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Blended learning in practice: an overview on recent developments

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Abstract

The digitalization of education is a challenge for institutions involved in teaching and professional training. This paper summarizes recent developments and trends in this field. It deals with the ongoing evolvement of massive online courses (MOOCs) and the employment of mobile devices for learning and teaching purposes (m-learning). Furthermore, it describes well-established and new components of blended learning models applied in education and further education.

Key words

MOOCs, mobile learning, m-learning, blended learning models, platform-independence, interactive learning objects, user-controlled visualization, open educational resources, statistics education.

Introduction

The progress in information technology shaped the way that is used today to teach and to learn. During the past half-decade, the arrangements for face-to-face and in particular for distance teaching changed considerably and still evolve. The changes are due to the emergence of new technical platforms and communication channels and new options for transmitting information.

This paper aims at providing an overview on recent developments with great impact on the practice of education and further education. It starts with describing the main types of massive online courses (MOOCs), their key features and limitations, and trends in designing MOOCs. The ensuing part is dedicated to the employment of mobile devices for learning and teaching purposes (m-learning). It outlines the state of m-learning and potentials for improvement.

The third part of this paper outlines the main pillars of blended learning models currently applied in education and vocational training. For illustration purposes, blended learning models applied at two German universities specialized in distance teaching are presented in brief. The final part refers to components of blended learning models that are either missing or not fully exploited. The case of statistics education is chosen for demonstrating that platform-independent and granular learning objects stressing interactive visualization have the potential of complementing existing learning and teaching scenarios.

MOOCs – a new pillar enriching the educational landscape

One important development and challenge in education is related to the upsurge of *MOOCs* (*m*assive *o*pen *o*nline *c*ourses) since approximately 2010. It is worth to have a closer look on the different types of MOOCs and on the impact of the appearance of MOOCs on higher education, lifelong learning and marketing strategies for educational institutions. Stephen Downes, one of the co-founders of MOOCs, introduced the terms *xMOOCs* and *cMOOCs* for the two main variants. In brief, xMOOCs [1] are focusing on the transmission of content whereas cMOOCs [2] are putting main emphasis on networking.

Nowadays, traditional face-to-face lecturing is complemented by streamed online versions offered to everyone through well-known online platforms such as *Coursera*, *EdX*, *Udacity* or *iversity*. These courses belong to the dominating category of xMOOCs. xMOOCs vary much as regards quality and underlying business models. The courses are rather inexpensive in production and usually offered for free, at least in a basic version, but services such as individual tutoring or the issuing of badges and certificates are predominantly liable to costs. All participants use the same technical platform that nowadays includes sophisticated facilities for collecting data on the activities and performance of learners. Most courses are based on prerecorded videos that are complemented by multiple-choice-type tests and quizzes. Communication related to the presented content is made available through tutor-moderated discussion fora.

cMOOCs follow a different philosophy. They are usually like xMOOCs built around a pre-defined topic but the content is provided by autonomous participants who are sharing knowledge and experience on a field of common interest. The debate heavily relies on these individual contributions. The communication is based on a bunch of different social media. The role of the course organisator is not that of an instructor but that of a facilitator.

Tony Bates, CEO of a company specialized in the management of e-learning and distance education, described the main characteristics of xMOOCs and compared xMOOCs and cMOOCs (Bates 2014). Table 1 is partly based on his findings. Justin Pope, adviser to the President at Longwood University in Virginia, summarized the experiences with MOOCs made so far (Pope

[1] The prefix "*x*" refers to „extended". xMOOCs resemble traditional lectures but they extend their range through the provision of online access.
[2] The prefix "c" refers to the learning theory of "connectivism". This theory assumes that the creation and construction of knowledge happens through networking.

2014). He pointed out that a few years ago enthusiastic advocates of MOOCs still believed that MOOCs might blow up the old model of education. However, this did not happen so far. High dropout rates led to disillusionment and the oversized expectations of the early boosters were shrinking. Nevertheless, high dropout rates are not necessarily a proof for a failure of MOOCs. Nick Anderson, responsible for higher education at the Washington Post, keeps in mind that a lot of people who are signing for a MOOC are only window-shoppers (Anderson 2014). Often, they just want snippets of freely available content. This holds as well for any distance university. Their dropout rates are usually much higher compared to traditional universities. Adults in employment often search for free or low-cost online material appropriate for professional training on the job without striving for a certificate or grade. Hence, dropout rates represent a biased measure for the performance of educational institutions offering free online material.

Table 1: Comparison of key features of xMOOCs and cMOOCs

	xMOOCs	**cMOOCs**
Main purpose	Online transmission of pre-set content by an educational institution or company, knowledge is provided by experts (teacher-centered / "sage-on-stage" model)	Self-organizing networking, sharing knowledge through personal contributions related to a pre-defined topic, participant-driven learning, content is not pre-defined, knowledge is generated through the community of individuals
Suitability for different target groups	Particularly useful for acquiring basic knowledge on a new field of interest (introductory courses in education and further education)	Valuable for advanced learner and experts, for example for scientists doing research on related fields, not mainstream for crowd learning
Role of the learner	Participants are novices learning from experts	No formal student-teacher relationships, participants act as colleagues
Platform	Specially designed platform (commercial or open) shared by all participants, inclusion of learning analytics facilities	Participants are connected via different tools and media, a common platform is usually lacking
Typical components	Videos (captured lectures), tests and quizzes with immediate feedback, online fora for discussion (tutoring usually directed to all participants), complementing material (audio files, slide sets)	Web conferencing tools, learning management systems, loosely connected social media (blogs, tweets, wikis)
Assessments	Usually computer-marked assignments (multiple-choice type)	Usually no formal assessment

After a half-decade of experience with different types of MOOCs, the number of MOOCs – in particular xMOOCs – is still increasing. Their quality has improved due to high-level funding by prestigious universities and a few companies. Nowadays, educational institutions have started to evaluate the experiences made so far. The discussion is still controversial. Ralf Lankau, media expert teaching at the University of Applied Sciences in Offenburg, Germany, published in the German weekly newspaper "Die Zeit" a very skeptical valuation of xMOOCs (Lankau 2014). He criticized the general lack of indivualization typical for automatized learning arrangements and stressed the paramount importance of face-to-face communication. Furthermore, he suspects that MOOCs can be misused as an instrument for cutting budget for teaching staff at universities.

These arguments need to be considered but they lost weight. We already observe that MOOCs become in tendency more customer-friendly through increasing availability on demand (flexible time schedule without fixed starting point). Videos are tending to get shorter in order to reduce long sequences dedicated to passive listening. The private online academy Udacity, for example, advertises that its lectures are short and are stressing active doing.

Marcel Salathé, assistant professor at Pennsylvania State University, USA, suggested as a further improvement for the design and organization of future MOOCs the implementation of more individualized learner support (Salathé 2014). He distinguished three steps involved in any learning process: exposure of the learner to the content (step 1), the process of learning itself (step 2), finally the verification of having successfully learnt (step 3). He pointed out that xMOOCs are very efficient in covering step 1 by employing state-of-the-art IT technology but relatively weak as regards step 2. Individual learning in an xMOOC setting requires the availability of immediate help when getting stuck, for example through video chat (tutor-on-demand) providing either one-to-one communication with the tutor or tutor-moderated communication within small groups.

It is obvious that MOOCs are more than a temporary phenomenon. The design and quality is still evolving and new variants will appear. MOOCs represent a relatively new but seemingly firmly established pillar in today's educational landscape. Universities cannot ignore them. They are rather challenged by elaborating a long-term strategy that incorporates MOOCs as additional components into their current media mix. xMOOCs have the potential to increase the visibility of universities and to attract new customers interested in training-on-the job.

Learning on the move

Another important development with paramount importance for education and further education is the increasing dissemination of mobile learning. The term *mobile learning* or its abbreviation *m-learning* refers to educational technology that emphasizes mobility and to pedagogical approaches involving portable devices. Smartphones, tablets, handheld computers and MP3 players belong to this category of portable technology. In particular, smartphones and tablets are amongst adolescents ubiquitous and influence their routines in daily life. Nowadays, these devices have impressive performances. Hence, it seems to suggest itself to make use of these devices in education.

This happened in fact as an evolutionary, non-disruptive process. Tae Rim Lee, Faculty of Natural Sciences at the Korea National Open University, described in detail a program launched at her university already in 2008 (Lee 2010). The program aimed at incorporating m-learning into a general framework for distance teaching and lifelong learning. In Europe, many research projects started during the past half-decade, usually based on external funding. As an example, the project MLEARN may be quoted. This still ongoing project is funded by the European Commission and embraces participants from the United Kingdom, the Netherlands, Greece, Romania and Italy. It aims at promoting teacher development as regards the appropriate pedagogic use of handheld devices. In European schools, the incorporation of mobile devices into classroom teaching is still confined to pilot projects. Most teachers need training for digital proficiency. At universities, mobile devices are mainly employed for social interaction between students and as a channel for transmitting news and personal information related to course enrolment and exam results. Smartphones with its usually tiny screens are not ideal for transmitting extensive learning content. Hence, their employment for content delivery is subject to didactical limitations.

Today, m-learning is part of numerous pilot projects running at schools, universities and at workplaces. However, the community of users is rather fragmented. Furthermore, innovative applications of m-learning are still rare. However, some m-learning applications are remarkable. They make use of high-quality apps and sophisticated functionalities of modern handheld devices. M-learning projects for students in geology can, for example, harness GPS data. Mobile-assisted language learning can employ software for automatized translation and speech recognition.

The development of m-learning and its incorporation into a broader concept for distance teaching and lifelong learning will continue. For the time being, learning content used for m-learning is

usually not designed for mobile devices with small screens. Instead of presenting on smartphones large amounts of text requiring endless scrolling, we need approaches tailor-made for m-learning. These can, for example, focus on self-contained mini-learning-worlds ("micro-learning") and emphasize active doing and interactivity. The display of such granular learning objects should self-adopt to the screen size ("responsive web design"). Granular learning content of this type can be embedded into different educational settings.

Components of blended learning models and working examples

Online material is often not more than a variant of classical media. A prerecorded video can be regarded as an iteration of the traditional lecture, an e-book resembles to the printed version of a textbook and traditional seminars to webinars. The table below shows components used in traditional and IT-supported settings for learning and teaching.

Table 2: Components of blended learning

Educational resources and technical platforms	Components used in traditional learning and teaching scenarios	Components for learning and teaching requiring IT technology
Learning environment	classroom, lecture hall	learning management system, personal learning environment
Technical platform	blackboard / whiteboard, paper and pencil	interactive whiteboards ("smartboards"), desktops and mobile devices
Text-based media for content delivery	printed textbook, paper, journal	e-book, e-paper, e-journal,
Text-based media for social communication	letter, notes	e-mails, online discussion fora, chats, newsgroups, blogs, tweets, wikis, e-portfolios
Lectures	traditional lectures (non-virtual)	recorded videos (captured lectures)
Information based on visualization (images / graphs)	printed version, static	animated or interactive version
Seminars	face-to-face (non-virtual)	webinars, video chats
Assessments, final exams	pencil-and-paper tests, supervised final exams	tests with automatized feedback, final exams via video chat

Blended learning models define the composition and weight of available educational resources and media. MOOCs emphasize the use of elements listed in the last column of Table 2 but differ with respect to their selection. In practice, the components above can be modified and enriched by new features interconnecting the non-digital and the digitalized world. The printed book, for example, can be enriched by QR codes joining up traditional textbooks to mobile devices.

In order to illustrate the concept and the practice of blended learning, two slightly different models in use at German distance universities are presented. The first model is operating at the University of Hagen, the only German State University specialized in distance teaching. Here almost 80.000 students were enrolled in summer 2015. The second model refers to the Hamburger Fern-Hochschule, a privately funded University of Applied Sciences located in Hamburg with currently about 11.000 students.

The University of Hagen has four faculties (Humanities and Social Sciences, Business Administration and Economics, Mathematics and Computer Sciences, Law). Within this spectrum of sciences, the university offers a variety of Bachelor and Master study programs. The distance education system still heavily relies on the printed version of courses authored by experienced teaching staff. The printed courses are distributed via traditional post mail. However, an e-version of all courses is made available through a university-owned virtual campus system ("Virtual University"). The e-courses are usually static pdf documents without enhancement through interactivity or animation. The system contains as well administrative functionalities (enrolment for study programs and courses) and password-protected personal information (results of online assessments and written or oral exams).

At the University of Hagen, the online communication between students on the one hand and between students and teaching staff on the other hand is predominantly covered by the open source environment Moodle[3]. Moodle serves as well as a platform for storing course complementing material (course-related news, streamed lectures on selected topics, pdf of journal articles, podcasts). Student support by teaching staff is offered within Moodle and includes virtual classrooms. The support is as well available outside Moodle via e-mail and phone. Furthermore, students are offered to visit one of about 50 study centers located in different parts of Germany and a few neighboring countries. Teaching staff at these centers is hourly paid and works as a sideline. Visiting a study center is optional for the students. The offer aims at

[3] Moodle is an acronym for "*M*odular *O*bject-*O*riented *D*ynamic *L*earning *E*nvironment".

facilitating the understanding of course content in a mortar-and-brick-setting. The final exams are decentralized events organized in supervised face-to-face settings.

Recently, the University of Hagen started to experiment with MOOCs. The virtual campus and Moodle are accessible via mobile devices but content tailor-made for m-learning is still in its infancy. In-house development of apps for m-learning is still missing but scheduled for the future.

The privately operating Hamburger Fern-Hochschule (HFH) offers study programs for Economics and Law, Health Care, Engineering. Similarly to the University of Hagen, the distance education system at the HFH is based on printed courses which are distributed via traditional post mail. Additionally, the courses are accessible in non-enhanced pdf format within a proprietary campus system ("WebCampus"). For implementing blended-learning concepts, the HFH uses the open source learning management platform OLAT[4]. This platform contains course-complementing media, for example animations or podcasts, online exercises and virtual classrooms.

Administrative functionalities such as course enrolment and password-protected personal information, in particular on course enrolments and assessment results, are available at the WebCampus. The virtual campus not only covers individual information for students. It serves as well as a point where social communication and course-related discussions happen. Student support by teaching staff is mainly offered here and, analogously to the practice at the university of Hagen, on a voluntary basis in about 50 study centers. The net of study center plays for the HFH a prominent role. Here, 50 study centers satisfy the need of traditional face-to-face learning support for only 11.000 students compared to about 80.000 students in Hagen. Teaching staff is likewise working on the basis of a secondary job. Written, supervised exams take place in the study centers.

Contrary to the distance University of Hagen, the Hamburger Fern-Hochschule still does not experiment with MOOCs but offers selected study programs purely online. These programs can be used on mobile devices but they are not tailor-made for m-learning. A pilot project involving learning content tailor-made for mobile devices started in 2015. Table 3 summarizes common features and differences of blended learning practices at both distance universities.

[4] OLAT represents an abbreviation for "*O*pen *L*earning *A*nd *T*raining".

Table 3: Comparison of blended learning practices at two German distance universities

<table>
<tr><th></th><th>University of Hagen</th><th>Hamburger Fern-Hochschule</th></tr>
<tr><td rowspan="2">Transmission of learning content</td><td colspan="2">Distribution of printed material via post mail, e-versions are made available online through a proprietary campus system (“Virtual University” in Hagen, “WebCampus” in Hamburg)</td></tr>
<tr><td>All study programs follow this mode of content transmission.</td><td>Selected study programs are offered purely online.</td></tr>
<tr><td>Storage of course-complementing media (for example streamed lectures or online assessments)</td><td>predominantly use of an open source platform (Moodle)</td><td>use of an open source platform (OLAT)</td></tr>
<tr><td>Online communication between students and between students and teaching staff</td><td colspan="2">via open source platforms (Moodle in Hagen, OLAT in Hamburg), for example through chats or virtual classrooms), in addition through e-mails, phone, social media</td></tr>
<tr><td>Administrative functionalities, access to personal information</td><td colspan="2">accessible via proprietary campus systems (“Virtual University” in Hagen, “WebCampus” in Hamburg)</td></tr>
<tr><td rowspan="2">Face-to-face communication (brick-and-mortar-setting)</td><td>50 study centers for 80.000 students</td><td>50 study centers for only 11.000 students</td></tr>
<tr><td colspan="2">Teaching staff teach in study centers only as a second job</td></tr>
</table>

Interactive and platform-independent learning objects

In today’s educational settings, the media mix applied represents a welding of teacher-centered and learner-centered approaches. The weight of teacher-centered and learner-centered elements varies of course. The majority of xMOOCs, for example, puts great emphasis on teacher-centered learning whereas a key feature of cMOOCs is the abundance of the “sage-on-stage” model in favor of peer-learning.

At universities specialized in distance teaching, learning content is distributed by employing a wide range of media (printed courses, e-courses, DVDs, videos). Student-student and as well student-teacher communication is enabled through a variety of communication channels. Students can make use of discussion fora within virtual campus systems or outside these proprietary environments by using blogs and e-mail. In particular, mobile devices are ubiquitously employed for social interaction between students. To a large extent, the need for learning through interaction between students seems to be already covered.

In spite of this, there is still potential for improvement and widening of blended learning scenarios. For self-study purposes and lifelong learning, there is a lack of platform-independent

environments stressing interactive visualization and user-controlled exploration. Learning content presented on handheld devices often contains either long documents that are not ideal for tiny screens or lengthy videos requiring long sequences of passive listening. Furthermore, m-learning often involves content that cannot be displayed on desktops or only operates on specific mobile devices. On the other hand, interactive applications developed for desktops, such as Java applets, do not necessarily operate on mobile devices. Apart from these facts, there is a demand for checking learning success through innovative approaches going beyond simple multiple-choice type assessments.

Hence, there is a strong need of expanding currently applied blended learning approaches. The need refers to platform-independent components for self-study purposes that open up new dimensions for education and further education. The components should emphasize active doing through interactive visualization of learning content. In addition, they should be designed in a way that facilitates their embedment into different scenarios for learning and teaching.

The approach to be presented in the following is related to statistics education or, more generally, the promotion of statistical literacy in daily life and vocational training. However, the underlying ideas can be easily adapted to mathematics and natural sciences.

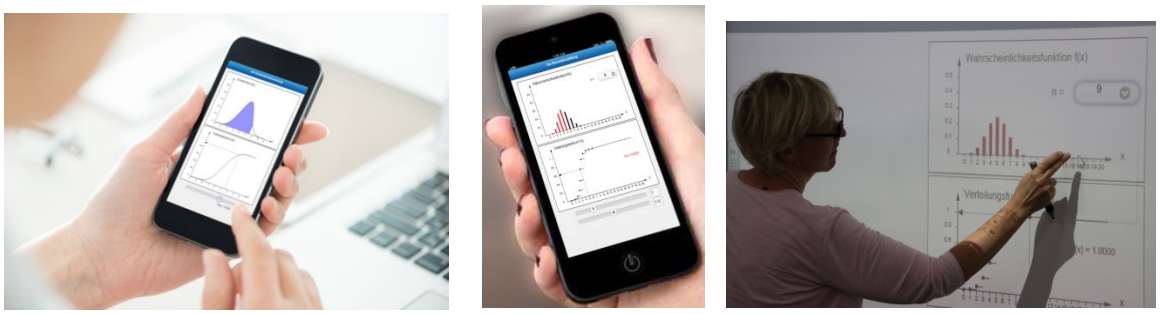
In order to fill the gap described above, an open repository containing granular learning objects has been developed. The repository represents a new open educational resource which is organized as a web app. For the time being, the app embraces more than 20 learning objects dedicated to facilitating the understanding of basic statistical concepts and to user-controlled exploration of interesting data sets. The app exists in German and English. Currently, only a few elements are available in other languages.

All learning objects are self-explaining and self-contained. They aim at learning through user-controlled experiments and simulations. All objects are tailor-made for smartphones but operate as well on other mobile devices, desktops or interactive whiteboards. Designing for devices with small displays required the avoidance of information overload. Formulae have been omitted likewise. The theoretical background needs to be provided by teaching staff, by printed material or online sources.

A key topic in statistics education is the approximation of real-world data through appropriate models. Every student attending an introductory statistics course will be confronted with some of

these models, in particular with the standard normal and the binomial distribution. Figure 1 presents learning objects dealing with these distribution models. The language is German. The learner is enabled to modify the value of the argument variable in case of the standard normal distribution (first part of Figure 1) or to change parameter values in case of the binomial distribution (second and last part). The effect of these changes is immediately visualized by means of two inter-related graphs. The last part of Figure 1 illustrates the feature "responsive web design". Here, the binomial distribution is displayed on an interactive whiteboard and the size of the graphs has adapted automatically.

Figure 1: Learning objects displaying the standard normal and the binomial distribution



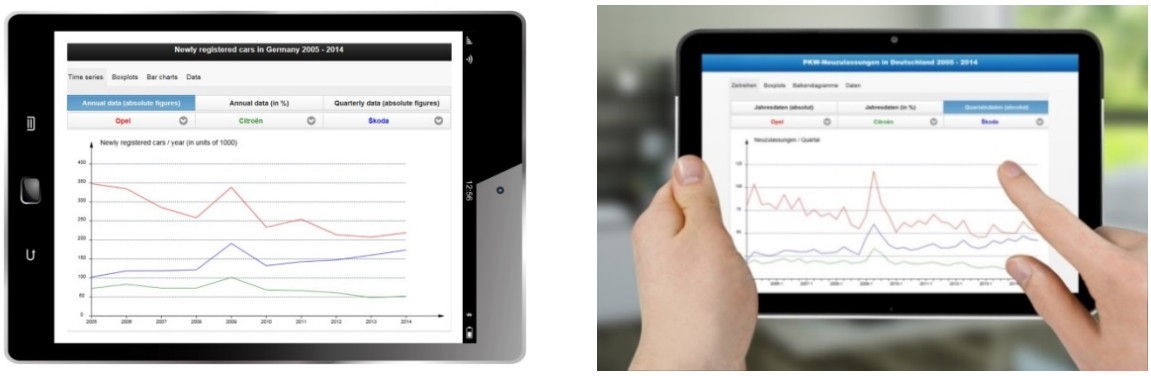
The minimization of text on screen and the design of the objects as self-contained mini-learning worlds facilitate their translation into other languages. Figure 2 shows again the learning objects presented above, but now in English and Japanese (standard normal distribution) respectively in English and Korean (binomial distribution).

Figure 2: Translated versions of learning objects (English - Japanese, English - Korean)

A few learning objects aim at interactively exploring interesting data sets by using different graphical tools. Again, information overload is avoided. Figure 3 shows the German and the English version of a learning object displaying official data for Germany on newly registered cars

for the period 2005 - 2014, with breakdown by brands. Instead of simultaneously displaying time series graphs for all brands, only three user-selected three graphs are visualized. The left-hand side of Figure 3 refers to quarterly data whereas the right-hand part presents annual data referring to the brands Opel, Citroen and Skoda.

Figure 3: Interactive exploration of official data for Germany on newly registered cars



The granularity and self-containment of the learning objects facilitates their use for different purposes. They can be embedded into traditional face-to-face teaching at colleges and universities. This has been illustrated by the right-hand side of Figure 1. Furthermore, they can be connected via QR codes with printed introductory statistics textbooks as practiced by Mittag (2016). This expands the scope of printed material used in the context of distance studies and lifelong learning. Interactive learning objects stressing visualization of learning content can as well employed as a new component of MOOCs. Finally, platform-independent environments for user-controlled data visualization will be of interest for data journalists. They can write a story around a data set that can be interactively explored by their readership.

Concluding remarks

The digitalization of education and the ubiquity of mobile devices boosted the upsurge of new components and new variants of blended learning models. MOOCs are an example for a meanwhile well-established new pillar enriching the media mix used in education and further education. Likewise, technology involving portable devices such as smartphones and tablets increasingly influences the educational landscape.

In spite of remarkable technical progress, the practice of blended learning still contains potential for improvement. There is, for example, a strong need for platform-independent learning environments emphasizing active doing through interactive visualization and user-controlled

exploration of learning content. This paper presented an approach satisfying this need. The approach refers to granular learning objects for statistics education, but can be easily adapted to other sciences.

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Web app containing interactive learning objects for statistics education:

English version: http://www.mittag-statistik.de/app/
English version, partly translated to Korean: http://www.mittag-statistik.de/app_kr/
German version: https://www.hamburger-fh.de/statistik-app/

QR code for the English version of the web app listed above: