

# Analysis of Criteria for and Benefits of Massive Open Online Courses (MOOCs)

## A Review Paper

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**Abstract** — The authors' institutions are Partners in the MECA (Micro Electronics Cloud Alliance) Erasmus+ Project, where open educational resources and learning materials were developed and a Europe-wide cloud platform was built to support the education in the field of microelectronics. Pilot tests regarding their application for self-study via remote access were carried out and the feedback of the participating students was evaluated. The positive result of the pilot tests encourages us to consider offering some of our courses for inclusion into the catalogues of the world's leading Massive Open Online Course (MOOC) providers. This may help to disseminate the information about our courses and attract more students to take the courses on-line. On the other hand, in addition to the benefits, we must weigh the efforts and further developments needed to meet the MOOC criteria. In order to make the right decision, the most successful MOOC providers were mapped and their strategies have been analyzed. In the present paper the conclusions are summarized.

**Keywords**—Open Educational Resources (OER), Massive Open Online Course (MOOC), microelectronics, education.

### I. INTRODUCTION

A Massive Open Online Course (MOOC) is an online course aimed at unlimited participation and open access via the web [1]. In addition to traditional course materials such as video lectures, readings, and problem sets, special feature of MOOCs is that provide interactive user forums to support community interactions among the learners, teaching assistants, and professors (i.e. the course authors).

Early MOOCs often emphasized open-access features, such as open licensing of content, structure and learning goals, to promote the reuse and remixing of resources. Later MOOCs use closed licenses for their course materials while maintaining free access for learners [2].

Although this definition and short characterization of MOOC seem to be very simple and clear, as the poster of Mathieu Plourde in Figure 1 [3] aptly shows, every letter of MOOC is negotiable, so the meaning of the words "massive open online course" should be explored.

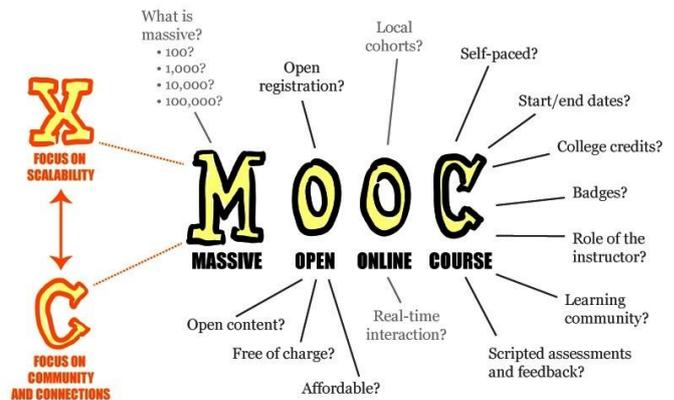


Fig. 1. "MOOC, every letter is negotiable" MOOC poster April 4, 2013 by Mathieu Plourde licensed CC-BY on Flickr.

### II. MAIN TYPES OF MOOCs

The first MOOCs emerged from the open educational resources (OER) movement, the term was introduced in 2008 [4]. From that time, many faculty members of high-rank universities designed and developed the content of thousands of MOOCs, which were delivered online through their own learning platforms. These MOOC courses make it possible for the universities to extend their high-quality education to more people from all over the world, which is in line with the objectives of our MECA Erasmus+ project and with the mission of the participating universities.

As MOOCs have evolved, some advanced learning platforms have become more popular and their use has made the course provision easier for the universities and other course authors. The missions and the characteristics of the most popular platforms are described in the next chapter.

Many MOOCs use video lectures, employing the old form of teaching (lecturing) using a new technology (video). In contrast, according to many opinions, MOOC courses should be designed to be challenges and the amount of data generated from the assessments should be evaluated massively using machine grading behind the scenes. Thus MOOC would be evidence-based, data-driven educational methodology [5].

Because of massive enrolments, MOOCs require instructional design that facilitates large-scale feedback and interaction. The two basic approaches are:

- Peer-review and group collaboration.
- Automated feedback through objective, online assessments, e.g. quizzes and exams. Machine grading of written assignments has also become an option.

According to these approaches two distinct types have appeared: those that emphasize the connectivist philosophy, and those that resemble more traditional courses. To distinguish the two, the terms "cMOOC" and "xMOOC" were proposed [4]. This marks a key distinction between cMOOCs where the 'C' stands for 'connectivist', and xMOOCs where the x stands for extended (as for example in edX) and represents that the MOOC is designed to be in addition to something else (university courses for example). The significant differences are summarized in Table 1 [6].

TABLE I. TABULATION OF THE SIGNIFICANT DIFFERENCES BETWEEN XMOOC AND CMOOC.

xMOOCs		cMOOCs
Scalability of provision	<b>Massive</b>	Community and connections
Open access - Restricted license	<b>Open</b>	Open access & licence
Individual learning in single platform	<b>Online</b>	Networked learning across multiple platforms and services
Acquire a curriculum of knowledge & skills	<b>Course</b>	Develop shared practices, knowledge and understanding

Assessment can be the most difficult activity to conduct online. Assignments usually include multiple choice quizzes and exams as well as essays and projects. In learners' opinions multiple choice tests are rather stressful and peer graded essays sometimes are painful.

Peer review is often based upon sample answers or rubrics, which guide the grader on how many points to award different answers. These rubrics cannot be as complex for peer grading as for teaching assistants. Learners are expected to learn via grading others and become more engaged with the course.

Assigning mentors to students is a successful interaction-enhancing technique. Techniques for maintaining connection with students include adding audio comments on assignments instead of writing them, participating with students in the discussion forums, asking brief questions in the middle of the lecture, and sending congratulatory emails on prior accomplishments to students who are slightly behind [7].

### III. MISSIONS OF THE MOST POPULAR MOOC PROVIDERS

Regarding the history of the MOOCs, according to *The New York Times*, 2012 was "the year of the MOOC" as several well-financed providers, associated with top universities, emerged, including Coursera, Udacity, and edX [8]. These years many universities scrambled to join in the "next big thing", and most of the online education services did the same. Dozens of universities in Canada, Mexico, Europe and Asia have announced partnerships with the large American MOOC providers [9].

The industry has an unusual structure, consisting of linked groups including MOOC providers, the larger non-profit sector, universities, related companies and venture capitalists. *The Chronicle of Higher Education* lists the major providers as the non-profits Khan Academy and edX, and the for-profits Udacity and Coursera [10]. The larger non-profit organizations include the Bill & Melinda Gates Foundation, the MacArthur Foundation, the National Science Foundation, and the American Council on Education. University pioneers include Stanford, Harvard, MIT, the University of Pennsylvania, Caltech, the University of Texas at Austin, Berkeley, and San Jose State University. Related companies investing in MOOCs include Google and educational publisher Pearson PLC. Venture capitalists include Kleiner Perkins Caufield & Byers, New Enterprise Associates and Andreessen Horowitz [10].

In the followings the missions and characteristics of the largest and most interesting MOOC providers are described, according to their websites.

#### A. COURSERA – [www.coursera.org](http://www.coursera.org)

Coursera provides universal access to the world's best education, partnering with top universities and organizations to offer courses online.

Coursera was founded in 2012 by two Stanford Computer Science Professors: Daphne Koller and Andrew Ng. They put their courses online for anyone to take; and taught more learners in a few months than they could have in an entire lifetime in the classroom. Since then, Coursera has built a platform having 160 partners across 29 countries and offers 2667 courses.

Every course on Coursera is taught by top instructors from the world's best universities and educational institutions. Courses include recorded video lectures, auto-graded and peer-reviewed assignments, and community discussion forums. The main characteristics are:

- Online and open to everyone
- Learn a new skill in 4-6 weeks
- Priced at about \$29-\$99
- Earn a Course Certificate

Real career transformation sometimes requires a university-recognized degree. Coursera has worked with its university partners to offer flexible, affordable online degree programs in business, computer science, and data science.

- Earn an accredited master's degree
- Earn a Specialization Certificate

B.  – [www.edx.org](http://www.edx.org)

Founded by Harvard University and MIT in 2012, edX is an online learning destination and MOOC provider, offering high-quality courses from the world's best universities and institutions to learners everywhere. With more than 130 global partners, edX is proud to count the world's leading universities, nonprofits, and institutions as members. edX university members top the QS World University Rankings® with the founders receiving the top honors, and edX partner institutions ranking highly on the full list.



edX is a global learning community, their students come from every country in the world. Whether they are interested in computer science, languages, engineering, psychology, writing, electronics, biology, or marketing, edX has the course for them.

edX's mission includes:

- Increase access to high-quality education for everyone, everywhere
- Enhance teaching and learning on campus and online
- Advance teaching and learning through research

The main differences in edX's activity are that

- edX is the only leading MOOC provider that is both nonprofit and open source.
- edX established Open edX, the open-source platform that powers edX courses and is freely available. With Open edX educators and technologists can build learning tools and contribute new features to the platform, creating innovative solutions to benefit students everywhere.

C.  UDACITY – [www.udacity.com/us](http://www.udacity.com/us)

Udacity's mission is to democratize education through the offering of world-class higher education opportunities that are accessible, flexible, and economical. Virtually anyone on the planet with an internet connection and a commitment to self-empowerment through learning can go to Udacity, master a suite of job-ready skills, and pursue rewarding employment.

Udacity students are a community of global learners united in a shared goal of uplift and transformation. Udacity's mantra is Students First, which means to provide the highest quality learning to as many students as could be reached. Udacity is where lifelong learners come to learn the skills they need, to land the jobs they want, to build the lives they deserve:

- Learn from industry experts and leading academics in an immersive online classroom environment.
- Immersive Curriculum with hands-on learning, interactive content, measurable progress.
- Experienced mentors, expert reviewers, engaged and dynamic student community.
- Industry-designed projects, actionable feedback, portfolio-ready results.
- Resume reviews, interview prep, and expert career guidance.

D.  – [www.p2pu.org](http://www.p2pu.org)

P2PU (Peer to Peer University) is a grassroots network of individuals who seek to create an equitable, empowering, and liberating alternative to mainstream higher education. The most important sentences of P2PU's mission are cited below from their website:

“We work towards our vision by creating and sustaining learning communities in public spaces around the world. As librarians and community organizers, we bring neighborhoods together to learn with one another. As educators, we train facilitators to organize their own networks and we develop/curate open educational resources. As developers and designers, we build open source software tools that support flourishing learning communities. And as learners, we work together to improve upon and disseminate methods and practices for peer learning to flourish.

In 2014, P2PU made a strategic decision to stop working exclusively online and partnered with Chicago Public Library to run in-person study groups for library patrons who wanted to learn together. This project became known as learning circles, which dramatically increased completion rates and reached new audiences who were new to both online learning and postsecondary education. Learning circles also formed strong social bonds for citizens from diverse backgrounds who shared common goals, and helped to highlight the library as a hub for community learning experiences

P2PU is driven by three core values:

- Peer learning – Underlying our work is the conviction that learning is a social activity. We believe that every person develops expertise through their own life experiences that people learn when they share and connect with others, and that feedback is necessary in order to improve.
- P2PU is a community-centered project, which is reflected across our organization from learning circles to our governance model.
- Equity in learning is only possible when we recognize education as a social good rather than a commodity. Creating space for access is not enough. Access does not equal equity, and we must actively design for inclusion and accessibility at every step along the way.

We strive to model our educational values in our organizational structure; as such, we set goals and make decisions collectively as a community. We invite you to join our [virtual community](#) and view our governance guidelines, annual goals, and policies on [Github](#). Moreover, if you want to use a course that is not listed on the P2PU courses page that is fine too! You can use any course from around the web so long as it is free for learners. Once you find a course you like, you can add that to our course page.”

E.  Udemy – [www.udemy.com](http://www.udemy.com)

The mission of Udemy is to improve lives through learning. They invite millions of students and instructors to join in the world's largest online learning and teaching marketplace, where students are mastering new skills and enriching their

lives by learning from an extensive library of over 80,000 courses taught by expert instructors.

Udemy has two branches:

**1. Udemy for Business:** the destination for workplace learning. Students can learn and improve skills across business, tech, design, and more. Courses are taught by experts to help the workforce do whatever comes next.

- Companies of all sizes choose Udemy for Business for top rated courses.
- The most engaging corporate learning platform available.
- Access business-relevant content instantly: unlock 2,500+ high-quality courses on key topics.
- Measure learning engagement: get valuable insights to user behavior and learning patterns.
- Scale your company's learning: build your own training content in a customized learning account.
- Learn from real-world experts on the topics they know best: 400+ leading practitioners, consultants, and luminaries at your fingertips.

**2. Become an Instructor,** teach the world online, share your knowledge, reach millions of students across the globe.

- Discover your potential.
- Earn money every time a student purchases your course.
- Inspire students: help people learn new skills, advance their careers, and explore their hobbies by sharing your knowledge.
- Join our community: take advantage of our active community of instructors to help you through your course creation process.
- Udemy is here to help: the Instructor Support Team is here to help you through your course creation needs; use the Teach Hub, a resource center to help you through the process; join Studio U and get peer-to-peer support from the Facebook group of an engaged instructor community.

#### IV. BENEFITS AND CHALLENGES OF MOOCs

Benefits of MOOCs are summarized as follows:

1. **Improving access to Higher Education.** – MOOCs are an important tool to widen access to Higher Education (HE) for millions of people, including those in the developing world, and ultimately enhance their quality of life. MOOCs may be regarded as contributing to the democratisation of HE, not only locally or regionally but globally as well. MOOCs can help democratise content and make knowledge reachable for everyone. Students are able to access complete courses offered by universities all over the world, something previously unattainable. With the availability of affordable technologies, MOOCs increase access to an extraordinary number of courses offered by world-renowned institutions and teachers [11].

2. **Providing an affordable alternative to formal education.** – The costs of tertiary education continue to increase because institutions tend to bundle too many services. With MOOCs, some of these services can be transferred to other suitable

players in the public or private sector. MOOCs are for large numbers of participants, can be accessed by anyone anywhere as long as they have an Internet connection, are open to everyone without entry qualifications and offer a full/complete course experience online for free [11,12].

3. **Sustainable Development Goals.** – MOOCs can be seen as a form of open education offered for free through online platforms. The (initial) philosophy of MOOCs is to open up high quality Higher Education to a wider audience. As such, MOOCs are an important tool to achieve Goal 4 of the 2030 Agenda for Sustainable Development [11,14].

4. **Offers a Flexible Learning Schedule.** – Certain lectures, videos, and tests through MOOCs can be accessed at any time compared to scheduled class times. By allowing learners to complete their coursework in their own time, this provides flexibility to learners based on their own personal schedules [13,11].

5. **Online Collaboration.** – The learning environments of MOOCs make it easier for learners across the globe to work together on common goals. Instead of having to physically meet one another, online collaboration creates partnerships among learners. While time zones may have an effect on the hours that learners communicate, projects, assignments, and more can be completed to incorporate the skills and resources that different learners offer no matter where they are located [13,11].

Some challenges and criticisms of MOOCs are listed below, as The MOOC Guide [13] suggests six possible challenges for cMOOCs:

1. Relying on user-generated content can create a chaotic learning environment.

2. Digital literacy is necessary to make use of the online materials.

3. The time and effort required from participants may exceed what students are willing to commit to a free online course.

4. Once the course is released, content will be reshaped and reinterpreted by the massive student body, making the course trajectory difficult for instructors to control.

5. Participants must self-regulate and set their own goals.

6. Language and translation barriers.

Although the above benefits and challenges more or less refer to all course providers, characteristic differences can also be found between their services. For example, a huge advantage for edX is that they use and offer Open edX ([www.open.edx.org](http://www.open.edx.org)), which is the open-source platform that powers edX courses and is freely available.

With Open edX, educators can build learning tools and contribute new features to the platform, creating innovative solutions to benefit all students. Since one of our main goals both in the MECA Erasmus+ project and at its BME Partner [17,18,19] was to develop new courses and/or transfer some earlier developed popular ones to meet the MOOC criteria, the use of Open edX have been studied carefully.

## V. WHAT IS OPENEDX ?

edX (edx.org) is a nonprofit online initiative created by founding partners Harvard and MIT and composed of dozens of leading global institutions, the xConsortium. edX offers interactive online courses and MOOCs from the world's best universities and institutions.

The Open edX platform is a free – and open source – course management system (CMS) that was originally developed by edX. The Open edX platform is used all over the world to host Massive Open Online Courses (MOOCs) as well as smaller classes and training modules. Institutions can host their own instances of Open edX and offer their own classes. Educators can extend the platform to build learning tools that precisely meet their needs. And developers can contribute new features to the Open edX platform.

The followings are included in Open edX:

- Open edX Studio is the tool that you use to build your courses. You use Studio to create the course structure and then add course content, including problems, videos, and other resources for learners. You also use Studio to manage the course schedule and the course team, set grading policies, publish each part of your course, and more. You use Studio directly through a browser; you do not need any additional software.
- The Open edX LMS (Learning Management System) is the Open edX tool that learners use to access course content, including videos, textbooks, and problems, and to check their progress in the course. The Open edX LMS can also offer a discussion forum and a wiki that both learners and course team members can contribute to. For course team members, the LMS includes an Instructor Dashboard, with options to enroll learners, produce reports, and administer a course as it runs. You use the LMS directly through a browser; you do not need any additional software.
- The capa\_module XBlock, which implements a set of problem types that are based on LON-CAPA problem types. It is the component architecture for the elements of an Open edX course. Software developers build XBlocks to create independent course components that work seamlessly with other components in an online course. A primary advantage to XBlocks is that they are deployable. The code that you write can be deployed in any instance of the edX Platform or other XBlock runtime application, and then used by any course team using that system.
- The ORA2 XBlock, which implements an open response assessment problem type.
- Discussion forum.
- Open edX Insights.

Open edX can be tried and used in different ways. In partnership with Bitnami, edX offers virtual machine (VM) images of the Open edX Cypress release. VM images are available for a number of widely-used cloud platforms, and give you a way to run Open edX in a trial mode.

Another option is to install and run the Open edX Developer Stack, or Devstack, which is a virtual machine image that is designed for local development. Running Devstack gives you the chance to discover and fix system configuration issues early in development. Devstack simplifies certain production settings to make development more convenient.

There are also several Open edX service providers who offer installation services. See the list in GitHub [15].

You can find all of the Open edX documentation at the [docs.edx.org](https://docs.edx.org) web site. In the section titled Open edX Documentation: Latest Release, you can find the most up-to-date guides for Open edX developers, service providers, course teams, and learners. When you work in Studio, documentation is available from its Help menu. If you are using an Open edX named release, the Help menu connects to the correct version of “Building and Running an Open edX Course”.

## VI. STUDIOX: CREATING A COURSE WITH EDX STUDIO

As it was mentioned earlier, the main advantage of Open edX Studio that educators can build learning courses and tools with its application. In order to get acquainted with Studio, its possibilities and best practice for its application an open course named StudioX: Creating a Course with edX Studio is offered by edX and was studied by our team. The main features of the course and the experiences are described below.

The ‘StudioX: Creating a Course with edX Studio’ course is designed for course authors who are responsible for developing and delivering courses to be run on the edX platform, either on edx.org or through an instance of OPEN edX. It provides application training with hands-on activities to guide you through the process of developing a course.

You must have access to Studio, edX's course authoring software to successfully complete the course. It is advantageous if you have some basic skills in HTML and JSON in order to complete all of the activities in StudioX.

The StudioX course is designed for six weeks with the following content:

Week 1: Learn how to take StudioX and pass the course. Get access to edX Studio on Edge or Open edX. Meet the rest of the course author community.

Week 2: Learn about the edX course outline and structure. Best practices for creating learning sequences. Publish your first course!

Week 3: Learn about the four basic component types in edX Studio. Create custom pages, handouts, and a welcome message in your course.

Week 4: Enable advanced tools and decide whether to use 3rd party tools. Use polls, surveys, teams, and peer instruction features in your course. Create blank advanced problems, drag and drop, and other input problems.

Week 5: Set up a grading policy for your course. Create common assessment types. Configure homeworks and quizzes.

Week 6: Ending your Course. Communicate with learners and teachers. End of StudioX.

After completing this course, you will be able to:

- Create a new course in edX Studio.
- Design an engaging and interactive learning experience.
- Create accessible content in a course.
- Set up a grading policy.
- Manage a course and a course team.
- Create a communication plan.
- Beta test and launch a course.
- Improve your course with analytics.
- Make decisions for ending a course.

This course is graded based on the following criteria: participation (20%), quizzes (30%), challenges (10%) and practice course activities (40%).

Regarding course structuring, it is important that the backbone of a course is how it is organized. Studio offers an Outline editor, providing a simple hierarchy and easy drag and drop to help you and your students stay organized.

Studio uses a simple hierarchy of sections and subsections to organize your content. You can draft your outline and build content anywhere. Simple drag and drop tools let you reorganize quickly. Build and release sections to your students incrementally: you don't have to have it all done at once.

In Studio you can work visually and by a simple click you can see exactly what your students will see. You can help your students understand one concept at a time with multimedia, HTML, and exercises.

Studio supports more than a dozen types of problems to challenge your learners. Common problem types include: checkboxes; dropdown; multiple choice; numerical input; text input; checkboxes with hints and feedback; dropdown with hints and feedback; multiple choice with hints and feedback; numerical input with hints and feedback; text input with hints and feedback. You can use the following advanced problems: circuit schematic builder; custom JavaScript display and grading; custom Python-evaluated input; drag and drop; image mapped input; math expression input; molecular structure; open response assessment; problem with adaptive hint. And you can create and include your custom problem as well.

Co-authors have full access to all the same authoring tools, so you can make your course better through a team effort.

## VII. CONCLUSIONS

We came to the conclusion that it would be worth the efforts of developing MOOC courses from our OERs. In addition to disseminate information about our courses and attract more students, it would give us the opportunity to show the success of these courses to politicians and decision-makers requesting more appreciation and support for the development of open on-line education.

On the basis of the study of edX Studio and the development of instance parts of a course we can conclude that the Studio provides tremendous tools, options and templates

for helping course creation, therefore it can be used efficiently, and we can offer it for use to our MECA Partners and all instructor colleagues world-wide.

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