A COMPARATIVE STUDY OF EDUCATION SYSTEMS

From traditional education to Massive Open Online Courses

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ABSTRACT

This thesis compares traditional education approaches to the new forms of online education in order to identify the major differences between the systems. It is done through research about sample cases, expert conversations and existing literature. The comparison provides evidence how Massive Open online courses contribute to reach and richness of education. The study finds that the newest online offering, namely Massive Open Online Courses offers higher flexibility than traditional education, as well as more interactivity and richer Media than existing online offerings. The use of information technology in education can address current needs, including tuition costs and access to education. Traditionally, there existed a tradeoff between educating many learners and providing them with a rich experience. The use of information technology in education can address current needs as tuition cost and access to education. New forms of online education suggest a pattern of reach and richness, where the tradeoff is smaller than traditionally. Educating online increases reach tremendously compared to traditional education. In the same time the design of the new online courses provides a richer experience compared to existing online offerings, coming closer to a traditional experience.

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Preface

I would first like to thank Prof. Andrei Villarroel for suggesting this research topic and therefore allowing me to tackle a research challenge and a very interesting semester. During the Dissertation Seminar and throughout the whole semester he devoted an extraordinary amount of time to individual meetings and discussions and gave me generous access to contacts and information. His mentorship as academic advisor and as an important source of knowledge was essential for the writing of this paper.

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This final semester of my Master Program brought with it many surprises and challenges, allowing me to acquire a lot of new skills and knowledge in the process.

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1 Introduction

This research will examine education and the evolution of education from traditional education as in the sense of universities to a new phenomenon of open online courses. Online education has been in existence for several decades and was always seen rather as an extension than a substitute for traditional education. However, this view has now changed, as discussed in this thesis, as a result of the introduction of new Massive Open Online Course offerings (MOOCS). The fast pace of Technological Innovation challenges the traditional education system, characterized by students and teachers learning from textbooks within institutional boundaries (Bouchard, 2010). The nature of the Internet enables education delivery to change to a more open web based approach.

This innovation in education enables students to participate in entirely online courses, often from well-known universities, and mostly free of charge. One main excitement factor of this innovation is the capacity to teach thousands of students within one course. For instance, the University of Pennsylvania, which has 25,000 enrolled students, offered one of their first online classes Greek & Roman Mythology in 2012, which attracted as many as 56311 enrollments, more than the total number of students at this comparably large institution. At the end of the course 2554 students earned a certificate (interview with John McDermott, Director for Instructional Technology at University of Pennsylvania, April 09, 2013) This implies that three of these online courses would be needed in order to reach the number of overall enrolments at the University of Pennsylvania. Judging from these numbers, the new online classes sparked an out of the blue excitement, promising to dramatically change the delivery of education.

It is argued that "…the campus based education is going to undergoing tremendous changes the next 10 years drive by these technologies…" (interview with Stephen Carson, MFA, External Relations Director at MIT OpenCourseWare, 20 May, 2013). The new online offerings captured the attention of investors, students, governments, higher education institutions (HEI) and new entrants, mainly from the IT sector. Platforms offering MOOCS received important amounts of funding. For example, Harvard and MIT each invested $30M to create the MOOC platform edX (Harvard Magazine, 2013). At the moment the American Council on Education (ACE) evaluates several courses offered on these platforms for their potential to qualify for credit. It has already recommended five to be qualified (ACE, 2012) whilst the first college credits were also awarded. Although the acceptance of online education to deliver equal or superior quality to that of face to face education by academic

leaders in the US increased from 57% in 2003 to 77% in 2012 the adoption of MOOCs by the traditional system remains low with the majority remaining undecided (Allen & Seaman 2012). “We [academic institutions] are surfing the online education Tsunami, and we don’t even know the size of the wave or the size of the board or wether the board is appropriate for the wave, let alone where it is taking us…” (experience of Prof. J.A. Villarroel, April 4, 2013).

1.1 Problem Statement

This huge excitement on the one hand and the hesitant behavior on the other hand shows a demand for the clarification of the potential, especially the potential changes made possible by new online delivery forms in education.

Information Technology has transformed entire industries, whereas the education industry is one of the last ones to be changed. Over the last two years, MOOCs, the new form of online courses has gained public interest and already seems to have had an impact on the traditional system. Indeed, there exists an enormous demand for overview and structure in the thematic. Identifying the major factors of change and potential which new innovations bring to the education industry is crucial for a general understanding and future planning concerning all players in this industry.

With this in mind the present thesis addresses the need for structured analysis of the change happening in the education industry by identifying the significant differences between traditional university education and the new online education offerings. It also explains the impact of these novelties

1.2 Research Question

In order to examine the effect of MOOCs, the findings of the comparison will be applied to the theory of reach and richness. Traditionally there exists a trade off between reach and richness (Daft, 1986, Evans & Wurster 2000). Information Technology and the emergence of new media could decrease this trade-off in several industries (Altarawneh & Allahawiah, 2010). To explore this in the field of education the following research question was formed:

RQ: How does the Massive Open Online Course (MOOC) revolution inform the general theories of reach and richness?

1.3 Thesis Structure

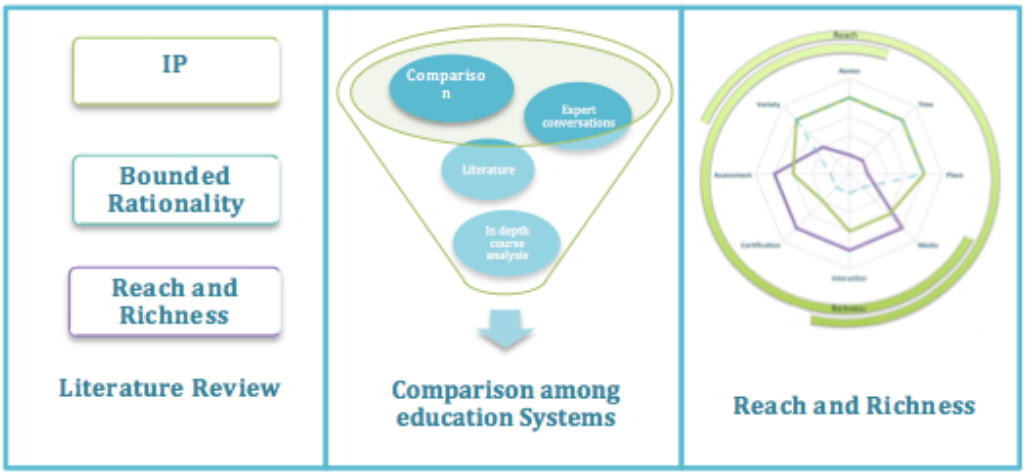

Figure 1: Thesis structure

Chapter 2 presents a literature review aimed to identifying the most important concepts when it comes to understanding the effects of Massive Open Online courses. It also aims to answer the research question posed. Chapter 3 explains the Research methodology used whilst Chapter 4 contains the findings of the comparative study among education systems. Chapter 5 applies the findings to the theoretical concepts and thus aims to answer the research question followed by a conclusion and the suggestion of managerial and theoretical implications.

2 Literature Review

In this chapter, the main theoretical aspects used in this thesis are explained. The following chart displays the theoretical overview of the concepts used and their relevance in respect to the research topic.

Theory	Description	Implication for	Implication for students
Intellectual Property (IP)	In closed IP regimes R&D happens inside of the firm, IP rights area strategic asset Open IP regimes leverage on collaboration and partnerships	Educator	• Knowledge possession is not a competitive advantage. • Due to the need for proficiency in IT open collaboration may be required
		Learner	• Materials can be consumed from more sources, downloaded, personalized and collectively edited
Bounded Rationality	Rational decisions are not possible even if intended due to limited • Time • Capacity • Information	Educator	• Hyper specialization is enabled since the possible audience is larger and it is also needed to compete.
		Learner	• IT enables a decrease in the limitations for rationality, more materials can be viewed at the same time and the best fit can be identified more rationally than offline

Reach and Richness	**Tradeoff between reach and richness of Media and Information**	**Educator**	• **IT and educational characteristics shall be combined to offer a rich experience to a huge audience**
		Learner	• **A high level of flexibility as well as a reasonably rich learning experience can be expected.**

Table 1: Relevance of theory

2.1 Intellectual Property and open Innovation

2.1.1 Transition from internal R&D to open collaboration

The industrial organization as a "firm" serving a "market" (Coase, 1937) was the dominant model of organizations in the middle of the 20th century. Decisions were made within the boundaries of an organization and every company generated its own ideas. Companies generated profits by using Intellectual Property (IP) rights to prevent competitors from exploiting IP (Chesbrough, 2003).

On a different stream, Hayek (1945) advocated that knowledge is unequally distributed and does not exist in a concentrated form. A central planning approach can never be the most efficient way of deciding (Hayek, 1945) due to its "…inability to aggregate distributed knowledge." (Lakhani & Panetta, 2007, pp.97). The realization of the importance to leverage knowledge outside the firm (Villarroel et al 2007; Villarroel 2008; Jeppesen & Lahkani, 2009) that otherwise could not be acquired (Hayek, 1945) led to alternative models for organizing innovation. Indeed, there was a "fundamental shift in how companies generate new ideas and bring them to market" (Chesbrough, 2003, p.36).

Companies must leverage on the most effective means possible to drive innovation, whether external or internal. In particular, they "…began to source technology through alliances, licensing agreements, and other contractual forms…" (Pisano, 2006). Electronic industries such as software and telecommunication were the first to follow this approach. By now this tactic has spread through financial services, the pharmaceutical industry and many others (Pisano, 2006).

Open innovation suggests that companies no longer need to protect their Intellectual Property as fiercely as some industrial companies previously had to. Leading industrial organizations have recently faced fierce competition from players who do little research on their own (Chesbrough, 2003). Many use e-collective work, which is a form of online knowledge-based work, where individuals, geographically distributed, collaborate and contribute as a collective

leveraging on the concept of distributed knowledge (Villarroel, 2008:Chapter 4). The newly evolving model describes neither the market nor the firm in the traditional sense and is also not self-organized (Villarroel, 2011). Open source software and forms of deliberate intellectual property sharing as well as crowdsourcing were first utilized in non-profit context, but are now being utilized by for-profit entities (Pisano, 2006; Villarroel, 2008).

Their success shows that an advantageous appropriability regime does not necessarily require strongly protected Intellectual Property (Pisano, 2006). Evidence suggests that knowledge intensive companies could benefit the most from strategically organizing crowdsourcing initiatives, leading to the emergence of Online Distributed Organization (Villarroel et al 2011; Villarroel, 2012: pp 177).

2.1.2 Facilitators for open collaboration

The emergence of the Internet (Lakhani & Panetta, 2007) is one of the reasons for the organizational transformation. Moore's law, Metcalfe's law, and Reed's Law emphasize the commonly accepted argument that advancement in Information Technology decreases communication costs, declines cost and product complexity steadily increases (Villarroel, 2012:pp 178). Distribution and assembly of resources were facilitated by information technology, thus significantly lowering transaction costs (Villarroel, 2008). For example, the emergence of email has reduced the cost of coordination and collaboration (Lakhani & Panetta, 2007).

2.2 Definitions of education systems

The following paragraph briefly characterizes the educational systems used for the comparison in Chapter 4.

2.2.1 Traditional

Traditional education is defined as "…a structured education program that focuses on face to-face teacher-centered instruction, including teacher-led discussion and teacher knowledge imparted to students…" (Staker, 2012, pp. 6) Further, the characteristics of traditional instruction comprise grouping students by age and ability as well as a textbook based lecture with individual assignments (Staker, 2012). Organizations in this category do use some sort of technology intermediate learning to a very limited extent.

2.2.2 Online education

This category labels all offerings of online and distance education between the traditional system and Massive Open Online Courses. In the comparative study this category is mainly used to describe the transition from "traditional" to "MOOC" and is therefore not the main focus of the research.

Evergreen Education Groups and iNACOL define online education as content delivery and instruction mainly using the Internet. Others argue that the term online learning is interchangeable with virtual learning, cyber learning and e learning (Staker, 2012) In this comparison, "online" refers to two different sub categories. The first are "virtual" degree programs, for example Open University UK. These offerings are close to the traditional system in the accreditation sense , however not fully online. For example VU Pakistan has a physical Campus to provide learners with computer, printer and the entire infrastructure for online learning which cannot be found at home (interview Dr. Naveed A. Malik, Founding Rector of the Virtual University of Pakistan, Pakistan Project Manager for MIT BLOSSOMS, May 17, 2013).

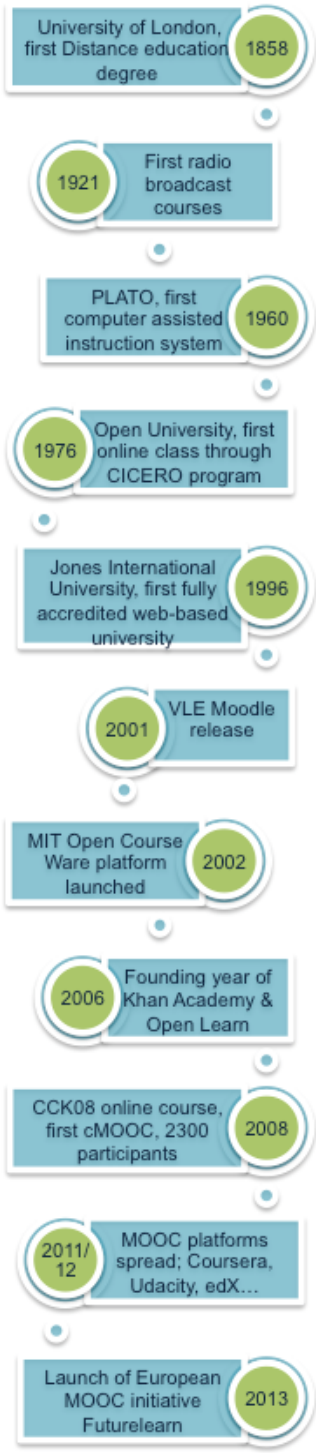

Figure 2: History of online education

The second subcategory is Open Online Courseware. A pioneer is the Massachusetts Institute of Technology. The institution launched the Open Course Ware platform in 2001 (Abelson, 2008). Most of the course contents are free to download and free for non-commercial use. Other universities as well as public consortia followed this approach to make educational content available online for free. In most cases the learner relies on self-assessment, as there are no feedback processes on his learning progress. In contrast with the degree programs, OCW platforms were not founded as an alternative to the traditional education process but were instead designed to support educators and students with open access to educational material. Figure 2 visualizes the development of online education over time.

2.2.3 Massive Open Online Courses

The term Massive Open Online Course (MOOC) was first used to characterize the online course Connectivism and Connective Knowledge (CCK08), taught by George Siemens and Stephen Downes in 2008 (Rodriguez, 2012; Yuan, 2013). The course was originally offered by the University of Manitoba. (Rodriguez, 2012)

It was a for credit course for 25 fee paying students and at the same time was open to learners around the globe. More than 2300 people participated for free, without receiving credits (Fini, 2009). "Introduction to artificial intelligence" a Stanford course taught by Sebastian Thrun in 2011 even reached 160'000 registered learners in more than 190 countries (Martin, 2012).

As the name indicates, these courses are designed to host a large number of learners and are openly accessible to everyone, entirely online. MOOC platforms leverage on social and networking activities scaling negotiated knowledge and represent a promising method of online instruction (Rodriguez, 2012). The initial MOOC philosophy strongly follows the connectivist theory of learning (Siemens, 2004). Each user decides about the type and intensity of participation according to their motivation and learning interest. (Siemens, 2004). Most MOOCs engage "…networked learning methods but not with- in the typical structure of a traditional course…" (Kop, 2011, pp.78)

At the time of this writing, the most popular MOOC platforms are Coursera, edX and Khan Academy, the most popular one in terms of traffic, followed by Coursera, which performed very well recently. It has to be noted that these courses are the most popular in the US, India and Brazil. (Appendix A). The platform hosting the courses does not typically prepare the courses themselves. Some platforms allow everyone to contribute content or create courses, such as P2PU (see Appendix B4), whilst others restrict this possibility to renowned universities as Coursera or edX do.

It is important to point out that these forms of online education only concentrate on the part of knowledge transfer and do not offer typical American education experiences such as on campus housing or sports facilities. In addition, as of today, they also lack the additional social experiences such as fraternities and student associations, offered by other traditional education institutions.

2.3 Bounded rationality

A model, often used in economics to describe the rationality of choice is the economic man. The assumption is that the homo ecomomicus seeks to maximize utility at minimal costs. The theory of the firm is a classic example of rationality theories. The goal is to maximize profit. To find the perfect solution for the equation of demand and cost function perfect market knowledge of the actor is assumed (Simon, 1972) However "How do human beings reason when the conditions for rationality postulated by the model of neoclassical economics are NOT met?" (Simon, 1989, p. 377) Bounded rationality argues that perfectly rational decisions are not feasible in the majority of real life situations since the assumptions for the decision are not given. Simon (1972) points out important constraints on information processing capacities of a decider arising from his/her limitations in information processing. Bounded rationality replaces the goal of utility maximization with the heuristic of satisficing when optimization is not possible (Kahneman, 2003), The rationality function could be adopted either when assuming perfect knowledge about the probability of the demand and cost function or assuming imperfect market knowledge. Another constraint to rationality is in the form of environmental factors as complexity in the cost function (Simon, 1972). Bounded rationality assumes that even people who intend to decide rationally are constrained by three factors. First, a decision maker often has only a limited and not fully reliable amount of information; the human mind has limited capacity when it comes to storing information meaning that decisions must often be made within a certain limited period of time (Simon, 1972). One approach to deciding is the satisficing approach, mostly employed in models applying "heuristic" methods to search for suitable alternatives. Today a decider can choose a variety of decision-making models. The importance lies in the ability to match the decider's bounded capability with the difficulty of the issue (Simon, 1972).

2.3.1 Hyperspecialization

It is argued that we have entered the area of hyperspecialization (Malone, 2011). Everybody being good in a specific field could fully concentrate on doing only this. The separation of tasks can achieve "…improvements in quality, speed and cost" (Malone, 2011, p.59). Hyperspecialization can speed up the process by dividing tasks and allowing experts to work simultaneously on small parts. For example, by employing an automated process, Casting Words uses overlaps to catch errors and to fit the single pieces into a final product. Cost saving can be achieved by making better use of employees' time. A specialist can carry out single tasks most effectively. This specialist could be paid with a multiple of the current hourly wage and the firm would still save costs by increasing efficiency. Hyperspecialization will require a new set of management skills. For a successful process it is necessary to break

down the work and recruit the right people either internally or external; this can also be done through intermediary companies. Following this, an appropriate quality control system must then be applied. Either they pay on the basis of an outcome or have multiple workers complete the same task or implement test tasks to sort those which do not complete the test tasks. Last but not least, a successful implication process is needed. Software can be used to manage the passing of work from one stage to the next, manage simultaneous work or integrate different parts into a whole. It is argued that people who are rejected in the traditional labor market might benefit. The danger is labor market arbitrage, since in different parts of the world there are different payment expectations. Malone argues that this is to decrease with the increase of globalization (Malone, 2011).

2.4 Reach and richness

This section aims to explain theories of reach and richness in respect to information and media. The information richness theory, first developed by Evans & Wurster (2000) describes the transfer of information as a trade off between richness and reach. For example, while shopping one can either screen many stores to receive overview information or concentrate on a few stores to receive in depth information at the same time (Altarawneh & Allahawiah, 2010). While the number of people exchanging information defines the dimension reach, six different aspects characterize richness, "Bandwidth" describes the amount of information exchanged, "customization" is the grade to which the information can be personalized, "interactivity" defines how much dialogue between the sender and recipient of information is possible, "reliability" describes the trust relationship between the participants, "security" says that managers usually like to exchange sensitive information between closed doors, and currency refers to the degree of actuality of the information (Evans & Wurster, 2000).

Online the trade-off between reach and richness can be reduced by allowing a broader product variety with better navigation systems. For example, it allows a shopper to browse through more shops and gain more information at the same time. This at the same time eases the limitation of bounded rationality on the decision maker (Altarawneh & Allahawiah, 2010). It is argued that the trade off decreases more for products which can fully be transformed to digital products (Altarawneh & Allahawiah, 2010). It is argued that a new trade off curve of reach and richness can replace the usual curve (Evans & Wurster, 2000).

The use of the media when transmitting information is a significant influencing factor. The way people interact with each other was influenced by these technological advancements, which developed from print press over email to chat and other new communication media

(Kock, 2004). The media richness theory coined by Daft & Lengel (1986) classifies different types of media from rich to lean. It describes the perception derived from the use of each single medium (Carlson, 1999). A rich medium enables communication in equivocal and uncertain environments. A lean medium is best to communicate analyzable content in a certain setting (Daft, 1986). Rich media resemble face-to-face situations better than lean media do. The criteria for richness are: feedback, multiple cues, language variety and personal focus. To define the richness of a media all the attributes are compared to the criteria for richness following which the mediums are ordered along the "media richness continuum" (Rice, 1992) from rich to lean (Carlson, 1999). All mediums possess attributes which lead to distinct objective richness capabilities. Face-to-Face, classified as rich, can be used to transmit content which is needed for interpretation or discussion. It reduces equivocality in a message receiver (Carlson, 1999) and thus allows insight and quick understanding (Daft, 1986). In contrast, text documents, as lean media, are best for transmitting structure as in syllabi or displaying analyzable content as mathematical formulas (Daft, 1986). One goal for managers should be to identify those technologies which reduce uncertainty and equivocality in different business situations the best (Daft, 1986). If the wrong medium is chosen, the receiver may misinterpret the message (Carlson, 1999) or participants are required to engage in clarification activities, which could lead to inefficiency in the conversation (McGrath & Hollingshead, 1993). This theory has been tested several times and has generally been supported when it comes to "traditional" media such as telephone, face-to-face and mail (Lengel & Daft, 1998). However, when tested on new media such as voice mail and email, inconsistent empirical results were displayed (Webster & Trevino, 1995). In an attempt to explain these inconsistencies the channel expansion theory claims that as a participant develops experience with a certain channel he/she will be able to communicate more effectively via a certain channel and will be able to use the same channel for different situations. Thus the "perceived richness" of this channel increases when participating in Massive Open Online Courses(Carlson, 1999).

3 Methodology

3.1 Research Design and Methodology

The primary purpose of this thesis is to contribute to theory development and practical knowledge in general. The little availability of academic studies and published performance information regarding the new online offerings as the early stage of development makes it difficult to conduct a more detailed oriented research. The outcomes of this work propose the framework of education reach and richness, which is subject to further testing.

First, primary sources of information included interviews conducted with academic and industry experts to gain in-depth knowledge, validate assumptions suggested by the observations and support the theory building. A brief summary of all the interviews conducted is attached in Appendix G. Observatory participation in some Massive Open Online courses served as another primary information source at the course level. (Appendix F) The participation of the courses was chosen to be among the three most popular platforms in terms of traffic. (Appendix A/B2)

In Chapter 5 the data are analyzed and applied to the theory reviewed in order to answer the research question and develop a framework of education reach and richness.

Second, to validate the conceptual understanding derived from primary sources, existing education offerings were compared in order to find those characteristics which vary the most among the systems. For this purpose, several sources of information were used: 31 cases were selected according to their relevance and the information available (See Appendix B). The information sources for this comparison are literature, newspaper articles, and mainly Internet sources as company websites and blogs. The reason for this choice of secondary sources is that they offered information about the most recent developments in the industry. To verify the data for the case studies, especially from online sources, multiple sources were used if possible. Among each category the most popular organizations/platforms were chosen, as well as some smaller ones or less known, to have a balanced sample for analysis.

The findings in this thesis should help gain an initial understanding of the developments in the industry and the implications, which are to be expected when embracing a new model for education. The aim of this thesis is to build theory for further testing.

4 Comparison among education Systems

This chapter shall explain the findings from a structured analysis along six main categories assessed. The intention is to explain the differences between the systems, particularly between traditional education and Massive Open Online Courses. In the section Media and Interaction, the focus lies on explaining the technological advancements compared to previous online education. The six dimensions chosen are Place, Time, Media, Variety, Access, Interaction and Assessment. Each dimension has subcategories, which are displayed in detail in Appendix C. The main subcategories discussed are displayed in a table at the beginning of each section.

4.1 Place:

Place		
In situ + attendance	In situ no attendance	Remote

Table 2: Place Variables

A differentiating factor between the systems is how much of the education process takes place online. Traditional education is mainly bound to a certain location. The more of the education process which is offered online, the less likely the institution is to have a physical campus. It is found that the existence of a physical campus is positively related to the number of employees and faculty. Further, a physical campus restricts the available places for students. Online there is no capacity restriction, which explains the positive interrelation with the use of Internet for teaching and number of students in the case studies. Existing online degree programs host most of the education process online, although examination often takes place in physical test centers, or students have to travel to the university's physical campus. Open Online Course Ware hosts all the materials online but is limited to content display functions. Massive Open Online Course platforms are the first to offer the complete education process, from registration to completion/certification online.

4.2 Time:

Time		
One time	Several times	Unlimited times
Specific point in time	Several points in time	Anytime
Within certain period	Extended period	Always

Table 3: Time Variables

In the traditional system courses are taught at a specific point in time, and are synchronous. The frequency one course is offered in the same period and is interrelated with the number of faculty and the number of students, as well as the size of the campus in the traditional system. With increasing degrees of virtuality, this correlation is no longer given. This can be explained by the characteristics of digital media. An online lecture can always be taken and retaken, any time and infinite amount of times without significant extra expenditure. Students can study "…at their best learning readiness time" (Harasim, 2000, p. 50). Learners can tailor the online materials towards their need (Picolli, 2001), and can skip certain parts and devote more time to others, or in the case of a video, alter the speed or replay certain passages.

However, it is interesting to observe that among the cases investigated, constraints concerning the enrolment time apply across all systems when formal assessment is applied. For example,

within MOOCs, students who aim to get certificates with signature track must enroll until a certain time and finish the exams within deadlines. Otherwise MOOCs can be accessed at any time after registration, and at some platforms (e.g. CS169.1x Software as a Service, edX) even after they are finished.

4.3 Media

Media Type		
Analog	Digital	Online
Media Production		
Text	Audio	Video

Table 4: Media Variables

The section Media explains which mediums are used for knowledge delivery and explains how their quality has evolved over time. Systems with a physical campus mainly deliver content via face-to-face lectures and text-based material. Existing online offerings first used printed textbooks only, which is still the main case in some distance education programs. Up until now, online education has relied mainly on digital text documents, TV broadcast or CD and DVD as for example the Virtual University Pakistan (interview Dr. Naveed A. Malik, May 17, 2013), before using the internet for its lectures. Massive Open Online platforms mainly rely on video delivery, accompanied by text documents, audio podcasts and animated presentations as the course ethnography showed The first striking difference between online educations so far and MOOCs is the quality of the Media. While those OCW platforms, which included videos, simply recorded the professor in class, the new videos are tailored especially for online consumption. For example, presentation slides are not recorded, and are instead directly inserted and animated. The video and audio quality has also improved. A schreenshot comparison of an OCW video and some MOOC examples is displayed in Appendix E. Techniques from TV such as studio-quality lighting, professional cameras, and post-production are being implemented in the development of MOOC videos (experience of Prof. J.A. Villarroel, April 04, 2013). Second, the variety of presentation methods has increased. MOOCs incorporate gaming and simulation technology, which makes the learning experience more dynamic. For example, some videos of the "Sustainability" course on Coursera are taught in open air and the student can follow the practice lecture without leaving home. The presentation media in online education has developed from HTML text based media, to a combination of video, audio and chat conferencing, thus enabling a richer experience which feels closer to the face-to-face delivery in the traditional system.

4.4 Variety

Material Variety			
Obligatory materials only	Additional readings	Many materials	
Contributor			
Professional teacher	Any teacher	Learner contribution	Networked learning

Table 5: Variety Variables

Within traditional degree programs two basic approaches can be compared, namely the credit based system and the curriculum based approach. In the curricular system the institution mainly determines the courses required to complete a certain degree, e.g. Universidade Católica Portuguesa, Católica-Lisbon School of Business and Economics. In a credit-based system the institution supplies a certain number of courses and the students decide among them more freely. The Wharton Business School for example advertises having the MBA with the most course offerings. Learners can enroll in 18 majors and have access to 230 courses and 200 electives. In comparison, at Universidade Católica Portuguesa, Católica-Lisbon School of Business and Economics, the Master of Science Program offers 5 different majors, with a maximum of 18 credits in general electives out of a pool of about 40 courses. The research showed that in the traditional system, larger institutions, with more faculty and more students are more likely to offer a broader variety of courses. (See Appendix B1/B2/B4)

Open Online Courseware was the first attempt to use the storage and sorting capacity of IT, making thousands of materials available on its platform. For instance, the Open Courseware Consortium published materials from more than 13,000 courses available in 20 languages (Open Courseware Consortium, 2008). Most sources are divided into courses or short videos or pieces of materials. Thus, a student can choose small pieces of knowledge and assemble them to his/her best convenience.

Whilst the number of courses can be significantly larger online, so can the variety of materials used on a course be higher as well. From the observation of some MOOCs, it was often the case that too many materials were posted by the instructor, that it was more than a student could target within the time suggested for the course (#EDCMOOC, 2012). This goes along with findings from the observation of ten courses offered by University of Pennsylvania via Coursera showed that "…people participate partially in the course, even among the people watching videos they are not watching all of them" (interview John McDermott, April 09, 2013).

In some MOOCs students are actively encouraged to create their own knowledge content and share it with other learners (Kop, 2011). This is either practiced through uploading

contributing content to a lecture or creating their own lecturer. In the E-Learning and Digital Cultures MOOC on Coursera (#EDCMOOC, 2012) fellow learners could see all artifacts and comment on them in addition to the peer review comments. The most open form of knowledge contribution is platforms, which allow everybody to contribute content. These platforms are the ones with a very vast amount of available content, e.g. MERLOT, OER Commons and Udemy. (See Appendix B2/B4).

4.5 Access

Selection criteria		
Active selection process	Prerequisites	Self selection

Monetary selection		
Tuition	Certification fee	No fees

Table 6: Access Variables

The category "Access" discusses monetary and non-monetary restrictions on education.

4.5.1 External Selection vs. Self Selection

Findings show that the more of the education process which is moved online, the less likely the institution has a physical campus the lower is the access restriction. (Appendix B1/B7). In the traditional system students are mainly grouped according to age or previous education, which are examples of basic acceptance criteria among most institutions. Some traditional institutions apply additional selection criteria. External selection often uses tests such as TOEFL, GMAT, SAT or have their own assessment center. In all cases diverse skills from mathematics to language proficiency, extracurricular activities and social skills are examined and a minimum in all sections is required. Representatives of these institutions argue that targeted selection shall ensure a minimum level of capability among students and that the best suited are chosen for the limited places available.(interview Stephen Carson, 20 May 2013) Since online learning takes place at each participant's pace without influencing another's performance it can be argued that it is not necessary to impose external access restrictions due to previous education or any other factors, when structuring the course properly.

Comparing online courses between the different platforms it was striking that the course description and the information given about the course before enrolling differed significantly. Some posted an introduction video, others provided an introductory text, some stated prerequisites, and others did not. The course and especially the profile of requirements are important to be communicated clearly when the student has to decide if this course fits its need or not.

4.5.1.1 Internet Access

One reason for the acceptance of online education could be the worldwide expansion of personal Internet access. In 2003, 12.2 million people were using the internet (World Bank, 2013), In 1990 2.64 million internet users were documented and 2012 already 2406 million people are connected to the internet (ITU World Telecommunication, 2011), which makes up for about 35% of the world population. The most remarkable extension of networked users and devices is currently happening in Africa, Asia and Latin America (Clemente, 2013). In 2010, Finland passed a legislation declaring Internet access as a legal right for every citizen. By that time 96% of Finns were already online (Johnson, 2009). One reason for this major increase is the steeply falling costs for hardware and broadband access. However, the cost of ICT services still averages 17% of the gross national income per capita in developing countries and only 1% on average in developed countries (ITU World Telecommunication 2011). Although developing countries remain disadvantaged, a trend of comprehensive Internet access can be expected, and mapping the trend to 2020 it suggests that most of the world population will be connected. Countries are reacting to the increasing number of the world's population who now have access to computers and Internet. For example, South Korea has announced plans to replace all paper textbooks and study materials for K-12 students with digital material accessible through tablets by 2025 (Usdan, 2012).

4.5.2 Selection through increasing tuition cost

Education is funded by several sources, one of which is tuition fees. There are countries where tuition fees for students are zero, e.g. Vienna University of Business and Economics (Appendix B7), where the major part of education is funded publicly or by private investors. In other parts of the world, in the US, Canada and in recent years especially UK tuition fees have increased dramatically. Over the past 30 years the cost of college education in the US has almost doubled from $10,000 in 1990 to almost $20,000 on average in 2012 (National Center for Education Statistics, 2012). The UK, for example, introduced tuition fees of £1,000 in 1998 and by 2012 many universities had announced to charge £9,000 yearly (Sedghi, 2011), the maximum allowed in the UK.

Most Massive Open Online Courses have a predominantly free access policy. Several profit strategies were announced by these platforms like signature track, cross selling, data mining and selling and advertising (Voss, 2013). It has not yet been proven as to whether this free access model is sustainable. Most recent platforms, which are free to use, started charging for signature track services between 39$ and 119$. Coursera offers a scholarship for those

students who cannot afford it (Koller, 2013). Contracts with HE Institutions include profit sharing agreements (Coursera & University of Michigan, 2012). At the moment, developing a quality online course can cost from $20,000-$50,000 (interview John McDermott, 09.04.2013). Moreover, the changing course survey (Babson, 2012) found that professors presently view MOOCS as more time intensive than their on campus counterpart. Especially challenging is keeping up with the student conversations and creating the right content (interview Stephen E. Carson, May, 20, 2013). An educator from Georgia Tech reports that they have 19 people developing a Massive Open Online Course and that even this is not sufficient (Hartnett, 2013). However, digital products have two characteristics, which are especially important in this context. They are reusable and can be used by an infinite number of people without major additional cost. Scale can be suggested as a major factor for the decreasing cost of education and thus tuition fees. "Cloud computing at low cost so that scale is not an issue…" contributes to the recent success of online education. (Interview, Dr. Daniel E. Hastings, Dean for Undergraduate Education, Massachussetts Institute of Technology, June 12, 2013)

This evidence and the interviews conducted lead us to assume that education will not be offered for free in the future but IT can help to decrease the cost of distribution and thus tuition fees.

4.6 Interaction:

Interaction Media		
One	Some	Many
Interaction Channels		
Written	Oral	Visual
Interaction Partner		
Content	Instructor	Learner

Table 7: Interaction Variables

We considered three types of interactions, namely learner-content, learner-instructor and learner-learner interaction (Moore, 1989). In the traditional classroom the students have the chance to make use of all three forms of interaction. Still, there remains a difference between small and large institutions once again. While in Wharton Business School 44 standing faculty members are available on the field of finance, there are 10 at Católica Lisbon, School for Business and Economics for accounting and finance. The advantage of having a broad variety of experts in one field is to receive diverse opinions on one topic while in a smaller institution the exchange can be more intense with a single person. This refers to the tradeoff between reach and richness. The same is applied to the student relationship.

Large institutions tend to have a higher student-to-faculty ratio (.See Appendix B1/B2) A good example for this would be WU Vienna where the ratio is approximately 1:46 (See Appendix B1/B2), including all registered students and all faculty members. This means that student-professor interaction is very rare and instead the other two dimensions increase.

Online setting so far learner-content interaction was the most commonly used. The number of students enrolled in virtual education programs thus far allows for occasional interaction with tutors and professors mostly vial email. OCW platforms, hosting significantly more users, restrict the communication to a one-way feedback channel from the user to the content creator. The lack in communication possibilities from student to student or also to the instructors was a major point of seeing online education as inferior to traditional education since interaction was identified as a significant factor for satisfaction (Picciano 2002).

In Massive Open Online Courses the Learner-Instructor interaction is very limited and often not possible since student-teacher ratios are for example 20000:1 in the course CS191x Quantum Mechanics and Quantum Computation at edX (edX, 2012a). In these courses form of interaction is often restricted to the information flow from instructor to student. To make students feel more comfortable participating in a large scale online class, welcoming emails are sent out by the instructor and can serve as "Virtual icebreakers" (Angelino 2009, pp. 6). These welcoming emails are not new themselves, although in MOOC courses an increasingly informal language is used whilst more personal information about professors is also included, such as hobbies, passions. For example, in the edX course 6.002x Circuits and Electronics (edX, 2012b), where the professors state their passions for chainsaws or watch repairing. Integrating students in social or subject-related activities leads to endurance of students in education (Tinto, 1975). The 2-sigma problem explained the potential improvement in learning outcomes when having a personal tutor (Bloom, 1984). Therefore, the other two channels compensate the remaining lack of communication between students and educator on platforms. MOOCs use IT and leverage on the huge audience to replace learner-instructor communication as far as possible. These methods are described in the next paragraphs.

4.6.1 Use of technology to compensate for missing instructor-learner interaction

When a significant number of students give the same wrong answer on a quiz, the reason for that can be examined and a detailed explanation of how they could have derived that answer is part of the feedback compensation. Further, instant feedback is provided when videos are stopped after some time and a question pops up. It must be answered before the student can go on with the video. The student can replay the video an unlimited number of times to

answer the question. This is called Retrieval Learning practice (Karpicke & Blunt. 2011). The advantage of doing that in the virtual environment is that every student has to answer the question (rather than only one student, as is often the case in the traditional classroom (Koller, 2013).

Since online the professor cannot react to nonverbal signals of students, clear content and detailed instruction are crucial in order to limit the potential for misunderstandings (Angelino 2009).
Khan Academy is one of the leading platforms (Appendix A) when it comes to the provision of visual structure for students (Appendix D). Therefore, it is used as an example of how to use IT for feedback, guidance and motivation. For example, the knowledge map shows the complete content of mathematic topics. A color code system shows the progress made in each section, as well as those sections/practice problems suggested for the student to study. Within the problem section a color bar shows the progress students make in the exercise. Positively answered questions are awarded with a motivational smiley. Additionally there is a hint function, where students can get some automatic advice on how to solve a problem, mostly broken down in visuals. The attain mastery shows how many questions have to be answered correctly in each section for proficiency to be achieved.

Another feature is to create your own goals by filtering the knowledge map for exercises and videos, which fit to the chosen goal and select some of them to be completed for the achievement of a new goal. A visual graph on the student's profile then shows how close one is to achieving the goal. Each learner has a profile on Khan Academy where he/she can see the number of exercises completed, videos watched and energy points as well as the activity profile and the focus graph which shows how the time was spent on the platform. Further, the learner can achieve badges. Badges show characteristics; if the learner is very fast in solving problems he/she received the badge "going supersonic". Additionally, the more points a student receives, the more choice he/she has for the avatar. A summary of the features of the knowledge map is displayed in Appendix D. Students can show their profile to the public or keep it private. If the student has a tutor he/she can see all the progress information of the student. It must be mentioned that Khan Academy is more focused on secondary educational content and younger participants, although the strategies presented can be implemented across all levels.

All these functions should help to give the student an overview of his/her progress whilst also providing some motivation to keep learning. It was found that advance organizers such as summaries, structured outline of what is taught and summarizing questions have a positive

impact of "…about 0.2 sigma on learning achievement and 0.4 sigma impact on retention" (Bloom, 2006, p.9). Some of these features are implemented all across MOOC platforms. Further, the possibility of continuous enrolment creates a need to guide new entrants on how to catch up with the material taught so far *(*interview John McDermott, 09.04.2013), which is done via timelines or wrap up emails for example.

4.6.2 Use of technology to enable learner-learner interaction

New online learning platforms focus on learner-learner interaction, which is also used to partly replace the missing learner-instructor interaction. Learner-learner interaction is a fairly new dimension in online and distance education (Moore & Kearsley 2005). Courses emphasizing on discussion, problem solving and collaboration among participants can be taught online when technologies that promote student-student interaction are used. (Picolli, 2001). Massive Open Online Courses use various tools such as forums, Facebook groups and others for students to interact. Also students create their own interaction spaces, blogs for example. The majority of these tools are Web 2.0 applications, which shall enable more collaboration to develop "…collective intelligence…" (Hung, 2008, p.345).

The observation showed that an increased integration of social media networks makes communication easier and faster. Further the user can combine text, images and videos in the same post. Today communication technology enables synchronous discussions in forms of chat rooms and video conferencing (Skype, Google live chat…) as well as a-synchronous communication through e-mail, wikis, blogs, webinars and other. MOOC platforms primarily used forums for interaction. However it was reported that one of the most difficult factors when designing a MOOC was the proper structuring of the forum, that the huge information flow can be processed properly. *(*interview John McDermott, 09.04.2013). The software tools used to design interaction spaces in present day MOOCs offer great potential, but remain limited compared to what social media platforms are already able to offer: "it doesn't provide as much interactivity yet" (experience of Prof. J.A. Villarroel, April 04, 2013). Through the introduction of social media (e.g. Facebook, Twitter), very rich and flexible communications tools, one can reach a very large audience. A survey on the #EDCMOOC Facebook Group found that students preferred social media platforms and blogs to the "traditional" course forums (#EDCMOOC, 2012).

Group work is one example where MOOCs online education meets their limits in a large-scale group. The course Fundamental of Online Education on Coursera planned to do group work using Google docs, which is limited to 50 participants. This indicates that some digital

solutions used for teaching at the moment do not suffice the demand of a course with several thousand students (Jatschik, 2013). On the contrary developments such as quad-blogging (Towndrow, 2013) show student initiatives to form groups in huge classes. It shall enhance communication and traffic on blogs, generate feedback circles but is limited to those students that enroll at the very beginning. The high fluctuation of participants due to the continuous enrollment and dropout possibilities show a major challenge for group work (Towndrow et al., 2013). Siemens (2013) suggests a dynamic model of group work using a queue system, where 20-30 minutes tasks are done in group, if they like to stay together they go on to the next task if not the groups are rebuild. He also indicates that there is something to learn about building groups in a flexible online environment from video games as Call of Duty and World of War craft.

While most of the research argues in favor of increased interaction in online courses some observed that students had troubles to adapt to the non-linear asynchronous nature of online interaction. A face-to-face situation typically enables one conversation at a time. Online several conversations can run parallel on different engagement tools. This can be disturbing and confusing for some user at the beginning (Moore, 1989). To enable face-to-face meetings as well some platforms offer a section for study groups where people can find fellows in their geographic region and arrange to meet in person. For example it exist 2903 Coursera communities worldwide. (Coursera, 2013)

4.7 Assessment:

Assessment		
No	Exam	Paper/ artifacts
Assessor		
Nobody	Machine	Instructor
Certification		
No	Certificate	Credit option

Table 8: Assessment Variables

4.7.1 Assessment types

As mentioned in chapter 4.1 exams in all education systems take place either on the institution's campus or in proctored test centers. Very seldom exams are taken online. MOOCs are the only ones where everything, even examination is done online. This has attracted much criticism concerning the risk of cheating and plagiarism. For example when Coursera developed only a honor code that should ensure that the student does not login on two accounts or cheat during the exam (Coursera, 2013b).

There are some solutions offered to professors already, one of which is proctored testing. However "…the correct implementation of online proctoring requires so many resources that it no longer makes it economically interesting to systematically use in free MOOCS…"(reference Prof. J.A. Villarroel, April 04, 2013). By now, signature track, photo ID, biometric profiles with keystroke pattern are other attempts to ensure a certain level of integrity are introduced in several courses, for example Clinical Problem Solving by Coursera (Coursera, 2013c).

The cheating control online is still seen as inferior to the traditional setting. However the American Council on Education "… is already evaluating MOOCs, and has approved five for its credit recommendations." (Masterson, 2013) taking into account especially the developments in assessment (Lederman, 2013). The University of Helsinki and some other colleges, mainly US based already give credits on regular basis for students in selected MOOCS using signature track (University of Helsinki, 2012). Signature track is a paid service, which costs the student from $69 at Coursera. Udacity offers for CS101 a proctored exam in a Pearson VUE testing center for students who want to obtain credits (Udacity, 2013). These security services offered by the platforms are to pay even at the platforms that provided entirely free access so far. (See Appendix B7) However, Coursera just recently introduced a financial aid program that will pay the fees for those students that need the certificate and cannot afford it. (Koller, 2013)

The traditional system has very regulated evaluation criteria professors are the ones awarding the final grade. The same applies for online degree programs. In both systems a higher student-to-professor ratio leads to increased automated evaluation. Open Courseware platforms mostly do not offer external evaluation, and if they do it is through multiple-choice questions with automated correction. Machine grading develops at a fast pace and the newest possibilities are implemented by MOOC platforms. The computer can grade multiple choice, shot answers, mathematical expressions; it recognizes semantic equivalence between formulas written differently. So different variations of formulas can be recognized. "Anything with a structured form, for example computer programs, computer models, financial systems or spreadsheets can be graded as long as the output has a pre-specified form.." (Koller, 2013, 21:38).

Massive Open Online courses use next to machine evaluation also peer evaluation, where five colleagues, after an introductory session how to grade and what to look for, grade another student's work (comparison of accuracy). That is essential for broadening the offer for disciplines as Humanities, less mathematic oriented studies. Some complications came up due

to the language diverse audience, where English natives should grade an artifact in Spanish for example (#EDCMOOC, 2012). Therefore either the group has to be large enough to comprise five students in each language or all the works have to be in the teaching language. In the starting phase of peer review there were some other problems as links that could not open and thus participants received 0 although the work was not negative (#EDCMOOC, 2012). Students then could alert teaching assistants to solve the issues. This points out that peer review is in its implementation phase, it cannot be seen as evaluation tool that does not require any professional help yet and its suitability has to be observed in multiple cases.

4.7.2 Retention rates:

The low retention rate of online education is one big debate around acceptance of this form of education (Chyung, 2001). OU UK for example reports a retention rate of about 20%.

The no show rate in MOOCS, meaning participants that did not even watch one video, is about 40-60%. The course Greek and Roman Methodology showed that 40% submitted a quiz, 10,1% submitted to peer assessment and 9.3% earned a certificate. While one can only earn a certificate when submitting more than one quiz it is suggested that the retention rate of those who actually participated in the course is much higher than 10%. *(*interview John McDermott, 09.04.2013) This goes in line with the argument of Coursera, indicating that of those students who sign up for signature track have a 70% passing rate (Kolowich, 2013). These findings suggest that a deeper evaluation is necessary to make any conclusions about the retention rate in MOOCs. Further "…arguments have been made that completion is not necessarily the most important relevant metric for success. Even for people that participate partially they find that it is a pretty valuable experience. *" (*interview John McDermott, 09.04.2013)

4.8 Comparison Framework

The graphic below outlines all the dimensions analyzed in this chapter. The main focus is on the traditional system and Massive Open Online Courses. The existing OCW offerings, represented through the dotted line is used to compare the improvements Massive Open Online Courses offer compared to their online equivalents

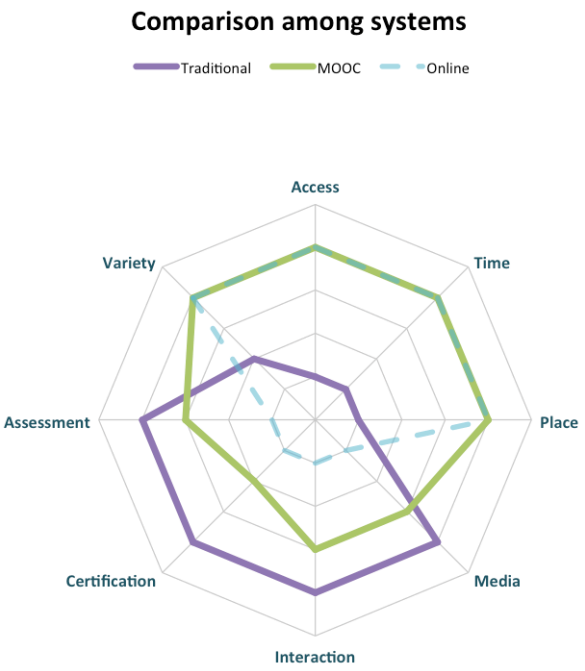

Figure 3: Comparison among education systems

While the traditional system is strong in Assessment, Certification, Interaction, and rich Media, online education so far was mainly concentrated on time and place flexibility as well as open access and material variety. Massive Open Online Courses take up the strength of online education so far and build on variety in media, improvements in assessment and partially in certification as well as strongly on broadening the interaction among all channels.

4.9 Limitations

The first limitation comes with the selection of cases, which is not a representative sample of the totality. When selecting the higher education institution three criteria applied. First to select those that are highly ranked in world university rankings, and then the universities most familiar to the author was chosen due to the knowledge about the institutions and their processes. Among the platforms only those with easy access to data or course material were selected to serve the purpose of the study. In order to minimize the limitation of the samples next to the most popular (those with the highest traffic rank) also very small and less popular platforms/institutions were selected. Additionally it was tried to achieve a mix of public and private initiatives among all categories.

A second limitation is the strong focus on UK and US based information, which does not only apply to the platforms chosen but also to the interviews conducted and statistics used. This limitation exists due to the availability of information in the Anglo-American as well as the huge interest in Massive Open online courses in these parts of the world. The exclusion of

any Asian institutions was due to the language barrier. However it was tried to get a sample of an Asian education institution with the Virtual University Pakistan and the interview conducted with Dr. Naveed A. Malik.
Last, since the research is based on ethnology, expert interviews and case observations the findings have to be further empirically tested, as soon as more statistic information about the MOOCs is available.

5 Applying reach and richness on education

This chapter aims to apply the concepts of reach and richness to the education industry to develop a framework of "education reach and richness" In order to do so the implications of the findings from chapter are analyzed among the dimensions reach and richness.

5.1 Reach

The dimension reach is characterized, as the theory suggested by the amount of people receiving knowledge. This means the number of students receiving education. In this case flexibility in time and place as well as broader variety in content and open access increase the number of participants.

5.1.1 Global Market

The comparison shows that Information Technology promises to lower cost per student, which will allow a greater number of students to participate in the educational process. Flexible time and place of education also contribute to the reach, since people who would not be able to participate in the educational process can do so now due to increased flexibility.

The flexibility in place erases the geographical boarders of the market. Students can take courses, not only browse material from all around the world, anytime, without prerequisites. The interviews conducted showed that the opinion regarding the necessity of being a global supplier of education is dispersed, while some argue that this will crucial in future (e.g. interview Stephen E. Carson, May, 20, 2013) others reason that local education would be preferred if it exists and that global offered courses could be monocultural (e.g. interview Sir John Daniel, Open University's Vice-Chancellor from 1990 to 2001, former President of the Commonwealth Of Learning, May, 20, 2013), influenced by he origin of the courses, now the majority being provided by American institutions. However if an institution is not planning on hosting online courses they share their potential customer base with the online offerings in

their category. “The marketplace for the best students is now global.” (Interview, Dr. Daniel E. Hastings, June 12, 2013)

The for-credit acceptance of some Massive Open Online Courses (see chapter 4.7.1) let one imagine a scenario where a college student can decide that he is satisfied with 80% of the classes but the 20% he does not like he will take at edX, for example and the university will transfer credits. (Reich, 2013).

5.1.2 Open Access

Another factor increasing the reach of education is the open access approach. Through online education some selection modalities get obsolete. As already mentioned selection due to limited space gets obsolete. Entry prerequisites such as previous experience seem less necessary due to the proposition that differences in ability and knowledge among a “class” of online learners do not hinder anybody in achieving the most possible for himself when appropriate structure is provided in the course.

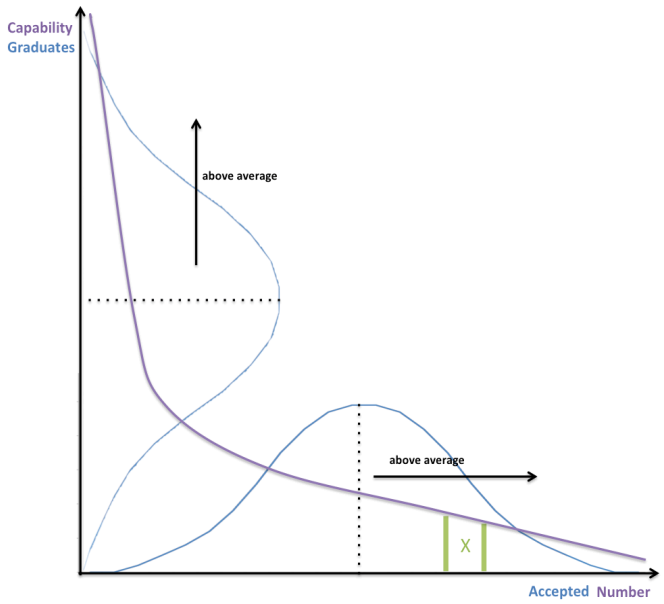

Figure 4: Selection Process Traditional System.
(Ref. Framework provided by Prof. J.A. Villarroel, June 6, 2013)

As explained in the previous chapter in order to be accepted at a university students need to meet various criteria. Prof. Villarroel suggested a framework depicting the “input” and “output” filters of education (see Figure 4). On the “input” side, traditional education selects incoming students who are “better on average” on all the fields as measured by standardized admissions or placement tests (e.g. SAT, ACT, etc.), described by the green “X” in Figure 4. Those who are especially capable in a specific field but perform poorly on a standardized test are thus left behind. On the “output” side, graduating students must “master on average” a broad variety of subjects. Massive Open Online Course platforms deliver single courses or even single lectures, where the student chooses his or her specific field of interest without prerequisites. This framework illustrates how open online courses bring education to a broad

range of learners with genuine talent in perhaps very specific areas, consistent with the concept of increasing hyperspecialization. An example would be the autistic student Daniel Bergman whose speaking vocabulary is very limited and who "…communicates by typing on a special designed Ipad…" He was a high performer in the Modern and contemporary American Poem class but due to his very specialized talent, and insufficiencies in other parts, as social ability, could never have attended Upenn due to the reasons explained above. (Koller, 2013, 12:00)

The same logic applies for the selection and acceptance of educators. They can concentrate on a very specialized field without having to teach a broad curriculum. It allows them to focus on their field of expertise. As online the competition is global such a specialization is necessary to develop a competitive advantage as mentioned above.

5.1.3 Collective contribution:

The case study comparison shows that there is a slight trend towards open contribution, letting everyone contribute to the process of education. P2PU is one example where everybody can design and teach a course. Further examples can be found in Appendix B4. The possibility for more students to contribute raises the possibility that there will be many more sources available on one topic compared to a situation where only professors select the content.As Hayek (1945) argued the collective knows more than the individual. Crowdsourcing initiatives such as the Netflix priZe show that when everybody is allowed to contribute, some inferior, a lot of average and some excellent contributions are to be expected (Villarroel et al 2012; Villarroel, 2012) when the size of the crowd is large enough.

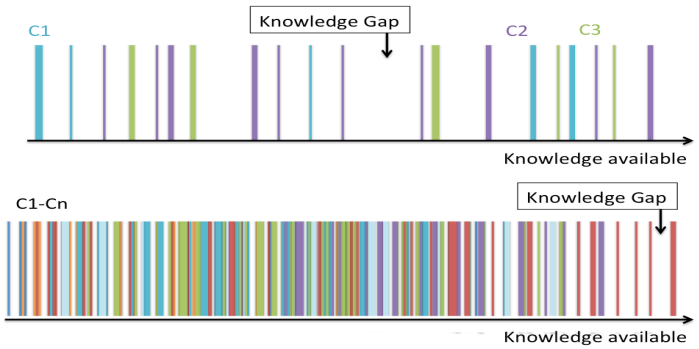

Figure 5: Knowledge Spectrum and Knowledge Gap.
(Ref. Framework provided by Prof. J.A. Villarroel, June 6, 2013)

An excellent example for the flood of knowledge available these days is that one company, in the majority of business sectors observed, stores more information than the UC Library of Congress, which is the largest research library in the world. (Manyka, 2011).

These days a massive flood of information is available on the web with just one click (Kop, 2011) ready to be transformed into knowledge.

In the education industry today there exists a gap between knowledge taught and knowledge available. The fact that more people can contribute, specialized, aims to close the knowledge gap of information available and knowledge transferred in universities. No university could offer the variety of knowledge 100 experts can provide. Prof. Villarroel suggested a "knowledge spectrum" framework for illustrating this phenomenon (see Figure 4), where the rectangular band represents the sum of all knowledge available and the vertical lines represent the specific knowledge delivered by education. In this particular depiction, the upper graph shows the current situation where a university's offering addresses only a small subset of the spectrum. The lower graph shows the knowledge covered by a higher number of sources. The knowledge gaps, outlined in white, decrease as the number of contributors increase. MOOCs students can choose from a broader spectrum and are not bound to the offerings at one specific university. Similarly, the framework suggests, specialized professors on MOOCs might have a broader audience in their specialty area.

Information Technology has the capacity to host all the hyper specialized information and to match hyper specialized students with professors however Massive Open Online courses are mostly still offering full courses at the moment. Provider are "randomly putting online courses", that have enough digital assets available (interview Stephen Carson, 20 May 2013) or select the courses of those professors that have already experience in online teaching (interview John McDermott, April 09, 2013). MOOCs detach the single courses from a fixed curriculum (see chapter 4.4). First attempts are made by specialized platforms (Appendix B4) as 10gen education, which only offers courses for Java Developers. However these attempts are far from offering hyperspecialized knowledge as Malone (2001) described it.

5.2 Richness

Richness in theory has various categorizations. In the context of education richness refers to the media richness, as well as the six categories of the information Richness Theory. The dimension Media, Assessment, Interaction, Variety, Access and Certification are used for analyzing richness.

5.2.1 Bandwidth

IT enables various solutions of screening vast databases. Machine reading, information retrieval, automatic summarization and more were developed to cope with an increasing number of data. In the field of health for example an observation of the changing count of Google searches for influenza helped to predict an epidemic flu faster than public health surveillance did (Evans, 2011). The search process can be done faster online, thus within the same amount of time more items or information can be screened with technological assistance than without. All the platforms examined offer search functions to screen the offerings according to special needs. While most platforms can be screened by school or field (edX, Udemy, Khan Academy, Coursera developed a more detailed search function by languages, time, signature track and categories (coursera.org). Since Massive Open Online Platforms are storing Demographics and a lot of user data (interview John McDermott, April 09, 2013) there is an opportunity to develop course recommendation systems as search engine do it. Khan Academy has developed this course suggestion system already, as explained in section 4.6.1. .As Dr. Hastings mentioned the storage capacity of the cloud is huge and affordable the database of knowledge stored online has the capacity to be nearly complete, referring to figure 5. Further with the enhanced search functions explained just now user can search more accurately and faster for their needs. The literature suggests that online the drawback of bounded rationality can be decreased (Altarawneh & Allahawiab, 2010). If this was applied on education it can be argued that a bigger amount of information can exchanged in the same time online than physical and that a better fit in education need and offering can be achieved through online education

5.2.2 Media

As explained in section 4.3 the quality in Media used by Massive Open online courses is far superior to online course so far. The implementation of videos adds a very rich media, according to the media richness Theory (Daft & Lengel 1986). Video as the most used delivery modus is the closest to face-to-face instruction, serving the learner with multiple cues (Daft & Lengel 1986). The various ways to use video for instruction explained in chapter 4.3, for example in the Sustainability class of Coursera enhances the learning experience and thus could enhance learning outcomes (Interview, Dr. Daniel E. Hastings, June 12, 2013). An AB test by Coursera showed that the group who had the video with just the slides was less satisfied and concentrated than the group where the video of the instructor was shown in the corner. (Koller, 2013). This outlines the importance of rich media for the learning experience. However synchronous media such as video conferencing are still limited, some courses use google live sessions (CS191x Quantum Mechanics and Quantum Computation, Appendix F)

to a certain number of participants, and face to face is not implemented in Massive Open Online courses, other than the regional meet ups, where people can schedule an physical meetings with people who do live close to their homes (Coursera, 2013a). Relating to the channel richness theory it can be concluded that the new generation of learners is savvier on a broad variety of media than the older generation. Young adults use information technology every day even without the educational context on social networks or online shopping and other. The earlier generation did not grow up with these new media and some may only use Facebook, Twitter and others for the educational purpose online.

5.2.3 Interaction

The new interaction Media enable students to use rich and lean media at their convenience and for example answer with text to a video post in Facebook groups. The large group of participants and especially the geographically diverse group enable fast feedback, which also is argued to increase the richness of the learning and communication experience as well as interaction among more people. At Coursera the feedback time is on average 20 minutes, disregarding of the daytime (Koller, 2012), which cannot always be achieved in traditional education. As already explained in the section Interaction more communication possibilities, e-mail, chat, forums, twitter, social media networks and others, exist and can be used according to their best fit. These communication media were not provided in this extend by online offerings developed previous to MOOCs. (Appendix B9)

In the traditional system apart from education also campus life, sports facilities and several clubs are available for students to enrich their education experience. This opens other forms of interaction which online education will never provide. .(interview Stephen Carson, 20 May 2013) Online there exist interest groups and virtual clubs and due to the number of participants one is more likely to find users with the same interest (Koller, 2012). However the full integrated program of living and studying on campus is not provided online.

5.2.4 Customized experience

The section customization describes to what extend the educational experience can be tailered to an individual student, referring to the customization of information in the information richness Theory (Evans & Wurster 2000) One advantage of MOCOs compared to traditional education is that individualize learning experience is enabled. (Interview, Dr. Daniel E. Hastings, June 12, 2013). Examples for a rich customized experience were outlined in chapter 4.6.1 on the example of Khan Academy and the knowledge map (Appendix D). The student can choose which media he wants to study with, for example text or videos as multiple

sources exist in Massive Open Online Courses, since in most course observed the course was designed so that not all of the materials have to had been covered. (see chapter 4.4) Further the possibility to stop a video anywhere and repeat some parts while skipping others, which is even facilitated by short videos instead of hours of lectures (Koller, 2012), supports a customized learning experience..

5.2.5 Reliability

Reliability refers to how reliable the circulating information is. Within MOOCs this addresses two aspects. First the lack of learner instructor communication. It is argued that wile now also experts on the field of the courses are attending MOOCs just out of curiosity difficult questions can be addressed and solved within a forum between students. However when only learners are left without experts there might be a need for a professional to answer complicated questions. (Interview Dr. Naveed A. Malik, May 17, 2013) Applying the argument with the Netflix prize in chapter 5.1.3 it can be assumed that if the crowd is large enough the crowd could answer even difficult questions. Thus this has to be observed.

Further assessment methods that prevent cheating and plagiarism are not fully developed yet. In the first attempts of using peer assessment many users ended up with 0 points (fail) since their peers could not open the documents, or the upload failed or any other not evaluated reasons. Then the student has the possibility to contact the instructors and in some cases the issue got resolved. (#EDCMOOC, 2012). The plagiarism control methods described in the chapter Assessment are a first attempt to an regulated assessment but still keystroke patterns or web cam proctoring for example cannot guarantee that there is not a second screen next to you providing the answers. The more “accurate” evaluation tools such as proctored testing are very expensive to implement and thus not in the economic interest of Massive Open Online courses. In respect to assessment there is huge development potential for MOOCS (ref. Prof. J.A. Villarroel, April 4, 2013). However it has to be mentioned that the for credit acceptance of some online courses shows a leap in perceived reliability compared to other open online education offerings.

5.2.6 Security

Security is referred to exchange of information in a closed environment. Massive Open Online Courses offer materials, often free to download but at least free to access for everyone. The open online offerings apply little IP protection and as the group accessing the material often can be anonymous, security of the exchanged information is not guaranteed.

Further open sharing is also necessary in terms of Partnerships. With the integration of IT in education knowledge in technology, pedagogy and on the subject is required. Very few are proficient in all of them. Most institutions will need the help to implement crucial factors either from educational or technological perspective. Cyber intermediaries, especially those who are capable of providing and guiding through the use of new technology are high on demand. Hyperspecialization and the need for Partnerships mentioned earlier require a loser IP regime. Just recent Coursera announced a partnership with 10 state university systems where students can take single courses online (Coursera, 2013). Udacity partnered with Georgia Tech to provide an entire Master's degree (Rivard, 2013).

6 Conclusion

6.1 Reach and Richness Trade off

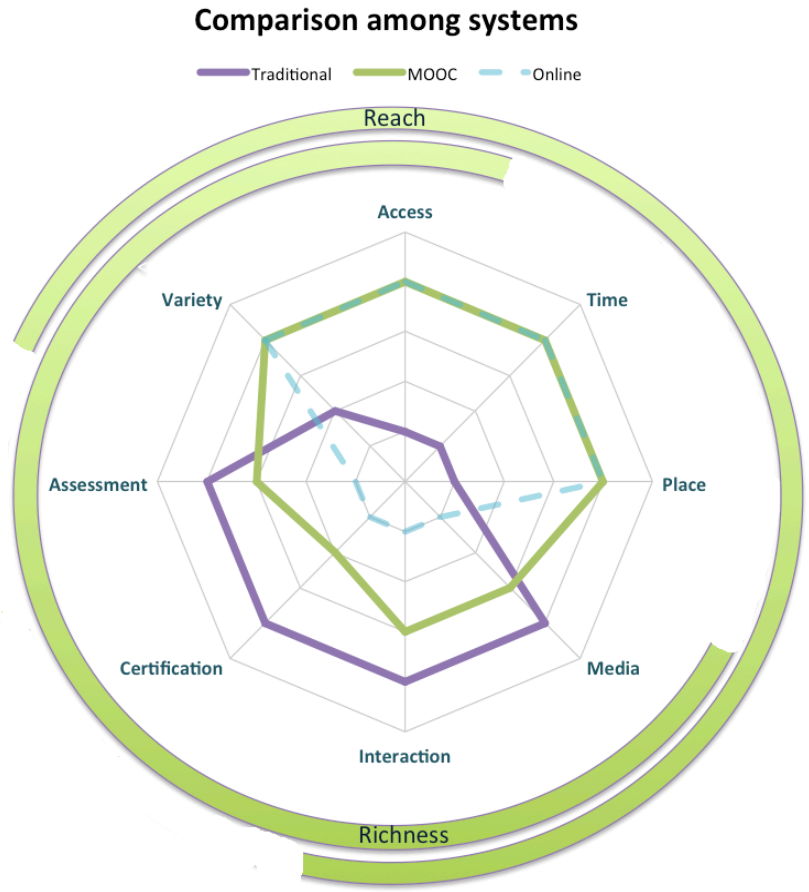

Figure 6: Reach and Richness of Education

As shown in the literature (Evans & Wurster, 2000), traditionally there is a tradeoff between reach and richness of information. This can be applied to education whereas one can either educate a lot of students or provide some with a very rich experience. Online education

removes this tradeoff partially, where increased reach in some point does not affect richness. Online education can due to open access approaches, flexibility in time and place, the variety of courses offered attract a huge audience. However the richness of previous online offerings was rather low. As explained the Media used were lean, modest quality and interaction was often not possible. Massive Open Online Courses manage to offer broader reach and increased richness at the same time. Richness is increased by providing a more complete education experience online, including assessment, certificates and feedback processes. Further rich communication and presentation media is used, which can be used from a very large group of students. Still face-to-face interaction is only possible through meetups, assessment methods are not fully developed. Comparing to the traditional system the reach of MOOCs is multiple and the richness comes close to traditional experiences. For the tradeoff this means that it still exists, however reach and richness are now met at a higher level. The graphic shows the dimensions referring to reach and richness. It is observed that some dimensions positively inform reach and richness in massive open online courses. For example since knowledge is acquired by exchange with colleagues not only by reading materials open access, which increases the number and diversity of participants positively influences the interaction as well as fast feedback, required for a rich experience.

It can be concluded that open online education as practiced in MOOCs has the potential to replace average experiences of traditional education due to the increase in possible richness. It is to observe if this form of education will sustain on its own, parallel to traditional offerings or if a new integrated model emerges.

6.2 Theoretical implications

This thesis has examined the differentiation factors of the new forms of online education and then applied the characteristics to the theory of Reach and richness. The final concept of education Reach and Richness contributes to the literature and the propositions underlying the concept can be a starting point for further empirical studies.

6.3 Managerial Implications

As the concept of Massive Open Online courses is very recent it is important for players in the industry to understand the impact of this innovation on the industry. This thesis shows all players in the industry that MOOCs have an enormous potential either to evolve on their own or to be implemented in existing offerings. Understanding the differences to previous online offerings and especially the reasons for these differences helps to understand what the possible improvements in an organization are to be on top of most dimensions examined.

6.4 Future Research

As this paper aimed to build theory, the assumptions made are respect to further empirical testing. The developed theory of education reach and richness and the underlying propositions could be statistically examined by surveying a representative set of education suppliers among all systems. It is further suggested to test the reasons for motivation, retention and participation as well as researching the factors most important for student performance in the new online environment. Referring to the huge data sets collected at the moment, testing could contribute to the explanation of the success of Massive Open Online courses as well as to address problems such as retention or decreasing motivation throughout the course, as suggested by massive drop-out rates (see 4.7.2), which were not mainly addressed in this thesis. When these models develop and first revenue models are established an analysis in respect to the business model and sustainability of Massive Open Online courses can be made. As the new online course delivery phenomena is fairly new a huge potential in further research is given.

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Appendix

Appendix A

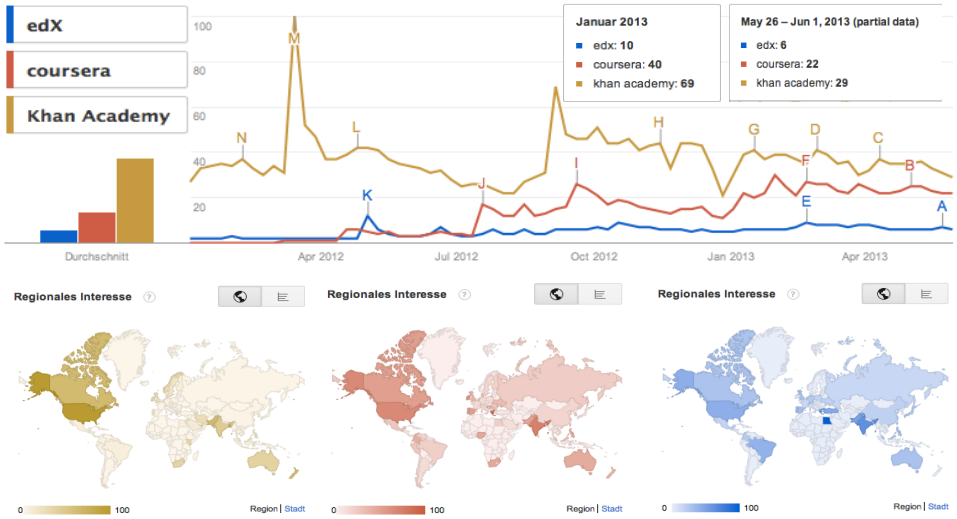


Figure 7: Google Trends: Khan Academy, Coursera, edX

Appendix B

Data of case study comparison

Appendix B.1

	GENERAL INFORMATION 1					
	URL	Year	Employees	Faculty	Partner	Campus
10gen Education	education.10gen.com	2012			0	0
Católica Lisbon School of Business and Economics (CLSBE)	clsbe.lisboa.ucp.pt	1967		85	>100	1
Connexions project by Rice University	cnx.org	1999				0
Coursera	coursera.org	2012	35		70	0
edX	edx.org	2012	40		15	0
ETH Zurich	ethz.ch	1854	10,040	428		1
Harvard	harvard.edu	1636	4,001	2063		1
Harvard's Open Collections Program (Harvard OCP)	ocp.hul.harvard.edu	2002			>1	0
Imperial College London	www3.imperial.ac.uk	1907	1,200		12	1
IREL-Open (Irish Universities)	irel-open.ie	2007	54	409	10	0
Johns Hopkins Bloomberg School of Public Health's (JHSPH OCW) OpenCourseWare	ocw.jhsph.edu	2005				0
Khan Academy	khanacademy.org	2006	36		>50	0
Massachusetts Institute for Technology (MIT)	mit.edu	1873	5197	978		1
Massachusetts Institute for Technology Open Courseware Platform (MIT OCW)	ocw.mit.edu	2001			>1	0
Multimedia Educational Resources for Learning and Online Teaching (MERLOT) ,California State Uni	merlot.org	1997			20	0
Open Education Resources Commons (OER Commons)	oercommons.org	2007			400	0
Open University UK (OU UK)	open.ac.uk	1969	4600	1,100	30	1
Open Yale Courses (OYC)	oyc.yale.edu	2007			1	0
OpenCourseWare Consortium (OCW Consortium)	ocwconsortium.org	2001	61		266	0
OpenLearn (Open Unviersity UK)	open.edu/openlearn	2006			>1	0
P2PU	https://p2pu.org	2009				0
ParisTech Pen Open Courseware (Paris Tech OCW) (ParisTech engineering)institutions	graduateschool.paristech.org	2006			11	0
Sharing of Free Intellectual Assets (SOFIA)	sofia.fhda.edu	2004			>2	0
Spanishmooc.com	http://spanishmooc.com	2012			0	0
Stanford	stanford.edu	1891	3,249	1995		1
Udacity	udacity.com	2012	30		>3	0
Udemy	udenmy.com	2010	50		<1	0
University of Notre Dame OCW	ocw.nd.edu	2006			1	0
Vienna University for Business and Economics (WU Vienna)	wu.ac.at	1898	996	562	220	1
Virtual University (VU) Pakistan	vu.edu.pk	2002	1000+	259	100	1
Wharton Business School	wharton.upenn.edu	1881	-	255	>175	1

Table 9: General Information 1

Appendix B.2

	GENERAL 2INFORMATION 2							
	Countries	Traffic Rank	Reach %	Page views %	Page views/ User	Time on Site (min)	Bounce	User
10gen Education		28,357	0.0049	0.00025	5	6:33	0.43	
CLSBE	40	135146	0.0011	0.00003	2.7	3:07	0.55	<1,000
Connexions	157	43234	0.0044	0.00008	1.89	2:14	0.74	12500
Coursera	196	2320	0.0502	0.00376	7.67	10:38	-	30000
edX	160	7926	0.0170	0.00091	5.84	7:13	0.30	70000
ETH Zurich	80	10670	0.0143	0.00046	3.2	2:53	0.60	15,000
Harvard	140	5694388	0.0000	0.00000	5	3:29	-	27,392
Harvard OCP	140	5694388	0.0000	0.00000	5	3:29	-	
Imperial College	126	24403	0.0060	0.00024	4.01	5:12	0.42	13000
IREL-Open	<1	70037	0.0023	0.00007	2.95	-	0.59	8500
JHSPH OCW	84	4665	0.0280	0.00142	5.21	3:38	0.35	
Khan Academy		4951	0.0006	0.00002	2.6	6:52	0.62	10000
MERLOT	190	1393	0.0931	0.00329	3.54	2:03	0.53	900,00
MIT	118	1409	0.0003	0.00001	3.1	3:49	0.41	10,000
MIT OCW	215	1409	0.0003	0.00001	3.1	3:49	0.41	10000
OER Commons	211	245097	0.0423	0.00002	3.5	2:25	0.51	350,00
OYC	80	370451	0.0003	0.00001	3.2	2:22	0.47	
OCW Consortium	191	4894	0.0268	0.00095	3.63	3:17	0.52	
OpenLearn	220	53626	0.0027	0.00010	3.48	4:26	0.42	10000
OU UK	23	53626	0.0027	0.00010	3.48	4:26	0.42	24000
P2PU	100	158521	0.0149	0.00113	7.76	2:29	0.26	30000
ParisTech OCW	<1	9170541	0.0000	0.00000	2	0:45		
SOFIA		86460	0.0013	0.00010	6.8	5:31	0.16	14,000
Spanishmooc.co		3,226,011	0.0000	0.00000	1.1	4:10	0.35	
Stanford	80	1436	0.0943	0.00284	3	3:21	0.56	19,945
Udacity	203	9320	0.0131	0.00114	8.9	10:06	0.36	40000
Udemy	200	7387	0.0222	0.00095	4.4	6:46	0.43	60000
University of	211	18343	0.0088	0.00027	3.17	3:13	0.54	300,00
VU Pakistan	2	17338	0.0081	0.00039	4.74	5:53	0.25	10000
Wharton	98	4063	0.0352	0.00102	2.84	2:51	0.58	4835
WU Vienna	20	41926	0.0030	0.00022	7.4	6:18	0.29	25705

Table 10: General Information 2

Appendix B.3

	Time flexible start & end	fixed start and end	flexible start fixed end	Few times	always
10gen Education	0	0	1	0	1
CLSBE	0	1	0	1	0
Connexions project	1	0	0	0	1
Coursera	0	0	1	0	1
edX	0	0	1	0	1
ETH Zurich	0	1	0	1	0
Harvard	0	1	0	1	0
Harvard OCP	1	0	0	0	1
Imperial College London	0	1	0	1	0
IREL-Open	1	0	0	0	1
JHSPH OCW	1	0	0	0	1
Khan Academy	1	0	0	0	1
MERLOT	1	0	0	0	1
MIT	0	1	0	1	0
MIT OCW	1	0	0	0	1
OER Commons	1	0	0	0	1
OYC	1	0	0	0	1
OCW Consortium	1	0	0	0	1
OpenLearn	1	0	0	0	1
OU UK	0	1	0	0	1
P2PU	1	0	0	0	1
ParisTech OCW	1	0	0	0	1
SOFIA	1	0	0	0	1
Spanishmooc.com	0	0	1	1	1
Stanford	0	1	0	1	0
Udacity	0	0	1	0	1
Udemy	1	0	0	0	1
University of Notre Dame	1	0	0	0	1
VU Pakistan	0	1	0	0	1
Wharton Business School	0	1	0	1	0
WU Vienna	0	1	0	1	0

Table 11: Time

:

Appendix B.4

	Variety courses/ materials	variety	level	Gatekeeper anybody can submit material
10gen Education	3	Specialized	Several	0
CLSBE	85	Specialized	University	0
Connexions project	2300	Broad	university	1
Coursera	327	Broad	Several	0
edX	32	Broad	University	0
ETH Zurich		Specialized	University	0
Harvard	8000	Broad	University	0
Harvard OCP	800	Broad	University	0
Imperial College London	242	Broad	University	0
IREL-Open	5	Broad	University	0
JHSPH OCW	113	Specialized	University	0
Khan Academy	4000	Broad	Several	1
MERLOT	40415	Broad	University	1
MIT	4717	Specialized	University	0
MIT OCW	2150	Specialized	University	0
OER Commons	53891	Broad	University	1
OYC	42	Broad	University	0
OCW Consortium	18000	Broad	University	0
OpenLearn	650	Broad	University	0
OU UK	679	Broad	University	0
P2PU	141	Broad	Several	1
ParisTech OCW	557	Specialized	University	0
SOFIA	8	Broad	Several	0
Spanishmooc.com	2	Specialized	Several	0
Stanford	3351	Broad	University	0
Udacity	25	Broad	Several	0
Udemy	6000	Broad	Several	1
University of Notre Dame	50	Broad	Several	0
VU Pakistan	180	Specialized	University	0
Wharton Business School	230+	Specialized	University	0
WU Vienna		Specialized	University	0

Table 12: Variety

Appendix B.5

	Media 1 non digital	CD	broadcast TV	Internet
10gen Education	0	0	0	2
CLSBE	2	1	0	1
Connexions project	0	0	0	2
Coursera	0	0	0	2
edX	0	0	0	2
ETH Zurich	2	1	0	1
Harvard	2	1	0	1
Harvard OCP	0	0	0	2
Imperial College London	2	1	0	1
IREL-Open	0	0	0	2
JHSPH OCW	0	0	0	2
Khan Academy	0	0	0	2
MERLOT	0	0	0	2
MIT	2	1	0	1
MIT OCW	0	0	0	2
OER Commons	0	0	0	2
OYC	0	0	0	2
OCW Consortium	0	0	0	2
OpenLearn	0	0	0	2
OU UK	2	2	1	2
P2PU	0	0	0	2
ParisTech OCW	0	0	0	2
SOFIA	0	0	0	2
Spanishmooc.com	0	0	0	2
Stanford	2	1	0	1
Udacity	0	0	0	2
Udemy	0	0	0	2
University of Notre Dame	0	0	0	2
VU Pakistan	2	2	2	1
Wharton Business School	2	1	0	1
WU Vienna	2	1	0	1

Table 13: Media 1

Appendix B.6

	Media 2 text	audio	videos	face-to face
10gen Education	1	0	2	0
CLSBE	2	1	0	2
Connexions project	2	0	0	0
Coursera	2	2	2	0
edX	2	2	2	0
ETH Zurich	2	1	1	2
Harvard	2	1	1	2
Harvard OCP	2	1	1	0
Imperial College London	2	1	1	2
IREL-Open	2	0	0	0
JHSPH OCW	2	1	0	0
Khan Academy	2	2	2	0
MERLOT	2	1	1	0
MIT	2	1	1	2
MIT OCW	2	1	1	0
OER Commons	2	2		0
OYC	2	0	1	0
OCW Consortium	1	1	1	0
OpenLearn	2	0	2	0
OU UK	2	1	1	1
P2PU	2	0	2	0
ParisTech OCW	2	0	0	0
SOFIA	2	1	1	0
Spanishmooc.com	2	0	2	0
Stanford	2	1	1	2
Udacity	2	0	2	0
Udemy	1	0	2	0
University of Notre Dame	2	0	1	0
VU Pakistan	2	2	2	0
Wharton Business School	2	1	1	2
WU Vienna	2	1	1	2

Table 14: Media 2

Appendix B.7

	ACCESS Registra-tion	Select-ion	Accep-tance	Reten-tion	Cost	Certifica-tion	Tuition $	Financial aid
10gen Education	1	0	1.00		0	0	0	
CLSBE	1	1	-	>0,9	1	0	>10000	
Connexions project	1	0	1.00	-	0	0	0	
Coursera	1	0	1.00	<0.1	0	$69	0	
edX	1	0	1.00	<0.1	0	0	0	
ETH Zurich	1	1	-	<0,5	1	0	>10000	
Harvard	1	1	0.06	0.97	1	0	<20000	
Harvard OCP	0	0	1.00	-	0	0	0	
Imperial College	1	1	-		1	0	>20000	
IREL-Open	1	0	1.00	-	0	0	0	
JHSPH OCW	0	0	1.00	-	0	0	0	
Khan Academy	1	0	1.00		0	0	0	
MERLOT	1	0	1.00	-	0	0	0	
MIT	1	1	0.10	0.98	1	0	<20000	0.9
MIT OCW	0	0	1.00	-	0	0	0	
OER Commons	0	0	1.00	-	0	0	0	
OYC	0	0	1.00	-	0	0	0	
OCW Consortium	0	0	1.00	-	0	0	0	
OpenLearn	1	0	1.00	-	1	0	0	
OU UK	1	1	-	0.2	1	0	<20000	
P2PU	1	0	1.00		0		0	
ParisTech OCW	1	0	1.00	-	0	0	0	
SOFIA	0	0	1.00	-	0	0	0	
Spanishmooc.com	1	1	1.00		1	0		
Stanford	1	1	0.07	0.98	1	0	<20000	0.7
Udacity	1	0	1.00		0	$150	0	
Udemy	1	0	1.00		1	0	$90 p.	
University of Notre	0	0	1.00	-	0	0	0	
VU Pakistan	1	1	-		1	0	60	
Wharton Business	1	1	0.09	>0.9	1	0	>20000	
WU Vienna	1	1	1.00	<0.5	0	0	0	

Table 15: Access

Appendix B.8

	Interaction student-content	student- teacher	student- student
10gen Education	1	0	1
CLSBE	1	1	1
Connexions project	1	0	0
Coursera	1	0	1
edX	1	0	1
ETH Zurich	1	1	1
Harvard	1	1	1
Harvard OCP	1	0	0
Imperial College London	1	1	1
IREL-Open	1	0	0
JHSPH OCW	1	0	0
Khan Academy	1	0	1
MERLOT	1	0	0
MIT	1	1	1
MIT OCW	1	0	1
OER Commons	1	0	0
OYC	1	0	0
OCW Consortium	1	0	0
OpenLearn	1	0	1
OU UK	1	1	1
P2PU	1	0	1
ParisTech OCW	1	0	0
SOFIA	1	0	0
Spanishmooc.com	1	1	1
Stanford	1	1	1
Udacity	1	0	1
Udemy	1	0	1
University of Notre Dame	1	0	0
VU Pakistan	1	1	1
Wharton Business School	1	1	1
WU Vienna	1	1	1

Table 16: Interaction

Appendix B.9

	Interaction online									
	forum	Moodle	e-mail	FB	blog	wiki	Hang-out	twitter	Feedback form	meet up
10gen Education	1	0	0	0	0	1	0	0	1	0
Connexions	0	0	0	0	0	0	0	0	1	0
Coursera	1	1	1	1	1	1	1	1	1	1
edX	1	1	1	1	1	1	1	1	1	1
Harvard's Open	1	0	0	0	0	0	0	0	1	0
IREL-Open	0	0	1	0	0	0	0	0	0	0
JHSPH OCW	0	0	0	0	0	0	0	0	1	0
Khan Academy	1	1	1	1	1	1	1	1	1	1
MERLOT	1	0	0	0	0	0	0	0	1	0
MIT OCW	1	0	0	0	0	0	0	0	1	0
OER Commons	0	0	1	0	0	0	0	0	0	0
Open Yale	0	0	0	0	0	0	0	0	0	0
OpenCourseWar	0	0	0	1	0	0	0	1	1	0
OpenLearn	1	0	0	0	0		1	0	1	0
P2PU	1	0	0	0	0	0	0	0	1	0
ParisTech OCW	0	0	0	0	0	0	0	0	1	0
SOFIA	0	0	1	0	0	0	0	0	0	0
Spanishmooc.co	1	0	0	1	1	0	0	0	1	0
Udacity	1	1	1	1	1	1	0	1		1
Udemy	1	0	0	0	0	0	0	0	1	0
University of	0	0	0	0	0	0	0	0	1	0
VU Pakistan	1	1	1	0	0	0	0	0	1	1

Table 17: Interaction online

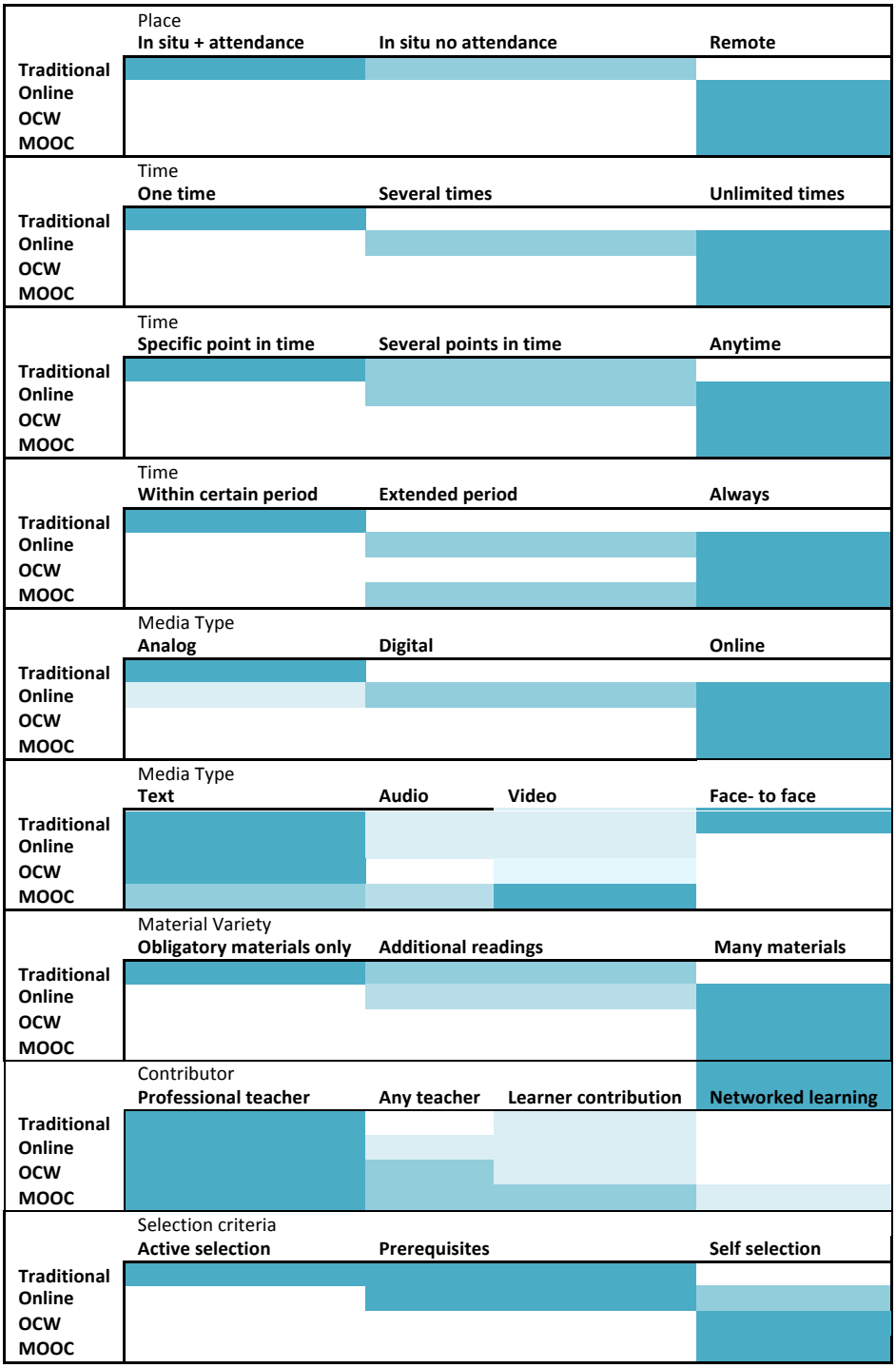
Appendix B.10

	Evaluation Instructor	peer	machine	Credit possible
10gen Education	0	0	1	0
CLSBE	1	0	0	1
Connexions project	0	0	0	0
Coursera	0	1	1	1
edX	0	1	1	0
ETH Zurich	1	0	1	1
Harvard	1	0	1	1
Harvard OCP	0	0	0	0
Imperial College London	1	0	1	1
IREL-Open	0	0	0	0
JHSPH OCW	0	0	0	0
Khan Academy	0	1	1	0
MERLOT	0	0	0	0
MIT	1	0	1	1
MIT OCW	0	0	1	0
OER Commons	0	0	0	0
OYC	0	0	0	0
OCW Consortium	0	0	0	0
OpenLearn	0	0	1	0
OU UK	1	0	1	1
P2PU	0	0	1	0
ParisTech OCW	0	0	0	0
SOFIA	0	0	0	0
Spanishmooc.com	1	0	1	0
Stanford	1	0	1	1
Udacity	1	1	1	1
Udemy	1	1	1	0
University of Notre Dame	0	0	0	0
VU Pakistan	1	0	1	1
Wharton Business School	1	0	1	1
WU Vienna	1	0	1	1

Table 18: Evaluation

Appendix C

Classification of "Traditional", "Online", "OCW" and "MOOC" among dimensions. Shading from dark = very much to light = not alt all



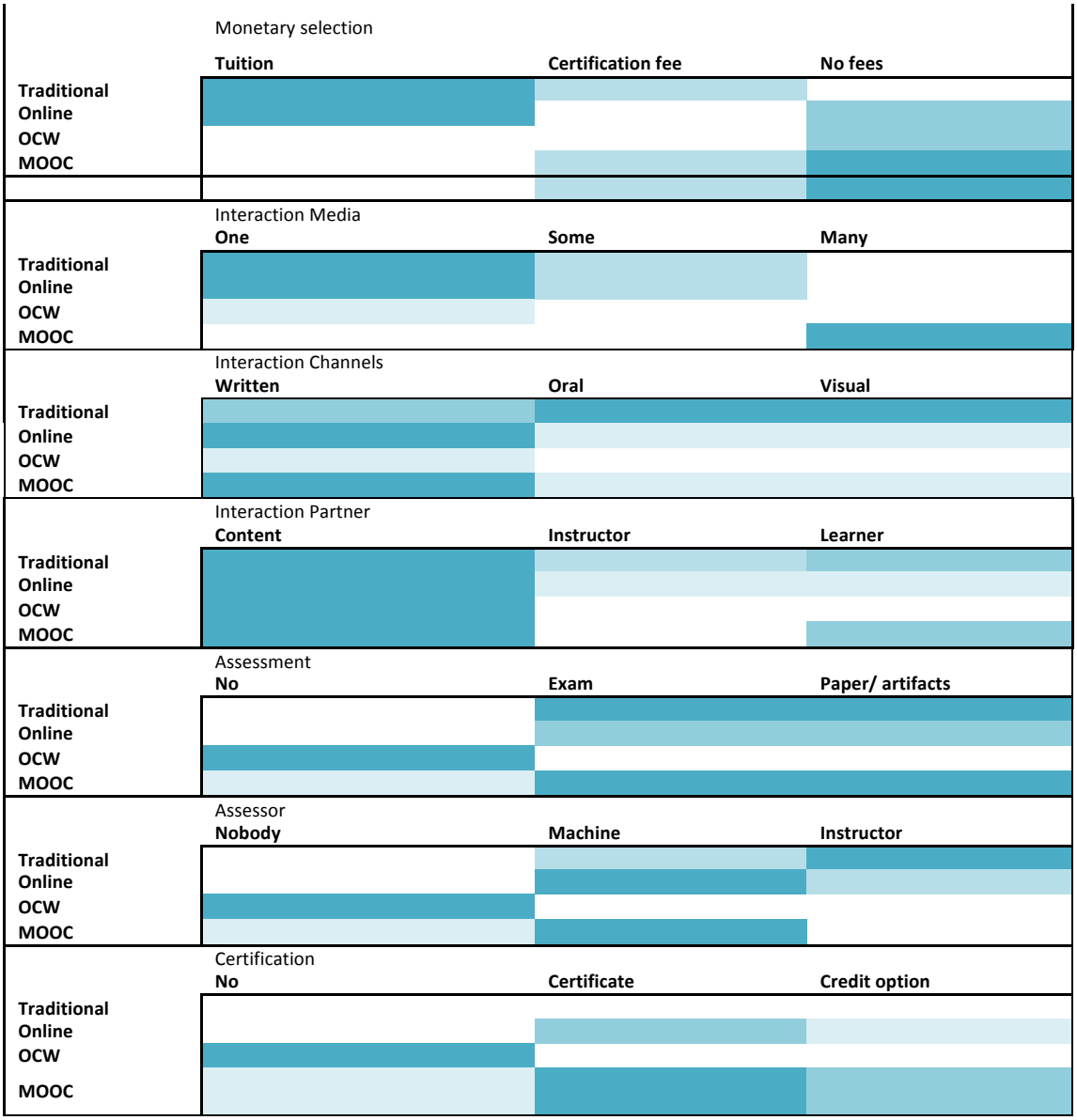


Table 19: Color-coded comparative Table

Appendix D

Ref. The knowledge Map, Khan Academy

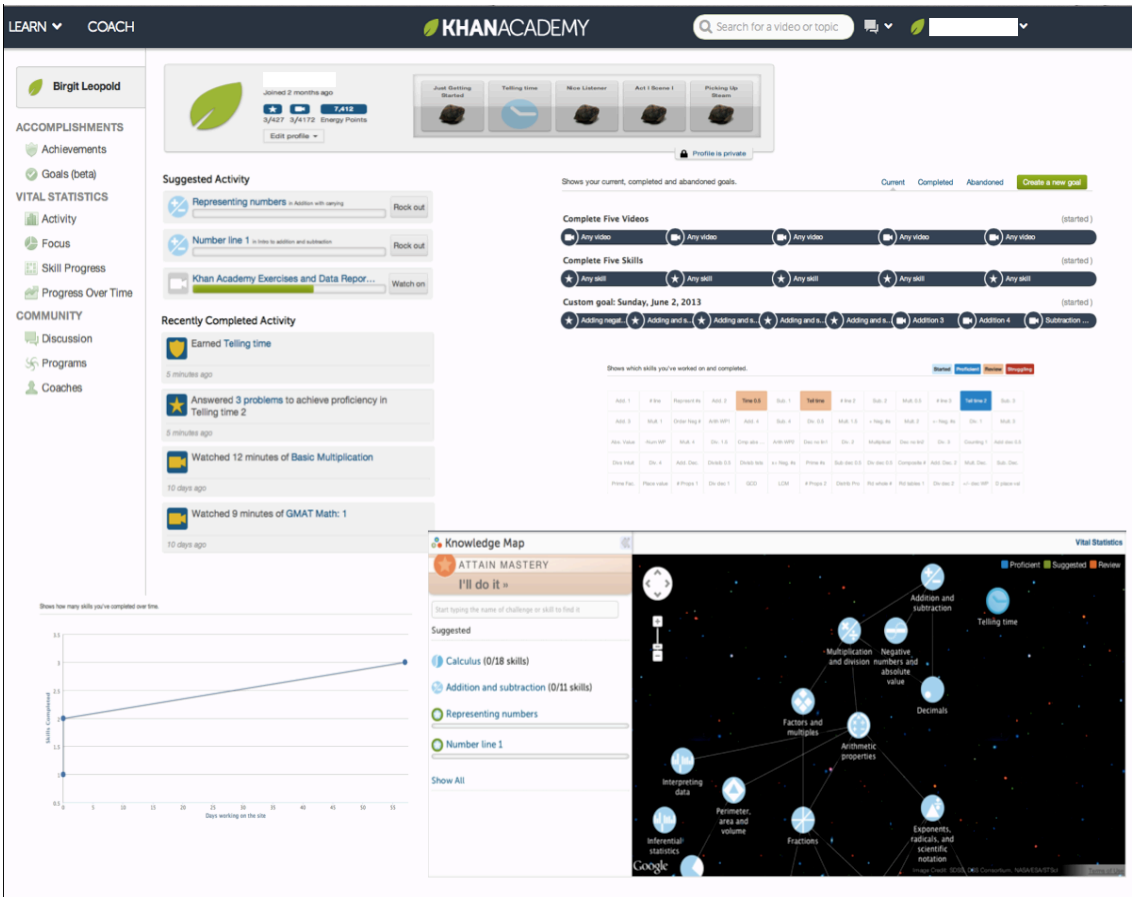
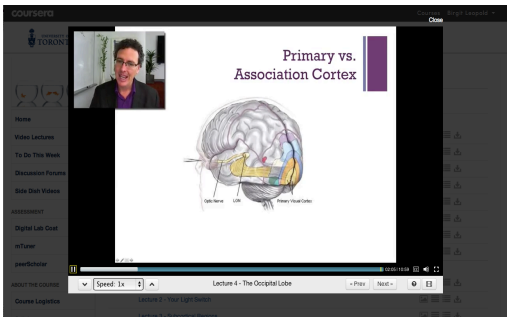


Figure 8: Features of the knowledge Map

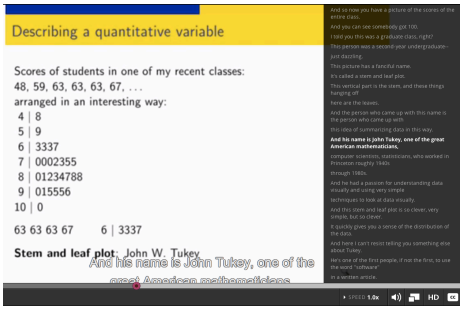
Appendix E

Energy Decisions, Markets and Policies MIT OCW

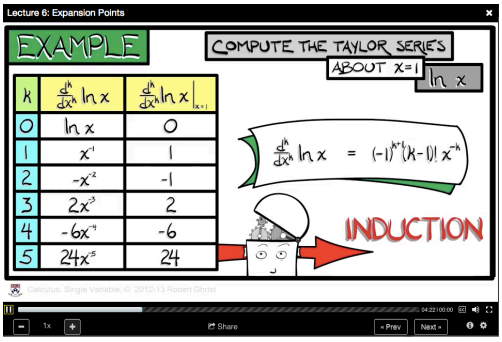
Desarrollo rápido de productos innovadores para mercados emergentes- Coursera



Introduction to Psychology- Coursera



Stat2.1x Introduction to Statistics: Descriptive Statistics, edX



Calculus: Single Variable -Coursera

Appendix F

Course List of classes observed

Course name	University	platform	Key findings
CS191x Quantum Mechanics and Quantum Computation	University of California, Berkeley	edX	Coursenotes and slides, few video, Live discussion session Personal video message from instructor, weekly wall posts, homework, midterms, exam 20k enrollments 80% passed

CS169.1x Software as a Service	University of California, Berkeley	edX	Textbook, slide lecture, tutorials, homework, quiz, discussion forum, wiki
6.002x Circuits and Electronics	Massachusetts Institute of Technology	edX	Collaboration Guidelines, Interactive Laboratory, Video Competition for students "In order to accommodate the Muslim holiday of Eid al-Adha, we have extended the deadline to submit the midterm exam to 23:59 (11:59 pm) on Sunday, October 28th, Boston time."
Stat2.1x Introduction to Statistics: Descriptive Statistics	University of California, Berkeley	edX	Video lecture, exercise set,
Introduction to Psychology	University of Toronto	Coursera	Video lectures, side dish videos, very informal language, mTuner midterm (reciprocal learning), wiki, meetup, text running next to video lecutre
CS188.1x Artificial Intelligence	University of California, Berkeley	edX	Mini-Contest, homework, project, wall posts, text running next to video lecture, "The forums will be frozen during the Final Exam window" If a potentially critical issue comes up about the Final Exam, you can contact us at cs188x-final@lists.berkeley.edu
Global Sustainable Energy: Past, Present and Future			Video Lectures, readings, peer assessments, quizzes, shoots outside, in buildings "Unfortunately, Coursera does not have automatic releases on the Module pages so I must release them manually. Again, I apologize profusely."
Calculus: Single Variable	University of Pennsylvania	Coursera	Animated video lectures,

Appendix G

Key findings from interviews

John McDermott	Director for Instructional Technology at University of Pennsylvania
Purpose: Information about MOOCs run by University of Pennsylvania	
Dr. Naveed A. Malik	• Founding Rector of the Virtual University of Pakistan, currently adviser • Life member of the Pakistan Institute of Physics • Pakistan Project Manager for MIT BLOSSOMS.
Purpose: Information about procedures in VU Pakistan, information about personal MOOC experience	
Stephen Carson, MFA	External Relations Director at MIT OpenCourseWare
Purpose: information about MIT and online education – MOOC/OCW, personal experience with online teaching	
Dr. Daniel E Hastings	• Dean for Undergraduate Education and the Cecil and Ida Green Education Professor of Aeronautics and Astronautics and Engineering Systems at MIT.
Purpose: understand MIT perspective of online education:	
Prof. Juan Andrei Villarroel Fernandez, PhD	Professor at Unviersidade Católica Portuguesa, thesis Advisor
Purpose: insights from personal experiences with MOOCs	