WHAT EMERGING TECHNOLOGY CAN DO FOR LEARNING ENVIRONMENTS: THE CASE OF MOOCS

Karen Ferreira-Meyers
kmeyers@uniswa_sz

Abstract: This paper seeks to address the position of emerging trends in higher education. It is the written version of a public lecture given at UNSRI in May 2014. It starts with an overview of emerging trends (flipped courses, Open Learning Initiative, MOOCs) as described by the Horizon Report 2013, a brief literature review, and then continues to propose a more detailed overview of both Flipped Courses and Massive Open Online Courses with the intention of opening up the debate on the use of these in a higher education environment.

Key words: *emerging technology, learning environments, flipped courses, MOOCs*

Apart from blended learning, other types of online learning modes or models have been proposed in recent years, some with a lot of success, others to be discarded very soon after they were suggested. In this paper, I do not dwell on those that have been discarded, even though there may have been useful directions, suggestions and activities in these technologies and strategies. The ones I look at in this paper are based on the Horizon Report.

Produced by ELI (Educause Learning Initiative) and NMC each year, the Horizon Report describes six areas of emerging technology that will have significant impact on higher education and creative expression over the next one to five years.

The areas of emerging technology cited for 2013 are Massively Open Online Courses (MOOCs) and Tablet Computing (the time for adoption was set at one year or less in the Report), Games and Gamification, and Learning Analytics (the time for adoption was set at two to three years in the Report), while 3D Printing and Wearable Technology were seen to be adopted in four to five years by the Report.
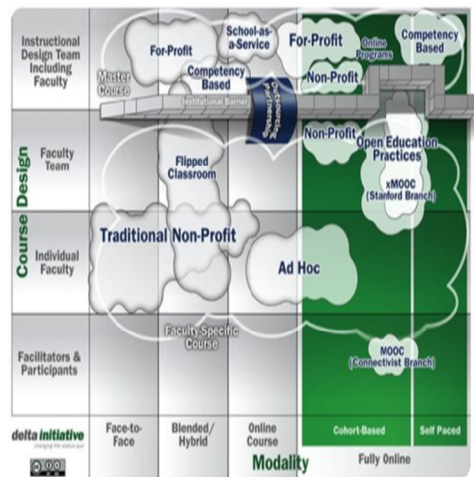

Figure 1. Educational Delivery Models, 2012

There are, of course, various models regarding the delivery of education. Delta Initiative proposed the one above which indicates, on the horizontal axis, modality of delivery and, on the vertical axis, course design options. In the paper, I will look at two modes: the flipped classroom and MOOCs in particular, which thus includes a type of blended/hybrid modality (flipped classroom) and a type of fully online course delivery (a MOOC). I will only

briefly touch upon course design issues, so for this article, little attention will be given to whether a course is designed by an individual, a course team (whether constituted by faculty members only or by a blend of facilitators and participants).

This paper questions how, as higher institutions of learning, we should position ourselves when faced with unprecedented, fundamental challenges and are surrounded by dramatic, rapid changes. This is not simply a difficult moment for higher education: it is the dawn of a very different era. The institutions that will succeed—indeed, thrive—in this era will be those that constantly innovate. What, then, are the new models that seem most promising? I will focus here on courses, since they are at the heart of the institution and may represent the beginning steps in institutional transformation. The paper will in turn look at Flipped Courses, at the Open Learning Initiative (OLI) and at Massive Open Online Courses. In my conclusion, after having looked at Massive Open Online Courses in detail, I will attempt to answer the basic questions of whether MOOCs are indeed one of the best ways to satisfy the global thirst for education.

REVIEW OF LITERATURE

The existing literature on both flipped classes/courses and MOOCs is still quite limited. Nevertheless, important lessons can be learned from what has been published so far. Papadopoulos and Roman (2010) saw that students progressed through material faster, that students understood topics in greater depth, and additional content could be covered without sacrificing the quality of the course as a whole when the teaching/learning strategy was that of a flipped course.

In 2008, teaching staff at the California State University, Los Angeles, flipped the freshman and sophomore Introduction to Digital Engineering course in order to increase opportunities for collaborative project-based learning. In a post-course analysis, flipping the classroom seemed to be effective in helping students understand course material and develop design skills (Warter-Perez & Dong, 2012). Their findings were reinforced by satisfaction surveys and focus groups in which over 70% of students said the class learning environment was more interactive. In the same study, all students strongly agreed that the new learning environment allowed them to gain better hands-on design skills and agreed that the flipped class helped them to learn the content better.

However, not all research on flipped learning in higher education has reported positive effects. In one study, students in a flipped college introductory statistics course reported being less than satisfied with the way they were prepared for the tasks they were given (Strayer, 2012). The reason may be that students in introductory courses have not yet developed a deep interest in the content, and thus may be frustrated when they encounter tasks that are not clearly defined. However, even in this particular introductory course, students indicated that they were more open to cooperative learning and innovative teaching methods (Strayer, 2012).

In another instance, students who experienced web-supported learning versus lecture-based learning were more satisfied with the peer collaboration stimulated by this learning environment (Frederickson, Reed, & Clifford, 2005; Crouch & Mazur, 2001). There were no significant differences in students' knowledge and anxiety levels between the two versions of the course (Frederickson et al., 2005).

With regard to MOOCs, there are several trends visible. Some authors have a positive viewpoint, others are

negative, while some are more critical or balanced in their approach. A good overview of these trends has been published by the UK Government and can be found here: https://www.gov.uk/government/.../13-1173-maturing-of-the-mooc.pdf.

In an article entitled *Your Massively Open Offline College is Broken,* Clay Shirky argues that MOOCs should be seen as a reasonable response to the failures of the US Education system. According to Shirky, MOOCs are part of the larger story of education technology. Shirky defends MOOCs as agents of necessary change.Ron Legon, Executive Director of the US Program "Quality Matters" which supplies a US quality benchmarking and certification process for online courses, endorses MOOCs from a perspective of online course quality.   Contrary to Bates, Daniel, and others with their roots in the cMOOCs movement, Legon hails the xMOOCs of Coursera, Udacity, edX and MOOC 2.0. According to him, the first wave of MOOCs (MOOC 1.0) was designed by faculties from elite institutions who produced a format that may be effective for the bright self-starter but is unsuited for the average or challenged student. MOOC 1.0 courses take no responsibility for learning results or for the monitoring, engagement, evaluation and accreditation of students. As such, for Legon, MOOC 1.0 is wholly inappropriate as a replacement for college-based credit courses, or as a means of expanding access to higher education or even reducing its costs.

The second generation of MOOCs (MOOC 2.0), according to Legon, focuses on the typical student, integrates more effectively with established distance and on-ground programs, and leads to credentials. In 2012 TED talk, *From Nand to Tetris*, Shimon Shocken discusses his 2005 computer course as a MOOC-like open learning innovation from before the term MOOC became current. Shocken argues that the essential role of educators is not teaching alone. John Daniel, writing in the autumn of 2012 in the Open University's Journal of Interactive Media (JIME), identifies "Myths and Paradoxes" in four aspects the xMOOC phenomenon: completion rates, certification, pedagogy and the purpose of MOOCs. Here, Daniel contextualises xMOOCs against previous learning innovations that promised to deliver radical extensions of university activity, including AllLearn, Universitas 21, Fathom, MIT open courseware and others. Regarding pedagogy, Daniel presents evidence that even though the MOOcs all claim to embody modern learning, they deploy "old and out-dated behaviourist pedagogy". Despite these negative comments, Daniel remains confident that MOOCs will not evaporate like the previous bubble of online courses from elite colleges. According to him, MOOcs will leave two important legacies: they improve teaching and they encourage institutions to develop distinctive missions. Casey (2012, in his blog post of the Central Saint Martins School of Arts), notes how the adoption and esteem of learning innovations is determined by social, political and cultural factors. Casey argues that an institutional lack of engagement with learning technology often hampers adoption and success, and that failures such at the UK's e-University reflect an overemphasis on technology along with a failure to address the social and political aspects of using technology in education. Casey identifies economic factors as motivations for MOOC platform providers Coursera and EdX, who have created what he defines as "a high volume low margin product".

In an article entitled MOOCs – Massive Open Online Courses (2013) that was published on the European University Administration website,

Michael Gaebel gives a technical overview of MOOCs. He defines them as large, online courses without credit, charges or barriers to entry) and views them not as a recent or original phenomenon but rather as a step in the ongoing effort to improve higher education participation and the learning experience.

FLIPPED COURSES

In the Flipped Learning model, teachers shift direct learning into the individual learning space, with the help of technology. Educators record and narrate screen/video/audio/podcasts of work they do on their computer desktops, create videos of themselves teaching, or curate video lessons from internet sites such as TED-Ed and Khan Academy. Many educators have started flipping their classes by using these readily available materials. The videos or screencasts can be accessed by learners whenever and wherever it is convenient—at home, during study, on the bus, even in hospital—as many times as they like, enabling them to come to class better prepared (Musallam, 2011).

Capitalizing on learners' preparation, lecturers and teachers can devote more time to opportunities for integrating and applying the learners' knowledge, through a variety of student-centred, active learning strategies such as conducting research or working on projects with peers. Lecturers and teachers also can use class time to check on each student's understanding and, if necessary, help students develop procedural fluency. They can provide individualised support as students work through the activities designed to help them master the material, meeting them at their readiness level.

Flipped Learning has been compared to online, blended, and distance learning because of the screencast or video components, but,

there are clear differences. Online education, for example, occurs only remotely, and instructor and learner are hardly neverface-to-face (Oblinger&Oblinger, 2005). Virtual class meetings, assignments and lectures happen online through a course management system of website and usually, but not always, asynchronously. Sometimes the lectures and other activities are augmented by group chats or other means of facilitating collaboration and peer instruction. Blended classes also have an online element, but that usually occurs during class time along with direct student-teacher contact (Allen, Seaman, & Garrett, 2007). Students' experiences in face-to-face sessions vary however and are not necessarily different than what occurs in a traditional classroom.

That is also the case in some flipped classrooms. The use of videos or other digital technologies to deliver content outside of class does not guarantee that anything different will occur during class time. However, due to the emphasis on learners becoming their own learning agents rather than the object of instruction, the flipped learning model can enable educators to make the shift from teacher-driven instruction to student-centred learning.

In "flipped courses," content is delivered as homework; class time is reserved for collaborating with others, increasing understanding and addressing misperceptions/misconceptions. The flipped model transforms the classroom from a focus on the delivery of information to interaction and comprehension. Eric Mazur, a physics professor at Harvard University, was an early adopter.[26] But the Khan Academy has received most of the recent attention. The Khan Academy began when Salman Khan wanted to help his nieces and nephews by creating little video vignettes about mathematics and

it now has more than 3,200 videos, covering topics such as arithmetic, physics, finance and history. The Khan Academy's goal is "to help you learn what you want, when you want, at your own pace". TED-ED creates powerful resources from TED talks and other YouTube videos.

The flipped course raises a powerful question. With content everywhere, available on demand from almost any kind of device, why are colleges and universities still bringing students together in a traditional classroom?

OPEN LEARNING INITIATIVE (OLI)

One of the early projects in the field of online courses was Carnegie Mellon University's Open Learning Initiative, which began in 2002. OLI courses include modern biology, media programming, engineering statics, chemistry, probability and statistics, the French language, speech, and logic. At least two aspects distinguish the OLI courses from many other online courses: OLI courses are created by teams, which often include participants such as cognitive scientists, discipline-content experts, scientists who study human-machine interactions, and instructional designers[1]; and OLI courses systematically gather data about student performance and feed that data into course improvement. In the fall of 2005, Carnegie Mellon undertook a study to determine whether students who take the stand-alone OLI statistics course performed as well as those who completed the university's traditional course[2]. An all-volunteer test group of 20 students registered in the traditional course were asked to work entirely online. They performed as well on all four exams as those who attended class, with no significant differences between the two groups. Moreover, on a 4-point Likert scale, 75 percent of the students said they would definitely recommend the online course to other students, and the remaining 25 percent reported that they would probably recommend it.

In addition to the above-mentioned aspects distinguishing OLI courses from others, the following have also been noted: ongoing, formative course evaluations[3] and broad dissemination: modular in nature, OLI courses are designed to be disseminated openly and freely to individual learners and (at low cost) to other interested institutions where faculty may deliver an entire

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[1] The so-called "cognitively informed" approach to online course design: OLI asks its faculty content experts to question their intuitions about teaching by participating in a multidisciplinary course-building process in which team members from the cognitive sciences construct a profile of a novice learner based on observations of beginning students tackling key concepts and skills within the faculty member's knowledge domain. Reminded of the novice learner's perspective throughout the design process (owing to the varying levels of domain knowledge represented by the members of the multidisciplinary design team), the faculty content expert often rethinks his or her entire approach to classroom instruction as well.

[2] Marsha Lovett, Oded Meyer and Candace Thille (2008). "The Open Learning Initiative: Measuring the Effectiveness of the OLI Statistics Course in Accelerating Student Learning" in *JIME Special Issue: Researching open content in education.* See also Yibin Zhang, "On Open Educational Resources Development and Application: A Case Study of Open Learning Initiative(OLI) of Carnegie Mellon University"

[3] OLI documents the course-development process, including the methods and assumptions used when applying learning science theory to online instructional design. The program has also established a systematic procedure for evaluating courses on a routine basis, using that evaluation to improve each course and feeding evaluation results back into the cognitive and learning-science research communities. These results can then contribute to the development of more effective theory-based instructional strategies, which in turn will be fed back into the OLI course-design process.

course as designed or modify the course content and chronology to fit their students' needs and curricular goals.

MOOCs

A MOOC is a model of educational delivery that is, to varying degrees, massive, open, online, and a course. Most MOOCs are structured similar to traditional online higher education courses in which students watch lectures, read assigned material, participate in online discussions and forums and complete quizzes and tests on the course material. The online activities can be augmented by local meet-ups among students who live near one another. MOOCs are typically provided by higher education institutions, often in partnership with "organisers" such as Coursera, edX, and Udacity, though some MOOCs are being offered directly by a college or university. MOOCs arise from the confluence of several trends[4], and they raise important questions about curriculum design, accreditation, what constitutes a valid learning experience and who has access to higher education.

The term MOOC (Massive Open Online Courses) was coined in late 2008 by Dave Cormier and Bryan Alexander in response to an open online course[5] designed and led by George Siemens and Stephen Downes at the University of Manitoba. Other open online courses were taught by David Wiley at Utah State University in 2007 and Alec Couros at the University of Regina in 2008. But the idea took off in the fall of 2011 when Sebastian Thrun and Peter Norvig, with 200 students enrolled in the face-to-face course "Introduction to Artificial Intelligence" at Stanford University, decided to offer the course free to anybody in the world[6].

In fact, MOOCs[7] are the latest in a long series of efforts to use technology

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[4] MOOCs arise from the confluence of several important trends: disruptive ideas about the sources and processes of education, major changes to the financial model of higher education, and the development and availability of technologies including consumer hardware, widespread network access, and educational applications. In a relatively short time (even by technology standards), the activity around MOOCs has drawn the attention of senior leadership in higher education, challenging longstanding models and premises about education. The growing interest in openness—in open access and open resources—in higher education brings added interest in MOOCs. Moreover, because of the scale of most MOOCs, vast amounts of data are being generated that, when analysed and more fully understood, will benefit not only future MOOCs but also education in other delivery models.

[5] The course "Connectivism and Connective Knowledge" was offered to 25 tuition-paying students; 2,300 other students from the general public took the online class free of charge

[6] They sent out a single e-mail, and 160,000 people from 190 countries signed up. More than 23,000 students completed the course. By the end of the course, only 30 of the Stanford students were still going to class, presumably because 170 found the online version more engaging. Out of the 23,000-plus course completers, 248 students had a perfect score in the course; none of them were Stanford students. In January 2012 Thrun resigned from his tenured professorship at Stanford to create Udacity, an online-education venture offering free courses.

[7] An aside on the definition of MOOCs: (based on Jonathan Herber's work): While it would be very easy to just fall back on the acronym and say that if a course is massive, open and delivered online then it must be a MOOC, each one of these words is either ambiguous or open to challenge.For example, what does "massive" mean?1,000 students? 10,000? 100,000? Are these students who merely enrolled, active students or course completers? I suppose "online" is relatively unambiguous (although even there you can make the case that initiative like Coursera's Learning Hubs are creating a hybrid online/offline environment), but I would say that even the word "course" is quite ambiguous. For instance, Jonathan Herber states that, if a million people download an iTunes lecture series that is massive, open (free) and online. In which case, it must be how

to make education more accessible. Although MOOCs make up a very small percentage of higher education offerings, their appearance has discussions around the globe about fundamental topics such as teaching, access, learning outcomes, cost, learning communities, etc.

Harvard Business School Professor Clayton Christensen's theories on disruptive innovations[8] note that MOOCs are a disruptive force that will lead to significant change in higher education.
I suspect, and I am definitely not the only one, that in the future, students will present their own universities with certificates of completion from MOOCs they took at Coursera, EdX, or Udacity. It is still unclear how universities will react to such submissions (reject them, allow them, give credit for them?). MOOCs also raise a number of legal questions: who owns MOOC content? What rules should govern the use of that content? When students create content as part of a MOOC, who owns that?

From my experiences as a participant and learner in a few MOOCs (MOOC on Open Learning Design Studio "Learning Design for a 21st Century Curriculum" from 10 January to 13 March 2013; MOODLE MOOC on Wiziq four week course in May-June 2013 and one offered by the South African Institute of Distance Education – SAIDE) and also as an instructional designer of a MOOC organised by the African Management

Initiative[9], I can deduce that, despite the stories of MOOCs with more than 100,000 students, some successful MOOCs operate on a much smaller scale[10].

In some way, MOOCs represent the latest stage in the evolution of open educational resources, after open access to course *content*, and to free online *courses*. As such, they are varied and diverse.

Types of MOOCs
The recent history of MOOCs includes the "connectivist" branch, sometimes called cMOOCs, established in Canada around 2008, in which online

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we define the term "course" that would lead most people to say that listening to iTunes lectures represents something different than taking a MOOC on the same topic (or even the same course offered by the same professor) delivered via a Coursera or edX.

[8]This describes a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors.

[9]The African Management Initiative (AMI) leverages technology to deliver accessible, locally relevant and practical management education to African managers and entrepreneurs, and to foster communities of lifelong learning, practice and accountability. In June 2013, AMI piloted the first Massive Open Online Course (MOOC) delivered by Africans for Africans. 850 participants from 25 African countries took the course, and a completion rate of 15% was observed (I will talk further on completion rates, but it should already be pointed out that this is a very good rate when compared to other MOOCs). As part of the MOOC, AMI also piloted Learning Labs with local partners, where participants work through the online material in facilitated groups.

[10]A variation on the MOOC is the "supersized" classroom. For example, John Boyer, a professor at Virginia Tech, taught an introductory course, "World Regions," to 2,670 students. He allowed students to attend in-person or online, communicating via Facebook and Twitter, and he used Skype to bring in world figures to talk with the class. The Virginia Tech model illustrates the power of new technologies to make these large-scale models engaging and effective. Undoubtedly, experimenters like Thrun, with his connections to Google, are developing a whole series of technologies and tools for even more effective MOOCs. The time for experimentation, as well as for careful thinking about policy and practice, is now, before these new experiments in large and free classes overwhelm traditional institutions

communities were formed, generally outside traditional educational contexts, to address questions of mutual interest. More recently, xMOOCs have been developed by experts associated with Stanford University and companies as Coursera and Udacity, as well as Harvard and MIT's edX initiative. These develop pathways for distributing content from a central source, such as a well-known professor, for example. Other recent developments include: non-massive OOCs[11], non-open MOCs[12], non-online MOCs[13] and non-class MOOCs. MOOCs do not necessarily need to be courses; they can exist as online and project-based communities. One way to think about course content is as a continuum between pieces of a course an instructor posts online to a full course. MOOCs may evolve in the direction of locally sourced courseware that competes more directly with traditional publishers' offerings.

Characteristics of MOOCs and their related pedagogical benefits

In their article entitled "The pedagogical foundations of massive open online courses" David George Glance, Martin Forsey, and Myles Riley made a narrative analysis in May 2013[14] of 138 articles found on Google Scholar (2012), Web of Knowledge (2012), Education Resources Information Center (ERIC) (2012) and PsycINFO (2012). Their conclusions are varied and relate to different topics. With regard to this article's focus, we note that the principle feature of MOOCs is they largely take place online, and online courses are at least as effective as face–to–face courses. Online learning offers flexibility of access to course materials from anywhere at any time (Allen and Seaman, 2005; Means, *et al.*, 2010) which is not possible in a solely face–to–face environment.

Several meta–analyses found no significant differences in student achievement when university students accessed content via online means or through face–to–face (Bernard, *et al.*, 2004; Cavanaugh, *et al.*, 2004).These finding were supported by comparative studies that also found no difference in academic achievement (Barker and Wendel, 2001; Kozma, *et al.*, 2000; Summers, *et al.*, 2005).

Even though the MOOC concept has become wildly popular during the last couple of years, empirical research on these initiatives is largely absent. From a historical point of view, research that characterizes emerging practices has been formative and focused on specific case studies (Dede, 1996).

Research on connectivist MOOCs is available (see Fournier's and Kop's work), but research on other types of open courses is just slowly starting to emerge (see the work on Lytics Lab and on P2PU). Research on MOOCs should include the following questions: What

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[11]Harvard, for example, capped enrollment an online course on copyright in the interest of preserving the course's pedagogical quality. Other schools are beginning to play with the notion that some aspects of a MOOC-like course can be massive, while other aspects are not. San Jose State University, for example, has been piloting courseware with online support groups, but with instructors running classes that add a face-to-face component to a MOOC

[12]Most MOOCs are not open, in the sense that their content is not provided under a Creative Commons license. Some recommend for-pay textbooks; others could charge fees in the future. You can have an open access course but still charge a fee. The most consistent kind of "open" is open access, which is related to but not the same thing as free.

[13]Some universities use a form of MOOC internally to support a hybrid model of classroom flipping. Campuses with the right network have a logical opportunity to enhance the learning experience in this manner.

education-specific research will be beneficial to the field? What do we need to know? How should we go about investigating what we need to know about?

Systematic empirical research can then generate a deeper understanding of MOOCs in all their forms, provide evidence to support or refute claims surrounding them and help universities and MOOC providers enhance course offerings. What follows is a set of research questions that, if answered, will generate insights into learner/instructor experiences, outcomes, practices, and interaction in massive open online learning courses: What are the learning outcomes of MOOCs? Who successfully completes MOOCs? What are the shared characteristics of the individuals who successfully complete MOOCs? Why do learners sign-up for MOOCs? What factors cause learners to persist or cease participation in MOOCs?

With large numbers of individuals seemingly enrolling in MOOCs out of sheer interest and curiosity, and perhaps merely exploring their options, what new knowledge can we gain about this issue? What is the learning experience like in a MOOC? How does this experience differ across designs and pedagogical models? How do learning communities and groups develop, grow, and dissipate in MOOCs, in both online spaces (e.g., Facebook groups) and face-to-face spaces (e.g., mediated by Meetups)? What factors are critical in sustaining learner interest, motivation, and participation in a MOOC?

CONCLUSION

One of the major questions that educators need to answer is whether traditional higher education is a domain facing disruption, soon to be radically reshaped or even shut down by competitors using new technologies? Christensen and many others think our university model is antiquated, we have too many similar traditional practices, our funding model depends on increasingly resistant consumers, our costs are rising at a rate greater than health care costs, our business model supports fewer students, and our institutions are not producing more graduates with greater learning outcomes. The greatest challenge for higher education is that reinvention is a three-part problem: We must educate *more* students, with *greater* learning outcomes, at *lower* costs.

With regard to MOOCs, boosters like to brag about the thousands of students—even hundreds of thousands—who sign on to learn from super-professors like Harvard University's Michael Sandel or Sebastian Thrun. But completion rates for these courses consistently hover in the mid single-digits. This does of course not mean that MOOCs are without value: MOOCs are forcing evolution in pedagogy, design of learning and student experience.

SUMMARY

Higher education institutions face unprecedented challenges, primarily driven by rapid technological change. To meet the challenges and adapt to the changes, we need new models, new approaches, and new practices. But more than anything else, we need new ways to think about the priorities for our work. In this paper a brief overview of new trends such as flipped courses, the Online Learning Initiative and MOOCs was given to open up the way to further discussion of the possibilities such methods, initiatives and approaches offer. Without doubt, additional analysis of what exists, what can exist and what should exist in the world of education needs to be undertaken. The term "analytics" describes a "method of warehousing, organizing, and interpreting massive amounts of data accrued by online learning platforms and student

information systems . . . in the hope of learning more about what makes learners successful". Institutions that systematically collect and analyse learner data are able to provide detailed information and analysis for institutions, staff and learners.

For institutions, analytics provides information that helps in predicting academic demand, tracking course success, preventing learner drop-out, enabling social integration and reporting information for different purposes. Analytics also provides crucial information to staff members about student success, including areas of misunderstanding, level of effort and persistence, and other details about learning. Finally, analytics provides information for learners for example regarding course selection, course and program progress, selection of majors, etc. In order to really be in a position to decide whether flipped courses, the Online Learning Initiative or even MOOCs are suitable for any learning institution, data analysis must inevitably take place.

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About the Author

Dr. Karen Ferreira-Meyers teaches at University of Swaziland and a Senior Research Associate at University of Johannesburg.