolving business education environment. The concept bracing MOOCs began in the 1960s; however, this approach to distance education re-ignites because of the digital education age (Flynn, 2013). As posited by Ta’eed (2012), Khan Academy was the first to house the free lectures. The Bill Gates Foundation and Google supported Khan Academy, a non-profit, with substantial backing in 2006. Today Khan Academy has over 3000 short video lectures, which were stated to have over 160 million hits (Severns, 2014; Ta’eed, 2012).

Understanding MOOCs and their relevance is important as MOOCs meaningfully progressed online distance education in past years (Rodriguez, 2012). Standing as an online distance educational model, MOOCs, are supported by colleges and universities; therefore, the need exist for faculty to understand and augment their knowledge regarding MOOCs’ past, current and future trends. MOOCS have several prescribed frameworks: cognitive-behaviorist, connectivist social and constructivist (Rodriguez, 2012), connectivism (Pence, 2012), constructivist, connectivist experiential, and social structure, (Koutropoulos et al., 2012). The postulations of these researchers are that MOOCs were formed by technologies
and reside beneath the online distance education environment.

**FACULTY DEVELOPMENT IN MOOCs**

Through the lens of MOOCs, readers, practitioners, and academician can postulate the reasons MOOCs emerged on the distance education platform. As educators continue to concentration on the online distance education environment, comprehending MOOCs is yet another lane in learning for meditation and conjecture. Faculty development with MOOCs has the potential to facilitate networking and permit instructors to converse and discuss concepts and experiences. Professors interested in MOOCs can add value to their repertoire of knowledge by engaging in MOOC mentoring, coaching, and job shadowing programs. Mentorships are associations encompassing a seasoned faculty member who guides faculty with minimal experience or faculty with no experience (Tareef, 2013). Coaching, as given by Rahim and Burrell (2013), is “having an ability to help an employee who has raw talent develop into a star performer”. Job shadowing involves investigating the actions of a professional systematically, and then including the desired actions into one’s work procedures (Leonard, Barton, & Barton, 2013).

Professional development within institutions of higher education remains a significant variable driving excellence of education learners’ academic experiences (Marshall, 2012; Mosley, 2007). Every institution of higher education should establish if, how, and when MOOCs will hold an academic space in their educational lineup. Faculty should comprehend the evolution of MOOCs into and around their institutions. According to Demirci (2014), the syllabus of MOOCs is very similar to other syllabus. Further learning activities are developed to accommodate large audiences. The lessons and activities can be organized as asynchronous and with flexibility (Demirci, 2014). Faculty should look to faculty development programs, mentorships, and coaching to gain additional information regarding MOOCs and their impact.

**HOW ARE MOOCS BEING SUPPORTED**

Elite institutions of higher education are supporting MOOCs. According to Thrift (2013), an obsession exists with MOOCs because (a) institutions of higher learning are enticed by the promise of profit in educational environments, (b) middle-class aggravation over tuition costs is fueled, (c) economic downturn is propelling countries to seek better priced education that is valued, and (d) MOOCs seem to provide a more efficient mode of education. Pence (2012), provided, the thought remains that partaking in MOOCs may gather meaningful stature. Another advantage of MOOCs provided by Pence (2012) is that MOOCs can produce analytics about education. Analytics can support a drive for operational sustainability. Data regarding MOOCs is found primarily through blog posts (Yong, 2014).

**OFFERING MOOCS**

Led by Sebastian Thrun, in 2011 Stanford University offered a MOOC. Thrun’s postulation was that eventually participants would graduate with degrees with MOOCs on the transcripts (Krause, 2014). Stanford’s MOOC enrollment was over “160,000 students from 190 different countries” (Flynn, 2013, p. 152). According to Krause (2014), 28,000 completed the courses. The MOOC project expanded. Thrun left Stanford to start Udacity, a for-profit company (Flynn, 2013, Krause, 2014). The goal was to make education a democracy by providing it to learners at no cost (Flynn, 2013). Udacity offers STEM courses, Science, Technology, Engineering, and Math.
Motivated by Thrun, Andrew Ng, and Daphne Koller, two other Stanford faculty members co-founded Coursera, a for-profit company (Krause, 2014). Coursera functioned akin to an educational cooperative between Stanford University, University of Pennsylvania, University of Michigan, and Princeton University (Flynn, 2013). According to Krasue, Coursera and Stanford, now partners with “33 high caliber universities” (Decker, 2014, p. 7). Coursera courses start frequently and are available in a wide range of topics.

Articulated by Flynn, (2013), $30 million each in institutional backing, funding of grants, and resources was donated by MIT and Harvard to launch edX, a MOOC. This not-for-profit initiative started with 32 charter members (PR, N, 2014). Harvard is the oldest institution of higher learning in the United States, established in 1636. Harvard’s support of MOOCs is significant. Kolowich (2013a), states that Harvard is very careful with its MOOCs partnerships. Since its beginning, edX has continuously progressed and offers courses on an array of subjects. MIT offers MOOC curricula (Kolowich (2013b).

Initially opposed to MOOCs, universities like Duke University decided against the MOOCs revolution. Disclosed by Kolowich (2013c), the faculty voted the measure down after Duke’s provost, Peter Lange, signed a contract with 2U, a MOOCs group. The Chronicles of Higher Education article provided that the faculty’s vote superseded the contract signed by Lange. Now Duke is a part of the MOOCs revolution and advertises MOOCs on its online website. Another institution that initially rejected MOOCs was Amherst College, a liberal arts institution. April 2013, Amherst College’s faculty rejected Harvard’s edX invitation to become a part of the elite association of higher education institutions providing MOOCs (Kolowich, 2013a). During this time, the academe world had mixed views about the MOOCs form of distance education. Today, when viewing Amherst’s web site, MOOCs are now advertised.

MOOCs CRITIQUED

Many elite colleges and universities have supported MOOCs. Some people see MOOCs as innovative and the future of education. Other people understand MOOCs to be all that is wrong with education. What is known is that MOOCs are receiving critiques. According to Rees (2014), MOOCs are akin to students going to the library to check out educational materials and then reading and studying the materials. Some believe that MOOCs will destroy today’s understanding of higher education (Fox, 2013). Others document that the course completion rate for MOOCs is too low (Guzdial, 2013). Questions are surfacing as to whether MOOCs will devalue instructors in the realm of education. The concern of sustaining revenue and not offering too many MOOCs is just another concern. What is understood about MOOCs is that they are perceived as a business model like other educational delivery models.

The MOOCs model was founded on the idea that institutions of higher of learning are the developing segments in line for the high-capacity, low-perimeter data and information-technology treatment after cost review, sales, and the media, as given by Thrift (2013). MOOCs are accessible and accommodate large numbers of learners. MOOCs support lifelong learning. In essence, MOOCs characterizes emerging technology whose educational impact has yet to be fully understood. As shown through Amherst’s and Duke’s later embracing of MOOCs, this form of online distance education will continue to undertake in the practices of higher education.

MOOCs IMPLEMENTATION AND CHANGE

The MOOCs phenomenon has driven an ever-increasing conversation regarding online courses whether in higher education, or business. These developments must be explored from an institutional policy standpoint, focusing on an examina-
tion of the different approaches to MOOCs and e-learning. MOOCS implementation represents change. This change points to (1) curriculum and course design and redesign, (2) a sound e-learning policy as a medium for curriculum development; (3) an emphasis on technology usage; (4) specific policies around licensing; (5) how MOOCs support student advancement; and (6) overall educational enhancement that drives student success.

The change to incorporate MOOCs requires a paradigm shift, a new approach to thinking about online educational processes and technologies. In order for MOOCs to be administered successfully, a top down approach is needed (Burton, 2016). Because people in like organizations will exhibit like behaviors, there must be a change leader to drive communication up and down the communication chain. This leader has to know the key organizational factors: understanding the vision of the implementation, ensuring accountability of key roles for the MOOCs implementation, ensuring the appropriate stakeholders’ involvement, determining what skills need to be developed (e.g., developer, staff, students, employees, etc.), ensuring the appropriate metrics, policies and actions, as well as determining how to reinforce behaviors. Initiating the change will require an understanding of the MOOCs implementation range and scope of the project. All leaders and project participants must understand all difficulties and intricacies involved with MOOCs development, and implementations. Timeframe be known for the development and implementation. Most of all, to make the implementation work, all involved must buy-in to the idea.

MOOCs are a disruptive form of education. However; due technology driving learning to the anytime and anyplace environment, the conversation about MOOCs has change. The new conversation need to be about how this form of education will progress leaning institutions and organization toward business process improvement. MOOCs can be implemented as change to support the learning institutions and organizations broader strategic objectives.

OPEN ACCESS LITERATURE

Open access is digital, online, free of charge for everyone with an internet connection, free of most copyright and licensing restrictions (Suber, 2004). Technology has opened many doors and opportunities for the current needs for many academicians, researchers, and practitioners based on the need to have open access availability for literature. The possibility of restricting literature in the future will come at a cost that will be indefinitely become a nuisance for businesses and schools to utilize. MOOC programs of today already are facing the possibility of creating online learning environments that only enhance and filtrate open access literature and learning. Open access has even made it possible for a vast majority of scholars to share theories, research and information such that it can be primarily used in an online database of journals for future reference and research.

Proponents of open access publishing sometimes argue their case on the fairness of providing everyone with access to scholarly material, and by so doing, creating a scientific/academic level-playing field (Nicolas, Huntington, & Jamali, 2007). Open access publishing has become a well known publishing and research style that many scholars, faculty, and practitioners are beginning to position themselves around based on the possibility of other scholars referencing and citing their research and work. This is the ultimate goal of open access literature. With better availability and access to vital research, data can be disseminated to more outside sources to create a better understanding of global research. Therefore, the literature of today needs to be adaptable and accessible for communities and scholars of tomorrow. Creating a validation for open access literature is a primary need for many societies to have based on the utilization of tools in the virtual and traditional classrooms. The tools and styles used are practices of students in virtual learning environments (Bessette & Burton, 2013). The learning environments of the MOOCs are ideally using and utilizing online open access literature and references such that it is readily
available to more people today than ever before. Libraries with traditional literature are becoming outdated as technology for academic advancement is taking place.

The age of the electronic journal has also brought another problem to the library (Chang, 2006). Traditional libraries of today are being more advanced to replace the current physical copy of journals and textbooks and utilizing technology to the max. This adaptation is creating a faster advancement and movement for the retrieval process of literature. More scholars, students, researchers, and practitioners are requiring access 24/7. The increase of the electronic journal and the open access journal are beginning to develop a keen sense of adaption for research to be published and researched at any time in any place. The need for high speed internet access has also become part of the availability and usefulness for online open access literature.

Scholars, faculty, researchers, and practitioners need to coordinate and publish exclusively in all types of scholarly journals. These journals also need to be read and referenced accordingly in order to successfully develop keen communication between scholars of different disciplines. Without scholastic publishing and referencing of open access work, scholarly research will be under-utilized and problems will persist. Costs of subscriptions for scholastic journals will increase, creating a crisis that is also known as serials crisis. To prevent the “Serials Crisis” situation from becoming worse, research organizations and libraries are starting to support open access publishing (Chang, 2006). Every academic discipline needs to currently outweigh the cost for using and utilizing open access literature based that all research needs to have an open accessible and ideal use based on the needs of scholars for the future.

The utilization of MOOCS into the open access literature will deviate cognitive learning and skill development for students. It is then possible to assume that students will accelerate their learning capabilities to such a level that is currently unmeasured. The need for the open accessibility and developmental change is in the hands of academicians today. MOOC classes will invite, 

![Figure 1. Screenshot of Directory of Open Access Journals](image-url)
Massive Open Online Courses

enhance, and protect the vital means of academic learning through learning techniques as part of program changes and alterations. Open access literature is needed for MOOC system improvements as well as academic and career changes nationwide. In the figure below is a screenshot of the Directory of Open Access Journals (DOAJ) which is one of the most popular sites for open access refereed works.

<table>
<thead>
<tr>
<th>Linux Distributions</th>
<th>Description and Potential Use</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ubuntu</td>
<td>One of the most popular Linux OS developed to be a complete OS that can be an easily replacement for other comparable OSs.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>Edubuntu</td>
<td>OS targeted for grades k-12. Contained in OS are tons of software applications that is useful to those who are education majors.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>Damn Small Linux</td>
<td>This OS is designed to as a small OS to be utilized on older hardware. This OS is great for institutions that have old computers and want to revitalize them for use. OS is also great for VMs as DSL requires a low amount of memory.</td>
<td>Knoppix-based</td>
</tr>
<tr>
<td>BackTrack</td>
<td>OS based on Ubuntu for digital forensics and penetration testing. Great tool for students majoring in technology fields. As cyber security is becoming a hot topic around the world this tool provides students the ability to learn from over thirty software applications that aid in penetration testing and more.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>Fedora</td>
<td>This OS is supported by the Fedora Project and sponsored by Red Hat. This OS provides a great resource for learning Red Hat Enterprise Language (RHEL). As there are thousands of jobs requiring expertise specifically with Red Hat this OS is a great tool to prepare students for employment in IT. Fedora has over six Fedora Spins such as Design-suite, Scientific-KDE, Robotics, Electronic-lab, Games, and more.</td>
<td>RPM-based</td>
</tr>
<tr>
<td>Kali</td>
<td>An advanced forensics and penetration testing distribution that is the successor of BackTrack.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>Elementary</td>
<td>OS is based on Ubuntu and showcases the Pantheon desktop. This OS is focused on usability, and design aesthetics. The desktop environment has been compared to Mac OS. This desktop origins from being an Ubuntu desktop theme.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>CentOS</td>
<td>This OS derived entirely from RHEL. The source code is developed from Red Hat which allows a student to learn RHEL with a small number of differences. CentOS can be used for teaching IT students on how to setup, administer, and secure a server.</td>
<td>RPM-based</td>
</tr>
<tr>
<td>Ubuntu Studio</td>
<td>This OS is derived from Ubuntu. This OS is developed specifically for multimedia production such as audio, video, and graphics. Departments for multimedia could use this OS for multimedia instruction and the development of projects. As many of the tools for multimedia production are expensive this alleviates large license costs for institutions.</td>
<td>Debian-based</td>
</tr>
<tr>
<td>Lubuntu</td>
<td>OS is based on Ubuntu and uses the LXDE desktop environment. It replaces Ubuntu's Unity shell and GNOME desktop.</td>
<td>Debian-based</td>
</tr>
</tbody>
</table>

STEM NEEDS FOR MOOCS

As STEM is continues to play a critical role in America, Linux could provide the ability an affordable large scale deployment. Even more important is the environment where individuals can practice skillsets and techniques learned from the classroom. Thus, Linux provides the ability for students to perform low level code analysis. In developing the class environments with cost in consideration Linux allows for this to be done with removing costly barriers with the exception of hardware. The barriers are proprietary software licenses, and software that operates on a particular
hardware configuration. The associated software licensing allows for applications to be used freely in MOOCs for enhancing the overall experience.

The addition of Virtual Machines (VM) in MOOCs enhance the overall courseroom experience. VMs can be loaded to the MOOC site which mimic the instructor’s teaching environment for a particular course [See Figure 2]. The course tools such as programming environments, networking tools, offensive security applications, and more can already included in the VM. Additionally, this environment can be exported to an ISO image file so that as this file format will work with multiple hypervisors.

SOFTWARE LICENSING

When considering software licensing it is essential to understand the license agreements for the applications that are used within the MOOC (Dawson, Leonard, & Rahim, 2015). This will allow for the use or redistribution of software. The use of OSS can greatly enhance the STEM environment (Dawson, Al Saeed, Wright, & Onyegbula, 2014).

GNU GPL v3

After a review of the terms and conditions provided by this license it appears to be more comprehensive in its requirements for use of the licensed software. It contains several more terms and appears to contain many more prohibitions that the previous version of the license terms contained. It contains the requirement to include appropriate notices for distribution of the code. It also contains specific prohibitions regarding restriction on the subsequent use of the code, including modified versions, by downstream users (Kumar, 2006).

GNU GPL v2

After review of the terms and conditions of this license, this version’s license does not appear to have as many requirements and certainly is not as long as the newest version of this software’s license appears to be. While considerably shorter than the subsequent version’s license, this license does still maintain and include the requirement that appropriate notices accompany the distribution of the code (Kumar, 2006).
LGPLv3

After review of the terms and conditions of this license, this version’s license does not appear to have as many requirements as either of the licenses under the GNU GPLv3 or v2, but it does maintain several requirements for compliance. Of note, is this license includes an exception to the GNU GPL license, namely that the work produced under this license may be reproduced without compliance with Section 3 of the GNU GPL, which relates to Protecting Users’ Legal Rights from Anti-Circumvention Law.

LGPL v2

After review of the terms and conditions of this license, this version’s license appears to somewhat longer than the terms and conditions of the subsequent version’s license, but it appears to be closer to the GNU GPLv2’s license terms than the LGPLv3’s terms and conditions, and noticeably does not include the exception to the GNU GPL license as is contained in the subsequent version of this license.

LLGPL

After review of the Lisp Lesser General Public License (LLGPL), this version’s license is like the LGPL but with a prequel. This prequel defines the effect in terms more typically used in Lisp programs. This license is grounded in the C programming language as the license specifically calls out functions not present in other languages that are not traditionally compiled (Greenbaum, 2013).

Apache 2.0

The previous Apache licenses were based on the GPL v2 however the Apache License v2 permits code that is covers to be subsumed into closed source projects (Rosen, 2015). It also explicitly grants patent right where necessary to modify, operate, and distribute the software.

MIT License

The MT license provides permission, free of charge, to any individual obtain a copy of the software and associated documentation. Additionally, it (Rosen, 2015). Also provided without limitation is the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the software (Rosen, 2015).

Creative Commons

After review of the terms and conditions of this license, it appears that this license is very similar to that of Modified BSD. It is interesting of note that the license begins by indicating that the company is not a law firm. Additionally, this license appears to include a waiver of copyrights and related rights, and a fall-back in the event that the waiver is invalidated, which appears to be based upon the purpose of promoting the overall ideal of free culture. In addition this license includes a limitation to make sure that neither patent or trademark rights are being waived by this license.

Artistic License 2.0

After review of the terms and conditions of this license, this license appears to be very similar to that at issue in the Jacobsen case discussed above. Moreover, it appears that this license makes clear that the copyright holder intends to retain some creative control over the copyrighted work overall, while still trying to ensure that the copyrighted material remains as open and available to others as possible under the circumstances.

Modified BSD

After review of the terms and conditions of this license, these terms and conditions appear to be the shortest list of terms and conditions of all of
the licenses reviewed in this paper. Additionally this license appears to allow reproduction and modification of the copyrighted material provided certain conditions are met, which if subject to legal challenge, a court might construe as being subject to only protection as a contract, at best, and a bare license at worst. Moreover, based upon the legal authorities cited in this paper, it may be unclear whether this license may provide sufficient copyright protection.

**Clear BSD License**

After review of the terms and conditions of this license, this license appears to be very similar to the Modified BSD License, in that it is very short, and appears to allow reproduction only if certain conditions are met. This license does make clear that no patent rights are granted by this license.

**VIRTUAL WORLDS**

Virtual worlds can provide a platform to teach the labs in an environment that is dynamic and takes advantage of ubiquitous learning (Davis, Dawson, & Omar, 2016; Dawson & Al Saeed, 2012). Access to a MOOC could occur in a manner that a student performs an engineering lab design in the virtual world environment. This would allow the individuals to have a low fidelity lab in which the activities provided in the MOOC can be done in an environment that allows for synchronous or asynchronous participation. The MOOC environment could be enhanced with the use of virtual environments with the use of virtual laboratories, virtual museums, augmented reality, collaborative e-learning, Neto, de Souza, & Gomes, 2016).

**CONCLUSION**

Despite the fact that many innovations in the field of educational technology have existed throughout the decades, undoubtedly the most conspicuous public conversations in mainstream media are pointed to the phenomenon, massive open online courses (MOOCs). Pappano (2012), in her New York Times November 2012 article branded the year 2012 as the “Year of the MOOCs”. This labeling help to propel MOOCs into being a significant educational technological catchphrase.
Conceptually, MOOCs appeared to be the utmost in learning in the online space; however, glitches appeared. These glitches include but are not limited to underwhelming involvement, lower than expected completion rates, and imbalanced content significance according to Marrapodi, Shimkus, and Onisk (2016). Notwithstanding the rising accessibility, attraction, and probability of MOOCs, their economic justification and their academic value required more exploration, and particularly the technological aspects.

FUTURE RESEARCH DIRECTIONS

More research is needed regarding MOOCs and quality of development, MOOCS and STEM needs, as software licensing. The data shows that the instructional quality of MOOCs varies. With this said instructional principals must be revisited to determine a best practice. Data needs to define the top principles of learning for MOOCS, and the specific types of learning environments. Some data exist about MOOCs in STEM education; however, more is needed. A key point of focus will be having the appropriate mix of academic information to learning exercises (e.g., videos, assignments, and activities). The key point is to make learning stick. Finally, when determining the type of MOOC course to develop, the development team must have a better understanding of the type of licenses required for MOOCs. It is important to know that key obstacle in terms of licenses are proprietary software licenses, as well as software that operates on a distinct hardware configuration. The associated software licensing permits the applications to be used freely in MOOCs for enhancing the overall experience.

MOOCS encompass a host of different types of courses. These types of courses allow for global delivery. Delivery approached will continue to vary; however, will need to be studied and concentrated as to the needs of different student populations. Technology is important; thus, due to ubiquitous technological advancement, software licensing will have to be consistently reviewed. MOOCs can prove useful as a new phenomenon of course delivery for students, faculty, and administrators to use. To effectively do this one must maximize the technical use OSS, open source technologies, and open access literature while minimizing the overall associated license costs. The use of virtual words with MOOCs would provide students an environment that allows student to be fully immersed in required technology labs (Calongne, 2008).

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**KEY TERMS AND DEFINITIONS**

**GNU Public License:** A widely used free software license that is managed under the GNU Not Linux Project (Stallman, 1991).

**Linux:** An open source version of the UNIX OS (Perens, 1999).

**MOOC:** An online course with the option of free and open registration, publicly shared curriculum, and open ended outcomes (McAuley, Stewart, Siemens, & Cormier, 2010).

**Open Source Software:** Software that allows the original source code to be freely available which may be freely redistributed or modified (Perens, 1999).

**Software License:** Legal instrument for governing the use or redistribution of software (Dawson, Leonard, & Rahim, 2015).