Beginning the Dialogue on the e-Transformation: Behavior Analysis' First Massive Open Online Course (MOOC)

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Published online: 21 January 2016
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Abstract The e-Transformation in higher education, in which Massive Open Online Courses (MOOCs) are playing a pivotal role, has had an impact on the modality in which behavior analysis is taught. In this paper, we survey the history and implications of online education including MOOCs and describe the implementation and results for the discipline's first MOOC, delivered at Southern Illinois University in spring 2015. Implications for the globalization and free access of higher education are discussed, as well as the parallel between MOOCs and Skinner's teaching machines.

Keywords Online teaching · MOOCs · Teaching machines

A student pursuing an academic degree may find their experience in college or graduate school to be very different from one that he or she might have experienced a few decades ago. At that time, students may have attended lectures in classrooms, completed assignments and studied outside of class, and perhaps participated in a range of extracurricular or social activities on campus in their spare time (Tett 2013). As Tett (2013) describes, today, students can complete courses without the requirement of being physically present in a classroom: They can download eBooks, Skype with an instructor or teaching assistant, view lectures from their dorm room or home, explore virtual museums, complete virtual laboratory experiments, and interact with other students online. Indeed, the increasing presence of online technology in academia has

been described by some as a “dramatic disruption” to higher education (Tett 2013), challenging our society's age-old conceptualization about what students should do to obtain advanced degrees.

The discipline of behavior analysis has not been untouched by this seeming “e-transformation” affecting today's colleges and universities. More and more institutions are offering predominantly masters-level courses in the discipline online. On some campuses, such courses may be “blended” or “hybrid” in nature, in which a portion of course components are delivered online or a course in its entirety may be implemented online with no requirement that a student ever engage in a campus classroom. Entire degree programs may be offered online as well. Carr (personal communication, February 27, 2015) stated that online behavior analysis training offerings have substantially increased in recent years, with 23.3 % (60) of the 258 institutions that offer a BACB Approved Course Sequence doing so via a distance education modality. Thus, as a discipline behavior analysis is not untouched by this “dramatic disruption” (Tett 2013). Given the implications that online courses and programs hold for institutions seeking to enhance their enrollment, the teaching of behavior analysis using online technology can only be expected to increase in the years ahead.

The overall purpose of this paper is to inform the behavior analytic community of a relatively new yet enormously impactful phenomenon in higher education known as the Massive Open Online Course or MOOC. MOOCs have the ability to disseminate information about a discipline to thousands of people from all corners of the globe and, as the number of MOOC offerings has increased exponentially since the first one was offered in 2011, have the potential for drastically altering the landscape of higher education. Behavior analysis' first MOOC was delivered at Southern Illinois University in the spring 2015, academic semester. In this paper, we (a)

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provide a brief history of the evolution of online teaching up to the point of a few years ago when MOOCs first appeared; (b) describe the history, characteristics, and controversy surrounding MOOCs; (c) sample the paucity of research published to date on MOOCs and their associated outcomes; (d) describe the development and implementation of the SIU MOOC, along with an analysis of data from the MOOC; and (e) share lessons learned from our first MOOC offering and the implications that open access educational resources may hold for the dissemination of behavior analysis.

Brief History of Online Programs

Distance education has been in practice for many years, developing from the late 19th century correspondence education model that was designed for people who were unable to physically attend a class. Studies conducted in the 1960s and 1970s showed that adult correspondence courses, which used regular mail, television, and teleconferencing, were as effective as face-to-face instruction and adult learners had positive attitudes towards it (see Stadtlander 1998). Course delivery via the internet was fully recognized as a modality of instruction by 1994, growing in popularity as a form of instruction when course management systems came into existence (Stadtlander 1998). By 2005, the Online Learning Consortium, formerly known as the Sloan Consortium, reported that online course and program offerings had entered the mainstream of higher education, becoming part of a long-term strategy for most schools: Sixty-two percent of institutions housing on-campus degree programs in the southern region of the USA were offering graduate courses online by that year, and 47 % of those same institutions reported offering entire master's degree programs online (Allen and Seaman 2005). By fall of 2010, almost one third of U.S. post-secondary students reported being enrolled in at least one course online (Hill 2012).

Some have questioned how the quality of online courses can parallel that of face-to-face courses. The Online Learning Consortium has played a major role in the distribution of “best practices” in online pedagogy, through scholarly journals, international conferences, and instructor certificate programs, such that now, with training and support for instructors, online courses need not necessarily be viewed as inferior to face-to-face courses. (The reader is referred to the Online Learning Consortium's website at <http://onlinelearningconsortium.org/> to view the consortium's many resources for institutions committed to online teaching.) Defining characteristics of high-quality online courses include automated grading of course exams or quizzes, brief, previously recorded micro-lectures (i.e., no longer than 15 min), opportunities for interaction among class-mates via blogs, tweets, asynchronous, and synchronous discussion boards or chat rooms, frequent interactions with the course instructor, early and regular

feedback to the student, and authentic, learner-centric activities such as group projects, web “safaris,” problems, case studies, and other “real-world” activities or tasks. Although it cannot be assumed that all online courses or programs are identical, research shows that those that include such “best practices” show outcomes equivalent to, if not better, than their face-to-face counterparts: Jaggars and Bailey (2010) reported that those who complete online courses learn as much as those in face-to-face instruction, earn equivalent grades, and are equally satisfied with their experience.

Online education offers other advantages to the students and faculty who are invested in it: Online education is appealing to researchers interested in studying the interaction between humans and computers (Larreamendy-Joerns and Leinhardt 2006), as every “click” a student makes in a course may provide useful data regarding student engagement in such courses. Online courses may also reduce the cost and time of commuting and may allow students with families and jobs to study on a schedule that is convenient for them (Jaggars and Bailey 2010), thus increasing the availability and accessibility of education. To this end, the term “open coursework” was recently coined by the Massachusetts Institute of Technology (MIT), a leader in the e-transformation, to refer to the availability of online course materials for people *not* enrolled at MIT. Open coursework has made it possible for individuals not enrolled at a university to join some courses (Tett 2013). The MIT open coursework platform has accumulated 100 million learners over the last 10 years (Tett 2013) and is not unlike other free educational resources available online today, including, for example, the Khan Academy, iTunesU, and TED talks.

Although it is clear that the teaching of behavior analysis in online delivery formats is not new, very little is known about the characteristics or efficacy of such courses and programs. It is important for our discipline to become a part of the conversation on the e-transformation, particularly as the possibilities for disseminating our science through open educational resources grow.

Massive Open Online Courses

A recent innovation that has been described by some as a disruption to higher education is Massive Open Online Courses, or MOOCs, the latest development in open access courses (see Pence 2012). MOOCs have only been in existence for a short time but have generated considerable controversy nonetheless. According to the acronym, a MOOC can be defined as follows: “Massive” refers to an extremely large number of participants taking a course at one time. Generally, at least a couple hundred individuals enroll in any given MOOC, with enrollments in some as high as hundreds of thousands of participants—a size that clearly differentiates

MOOCs from other larger, credit-bearing online courses). “Open” refers to open registration—most MOOCs are free or available for a small fee (typically, fees are substantially less than what one would pay for a credit-bearing course) and the course content is freely accessible. “Online” refers to the course being implemented exclusively online, typically as collaborative efforts between a college or university and a second party company, such as Coursera, EdX, or Udacity. Coursera is probably the most well-known MOOC provider, with over five million learners reportedly enrolled in a Coursera MOOC during October 2013 (Radoiu 2014). “Course” refers to MOOC content being organized around learning objectives just like any academic course. Common characteristics of MOOCs include the use of automated feedback for quizzes or exams, peer grading for assignments or papers, brief, previously recorded micro-lectures or presentations by world-renowned figures in the discipline, and the use of social networking or asynchronous discussion to build community among participants who could conceivably be from all over the globe. The instructor, typically recognized for his or her expertise in the field, serves to guide students through course content and facilitate class discussion (Radoiu 2014; see also Kennedy 2014).

The University of Manitoba offered the first MOOC in 2008 on Connective Knowledge. This was followed by a MOOC on Artificial Intelligence at Stanford in 2011, which enrolled 160,000 students. The number of MOOCs has since risen rapidly (the reader is referred to <https://www.mooc-list.com/>, for an aggregate list of currently available courses). Some institutions offer already existing courses as MOOCs, while others offer “special topic” MOOCs, focused upon graduate-level, professional, or leisure topics. Individuals’ reasons for enrolling in MOOCs range from personal improvement, acquisition of professional skills, or to test the waters of a discipline before officially enrolling in an academic program. Some MOOC participants are motivated by the opportunity to obtain a certificate or badge following course completion (Milheim 2013).

One of the advantages of MOOCs seems to be their ability to deliver academic content to millions of people around the world at potentially lower costs, giving students the opportunity to share their knowledge and expertise with one another and manage their own learning (Milheim 2013). Universities have invested millions of dollars into companies such as Coursera and Edx, as well as generated excitement for bringing high-quality education to students who may not have access. Milheim (2013) reports that 70,000 new students per week sign up for courses. Institutions report a number of reasons for implementing MOOCs, including outreach, research, and the expansion of online degree programs (Macleod et al. 2015).

In spite of these potential advantages, MOOCs would seem to question the notion that educators and educational

institutions control learning, as MOOCs make education readily available online for those looking to expand their knowledge (Yeager and Bliss 2013). These concerns are fueled by the courses’ consistently low completion rates, which Radoiu (2014) reports to be typically under 10 %. Stein (2013) found that only about 50 % of those registered for MOOCs through the Pennsylvania Graduate School of Education ever viewed the course material, and only approximately 4 % completed the courses. Recent speculation suggests that many who sign up for MOOCs may actually have no intention of completing the courses, however—many may fully intend to “lurk,” or observe but not actively participate, if even that (Fischer 2014).

Because of the amount of user data they may produce, MOOCs are appealing for those wishing to study the factors that contribute to student success in online courses. A new emerging discipline called learning analytics analyzes user data from log files to understand how learning occurs in a technology-mediated environment (Firmin et al. 2014). For example, Firmin et al. (2014) found that student effort was the strongest indicator of success, with those who engaged in the course frequently and early performing the best. Koutropoulos et al. (2012) examined online discussions and found that about a third of those enrolled met the definition of a “lurker,” or one who, as previously described, logs into a course but engages with content and class-mates only minimally. Unfortunately, the number of published studies on the efficacy of MOOCs is far smaller than the number of opinion articles published on the topic. Fischer (2014) notes that research is necessary to evaluate whether MOOCs work well only for people who are self-motivated, as well as inspire important career changes for those who enroll.

A MOOC in Behavior Analysis and Therapy at Southern Illinois University

Although other public and private universities in Illinois had been offering MOOCs in the years prior, a MOOC entitled, “Behavior Analysis and Therapy and Autism Spectrum Disorders” was selected as Southern Illinois University’s first MOOC, with development to begin in January 2014. Following a year of development, the course was implemented in January 2015. The Behavior Analysis and Therapy program was selected to offer the institution’s first MOOC given the high enrollment in the existing off-campus, on-campus, and online programs, and the specialized training completed by the course instructor, who, in addition to completing intensive workshops and fellowships in online learning at her own institution, became a certified online course instructor through the Online Learning Consortium.

The course was intended to be an introduction to the discipline of behavior analysis with emphasis on autism spectrum

disorders. The 10-week course was divided into seven modules of content, as follows: Autism Spectrum Disorders and Evidence-based Treatment; Introduction to Applied Behavior Analysis; Naturalistic Approaches to Teaching; The Verbal Behavior Approach; Augmentative & Alternative Communication; Behavioral Assessment & Treatment of Challenging Behavior; Interventions for Adolescents and Adults; and the Professional Discipline. Students were given additional time during the course's final weeks to complete a project, critique that of a peer's, and complete an exit survey. Marketing for the course began in spring 2014 and included massive mailings, emailings, social media, distribution of flyers at conferences, and a promotional website maintained by SIUC's Office of Extended Campus, who also maintained a mailing list for individuals interested in the course. Human service and school professionals who were already familiar with behavior analysis and were working with clinical populations were heavily recruited for the course. We anticipated that such individuals would find the course to be a positive experience and seriously consider furthering their formal academic training in behavior analysis upon conclusion of the course. If they did not pursue formal training, we hoped that the MOOC participants would nonetheless come away with an interest in and appreciation for the discipline that could be shared with others.

A number of university staff and professionals were involved in the marketing and development of the course, including staff from the Office of Extended Campus, the Center for Teaching Excellence, Disability Support Services, and Legal Counsel. Total costs associated with the development and implementation of the course were estimated to be \$52,078.68.

The course was created in conjunction with the Desire2Learn Open Courses platform. The course included 7 weeks of content, an introductory and orientation week, and two final weeks for students to post and discuss a final project and complete an exit survey. Course content included publically accessible YouTube videos, publically accessible journal articles from journals such as *Behavior Analysis and Practice*, for which content is freely available through Pub Med Central, and relevant websites for such organizations as Autism Speaks and the Association for Science in the Treatment of Autism, to name a few. The course also included content that was prepared specifically for the course, including lectures by the course instructor, research presentations by other program faculty, podcast and video interviews arranged with other internationally recognized researchers and leaders in the field, including, for example, the executive directors and CEO's for both the Association for Behavior Analysis International and the Behavior Analysis Certification Board (Dr. Maria Malott and Dr. Jim Carr, respectively), as well as Dr.'s Linda LeBlanc of Trumpet Behavioral Health and Dr. Andy Bondy of Pyramid Consultants. Each module included a 20-question multiple-choice quiz, and participants were allowed

three attempts to attain a score of 16/20, or 80 %, mastery. All of the content was available for participants to complete according to their own time and schedule, but each module was designated a specific calendar week in the course syllabus. The course used extensive asynchronous discussion, in which students were required to respond to the instructor's discussion questions during each week and then respond to a specific number of class-mates' posts, specifically referencing content for that module. In some modules discussion centered on "web safaris" that students completed, where they conducted their own online research on a variety of topics and posted what they learned, such as, for example, internationally recognized agencies or schools specializing in the treatment of severe challenging behavior. In other modules, students viewed presentations by SIUC faculty and then played "Ask the Expert" with the particular presenter, which involved presenting a question on the presentation in class discussion and receiving a response from the presenter within 24 h. Additional tools to promote engagement during the course included regular postings of "news" announcements or clarification from the course instructor, regular participation by the instructor in class discussion, and Kwik Polls (see <https://kwiksurveys.com/>) and Answer Gardens (see www.answergarden.com), where students had further opportunity to share their input and view input from their class-mates.

A final project was required in the course. Students had the option of selecting from two projects, one of which involved the critique of a journal article evaluating the efficacy of some behavioral intervention, the other of which involved the researching of a fad or bogus treatment for ASD. Students posted their projects in the class discussion forum, where it was graded by the instructor, and they were likewise required to provide a critique of five of their class-mates' projects. Students who attained a score of at least 80 % on module quizzes received a badge each week. A certificate was delivered at the end of the course for students who scored an 80 % in the course overall.

The course captured several best practices in online teaching, including strong instructor presence; high interaction with class-mates; automated grading and repeated attempts allowed until mastery; peer grading; brief video lectures; a variety of multimedia; projects; and numerous opportunities to provide input via asynchronous discussion and other tools (see Bonk and Zhang 2008). Table 1 summarizes the key features of the course that reflect best practices in online teaching. Figure 1 shows a screenshot of learning activities associated with one of the course modules. Figure 2 shows an example of student and instructor interaction occurring during asynchronous discussion. Figure 3 displays examples of two interactive features of the course, including Kwik Polls and Answer Gardens

Table 1 Defining features of the MOOC

Automated grading of weekly quizzes with 3 attempts allowed to attain mastery
Weekly badges distributed to students who attained mastery criterion for the particular module
Certificate of completion upon conclusion of the course
Asynchronous discussion with requirements to respond to a specified number of class-mates' posts
Instruction self-paced within each module
Regular and frequent interaction with course instructor via announcements and class discussion
Opportunities for interaction via Kwik Poll and Answer Gardens
Assigned project with peer critique
Web safaris
"Ask the Expert:" Video presentations from experts with the opportunity to engage in class discussion with those experts
Podcast and video interviews with experts and leaders in the field
Variety of multimedia learning experiences including YouTube videos and access to scholarly journal articles

Participant Demographics

Participants provided informed consent for their demographic information to be utilized following completion of the course via their completion of an exit survey. Forty-five of the individuals enrolled in the course completed the survey on the specified due date, so demographic information is available for only those forty-five individuals. It can be assumed that the participants who completed the exit survey, which was only available following the final module, were the same

individuals who completed the course and obtained a certificate of completion. Survey results revealed that 84 % of respondents enrolled in the course due to a personal interest in the topic. Forty-nine percent of respondents indicated that they learned about the course through friends or colleagues, whereas 22 % learned about the course through Facebook. Thirty-eight percent of those who completed the exit survey indicated that they were employed in a setting working alongside a Board Certified Behavior Analyst(s) at the time of the course. Forty-nine percent of respondents were 25–34 years old at the time of the course, and 90 % were female. Eighty-seven percent of respondents were not attending school at the time of the course. Thirty-six percent had a Bachelor's degree, while 31 % held a Master's degree. Eighty-two percent of all respondents resided in North America. Other countries besides the USA represented in the course included Columbia, Thailand, UK, and the United Arab Emirates.

Participants' Performance and Engagement in Course

Overall, course data indicated that 65 out of the 327 participants (20 %) met the course mastery criterion and achieved a certificate of completion. Sixty-five users (20 %) completed some amount of work but did not attain mastery to earn a certificate of completion. One hundred and ninety-seven students registered for the course but did not complete any work.

The overall average duration that users dedicated to the course content was recorded as 39:54. Shown in Fig. 4 is the number of users who visited course content and the average time spent engaged in content. The figure shows that the most

Fig. 1 Screenshot of examples of learning activities from course

Applied Behavior Analysis with Adolescents & Adults with Autism

- Read** Renee and Barry Gordan's article from the Autism Speaks website, [What Can Be Done to Help Parents of Autistic Adults. What support needs do you think parents of adults with the disorder may have, and how can a behavior analyst help?](#)
- Read** [Teaching Teamwork to Adolescents with Autism](#) by Taylor and colleagues, and [Rapid Training of a Community Job Skill to Nonvocal Adults with Autism](#), by Lattimore and colleagues, for a taste of the types of interventions that have been used with the adolescent and adult population. (Articles provided courtesy of the PubMed Central website.) In both of these studies, see if you can grasp the details of the interventions used and what the results showed about the particular intervention.
- Do a Web Safari** on well-known agencies that provide behavior analytic services for adults with autism spectrum disorder. First, choose one of the agencies from the following list: [Trumpet Behavioral Health](#); [Alpine Learning Group](#); [The Princeton Child Development Institute](#); or [The May Institute](#). Second, post on the Discussion board what you learned about the agency's program(s) for adults, and anything else you learned as you perused the site. Have fun! **Post on Discussion Board.**
- View** a CBS story about employment opportunities for adults with autism spectrum disorder. Pay attention to the unemployment rates for this population, as well as the challenges facing adults with autism who desire meaningful employment. Importantly however, what benefits might a person with autism bring to specific job settings? (Video is owned by Fast the News, and is publically accessible on YouTube.)

[\(Click here for Closed Captions\)](#)

Fig. 2 Example of interaction that occurred during asynchronous discussion between instructor and students during the course. Student names have been blocked out

users visited the Course Orientation module, and the number of users who engaged with content steadily declined after that. The module for which the most time was dedicated was the module on Interventions for Adolescents and Adults, in which an average time of 8:24 was recorded. Figure 5 shows the number of discussion threads and replies for each of the course's modules. The figure shows that module 2 on Introduction to Applied Behavior Analysis generated the most discussion among MOOC participants. Average quiz scores ranged from 90 to 96 %. Figure 6 shows the number of users per unit or module who submitted quizzes. Module 1 had the most submitted quizzes by users (123 users), while the users who submitted quizzes for the remaining modules ranged from 69 to 94 and steadily declined over the span of the course.

Participants' Satisfaction with Course and Future Plans

Participants indicated their satisfaction with the course via the same exit survey from which demographic information was obtained, so satisfaction results are reported for the 45 individuals who completed the survey on the specified due date. Eighty-seven percent of respondents indicated that they were able to keep up with the pace of the course, and 87 % indicated that they received sufficient assistance while they were taking the course. Forty-two percent of respondents found the module on behavioral assessment and treatment of challenging behavior to be the most beneficial and interesting. When asked which components of the course

participants were most motivated by, the content itself and the opportunity to obtain a certificate were noted as the biggest motivators (64 %). Class discussions were found to be the most motivating for 44 % of respondents, the weekly point system was found to be the most motivating for 49 % of respondents, and instructor's regular communication was found to be the most motivating for 40 % of respondents. Weekly badges were the most motivating course component for 25 % of respondents, as were the interactive activities such as Kwik Polls and Answer Gardens. All respondents indicated that they would recommend the course to others.

When asked whether they would be exploring formal academic training in behavior analysis after completing the course, 60 % indicated that they would be. Fifty-six percent indicated that they would pursue national certification in behavior analysis sometime in the future following their completion of the course.

Discussion

Student Engagement

The 20 % completion rate obtained for our first MOOC offering may seem startlingly low given the large number of individuals enrolled in the course, but this number is actually higher than what might be expected on the basis of the published literature: Radoiu (2014) identified MOOC completion rates as typically being under 10 %, while Stein (2013) reported completion

Fig. 3 Examples of interaction that occurred using Kwik Polls and Answer Gardens

rates to be as low as 4 %. Thus, if completion rate is viewed as one measure of success, it appears that ours was, at least in comparison to the published standards on completion rates. It may well be the case that many of the individuals who enrolled in the MOOC had no intention of completing the course whatsoever. The MOOC may have offered some benefits for those who enrolled, including the opportunities to

test out a subject matter and acquire new knowledge. An individual who enrolled in the course may have experienced these benefits without necessarily completing the course. Why our completion rate was higher than that reported for prior MOOCs is uncertain. The course employed a number of strategies to enhance participants' engagement, including frequent opportunities for interaction with the instructor and

Fig. 4 Number of students who visited the site and the average number of minutes spent engaging in each module

Fig. 5 Total number of responses during asynchronous discussions for each module

other students, weekly badges for those who attained mastery criterion during each module, and the opportunity to retake quizzes until mastery. How these strategies contributed to student engagement is a question that warrants future investigation.

Although our completion rate was higher than expected, we observed a steady decline in engagement over the course of the class. This decline in both the time allocated to course content and the number of students who engaged in the course content suggests that the various features of the course designed to sustain student engagement were not sufficient as the course progressed. Indeed, survey data for the small number of students who completed the exit survey suggested that the weekly badges and regular interaction with others were not the most powerful motivator. Rather, the certificate of completion available at the end of the course was most frequently identified as the feature of the course that motivated participants to continue. The functions of this certificate may well have varied for the course's participants. Some may have documented the certificate on their resumes, while others may have been encouraged to obtain the certificate by a supervisor or manager. That promise of such a certificate may be an important variable in sustaining participant engagement in open access courses is telling.

Fig. 6 Number of quizzes submitted for each module

Our findings underscore the need to empirically evaluate many documented “best practices” in online pedagogy, including those disseminated by the Online Learning Consortium’s. If some of the strategies employed in this course were not sufficient for sustaining engagement for hundreds of individuals, it may be the case that those who completed the course would have been just as likely to complete a course that lacked the regular, ongoing interaction with the instructor and other students that our class provided—particularly if a certificate of completion was available at the end of the course. It is unlikely that MOOCs with thousands of participants provide similar opportunities for interaction as our course, as instruction in very large courses may be completely automated. Future research should isolate the differential effects that instructor presence and interaction with others may play in enhancing student engagement in large online courses.

Evaluating the success of our MOOC relative to MOOCs from other institutions is difficult due to the different measures of success that an institution might employ. As previously mentioned, the completion rate for our MOOC was higher than that typically reported. A reasonable concern for other institutions wishing to offer MOOCs is the sheer cost to develop and implement the course. In addition, MOOCs may well prove to operate on a cost-recovery model, particularly as more and more institutions offer academic credit for their MOOCs. Lin (2013–2014) reported that Arizona State University, the University of Cincinnati, and the University of Arkansas system, at the time the article was published, decided to convert introductory courses from their existing online courses into MOOC courses. The courses are to be free to anyone but will carry credit for learners anywhere in the world who will pay certain fees to subsequently complete a degree program (Lin 2013–2014). In evaluating the success of the first MOOC offering at Kennesaw State University, Stansbury (2015) discussed other measures of success beyond student completion rate, including institution branding and student access. The institution’s leadership team evaluated the number of unique visitors, social media mentions, new Twitter followers, and course institution awareness and concluded that

the number of learners engaged in materials produced and made available by the institution defined the success of the course (Stansbury 2015). Thus, although the costs certainly appear to be prohibitive, Lin (2013–2014) concluded that if MOOCs are expected to achieve an acceptable level of quality, they are unlikely to be an inexpensive endeavor for institutions.

Implications of MOOCs for Behavior Analysis

Many students who completed the exit survey reported that they would be pursuing formal academic training in behavior analysis in the future, and all of the individuals who completed the exit survey indicated that they would recommend the course to others. At the time that this article was submitted, eight individuals from the MOOC had applied to one of our institution's academic programs in Behavior Analysis and Therapy. Thus, our discipline as a whole might consider the role that MOOCs may play in stimulating interest in the discipline, particularly from areas of the globe with less representation in the field (our course included representation from five countries). At some institutions, MOOCs are used as components of introductory courses, while others are targeted specifically for high school students exploring career options (Rowley 2015). Future MOOCs in behavior analysis may well be conceptualized as tools by which to recruit younger populations into the discipline. Little is known from the published literature about what percentage of MOOC participants can be expected to officially enroll in an academic program following their completion of the course. Longitudinal analyses are certainly warranted to determine the degree to which MOOCs may actually serve as a platform into an academic discipline for those who complete them.

MOOCs may also provide a role in delivering specialized training for professionals already working the field. McAfree™, for example, recently converted an 80-h new-hire orientation into a MOOC, which was reported to save time and increase sales revenues for the company by \$500,000 per year (Meister 2013). Likewise, in 2014, the U.S. Department of Education endorsed four universities to deliver continuing education units for teachers through MOOCs, allowing school districts a convenient and low-cost way to enhance professional development (Duke Online Education Initiatives 2014). Finally, Liyanagaunawardena and Williams (2014) reported that MOOCs are being implemented more frequently in healthcare and medical fields to increase continuing education for healthcare professionals, provide supplemental courses for healthcare students, and increase health literacy and education for professionals, patients, and the general population. For behavior analysis, future MOOCs could provide supplemental training for school and agency personnel and continuing education units for board certified professionals.

MOOCs as Teaching Machines

Recent years have seen a growing disenchantment with traditional methods of teaching among college educators. The traditional lecture format, the original purpose of which was to disseminate information to students prior to the widespread printing of textbooks, is finally being replaced with more “learner-centric” approaches to teaching, by such names as the “flipped classroom,” problem-based learning, and team-based learning, to name a few. Skinner (1961) forecasted numerous limitations with traditional approaches to teaching, describing the teacher as the one who “imparts information” by “exposing students to verbal and nonverbal material and calling attention to particular features of it” (Skinner 1961, p. 229). Skinner (1961) depicted the student as more than a mere receiver of information, but rather as an “active” learner who is to engage in meaningful behavior if learning is to occur. Online courses, because they require more independence and initiation from students, may be particularly feasible for the incorporation of learner-centric approaches. High-quality online courses typically present many requirements for students to engage in meaningful behaviors, via, for example, projects, exploration of digital media, and class discussion—far more than what might be encountered in a predominantly lecture-based course (the reader is referred to Bonk and Zhang 2008).

Skinner (1958) offered a number of examples of ways that teaching machines may make teaching more efficient. Skinner (1958, p. 969), stated that, “even in a small classroom the teacher usually knows that he is moving too slowly for some students and too fast for others. Those who could go faster are penalized, and those who should go slower are poorly taught and unnecessarily punished by criticism and failure. Machine instruction would permit each student to proceed at his own rate.” MOOCs, including ours, would seem to capture the benefits Skinner described with “machine instruction,” with exams and quizzes scored automatically and feedback delivered immediately. In addition, our MOOC participants proceeded through each module at their own pace and were allowed three attempts until mastery for each module's quiz. Between quiz attempts, they were permitted to look back at their course material. Skinner (1958) emphasized that well-devised teaching machines ensure that students move through a carefully designed sequence of steps at their own natural rate and are immediately reinforced. Skinner (1961) additionally suggested that students should be required to compose responses, rather than simply select response options from a set of alternatives, for teaching machines to be used effectively. A limitation of our MOOC is its utilization of multiple-choice quizzes, which targeted only student recognition. Future work may explore the use of intelligent agents in grading students' written work. In addition, future MOOCs in our discipline should explore the feasibility of being entirely

self-paced. As such, well-designed, carefully executed MOOCs could well be regarded as modern-day teaching machines (see Demuth 2014). Future research should determine the conditions under which Skinner's nearly 50-year-old notion of a teaching machine is effective.

MOOCs as Vehicles for Research on Pedagogy

Some behavior analytic researchers have rightfully focused their energies on evaluations of pedagogical approaches in college teaching. Popular topics of investigation have included interteaching, response cards, and guided notes, to name a few (see also Michael 1991). With more and more courses and programs in the discipline being offered online, we have the responsibility to evaluate the efficacy of our instructional methods that are tailored for the online modality. MOOCs offer the ability to track numerous measures of student engagement for numerous individuals at a time. Our MOOC, for example, recorded the time students allocated to the individual learning activities within each module. We were also able to record the number of discussion board postings, the number of times quizzes were retaken, and of course, scores throughout the course. One could conceivably correlate any of these measures with students' overall outcomes in the course, so that predictors of student success could be identified. Such analyses would enable researchers to establish the conditions under which teaching machines are effective (Skinner 1961).

Certain ethical obstacles may make analyses of this sort untenable. One obstacle concerns the feasibility of collecting informed consent from many users. An additional obstacle concerns the rights of individuals enrolled in MOOCs to know that their user data is secure and private (see Robbins 2013). The latter issue has raised particular controversy with regards to the population of individuals under 18 enrolling in MOOCs. EdX, a popular MOOC platform, explicitly states in its privacy policy that the company will only obtain the data that allows for the company to understand how participants learn. Some universities and edtech companies have developed pledges that state they will adhere to proper ethical guidelines when dealing with student data. As open access online educational resources continue to proliferate, conversations regarding strategies for conducting research on student learning that ensures the protection of participants will be critical.

Conclusion

The purpose of this article was to describe the role of MOOCs in the advancement of online education and to propose how MOOCs may benefit the field of behavior analysis. We also described the development and implementation of the MOOC offered on Behavior Analysis and Therapy and Autism

Spectrum Disorder at Southern Illinois University. We propose that MOOCs may serve as a vehicle for disseminating our science around the globe, recruit new persons into our field, and deliver training and supports for professionals already working in the field. We also discuss the parallel between MOOCs and Skinner's (1961) earlier conceptualization of teaching machines and suggest that MOOCs may have an important role in behavior analytic investigations of learning in online courses, investigations that, as a discipline, we have a responsibility to undertake.

Acknowledgments We gratefully acknowledge support from SIUC Extended Campus and the Center for Teaching Excellence

References

- Allen, I. E., & Seaman, J. (2005). *Growing by degrees: Online education in the United States, 2005*. Wellesley, MA: Sloan-C.
- Bonk, C. J., & Zhang, K. (2008). *Empowering online learning*. San Francisco, CA: Jossey-Bass.
- Demuth, P., How B. F. (2014). Skinner will save online education. Retrieved from <http://www.forbes.com/sites/phildemuth/2014/10/15/how-b-f-skinner-will-save-online-education/>
- Duke Online Education Initiatives (2014). DOE Endorses Duke MOOCs for Teacher Professional Development. Retrieved from <https://online.duke.edu/doe-endorses-duke-moocs-teacher-professional-development/>, May, 2015.
- Firmin, R., Schiorring, E., Whitmer, J., Willett, T., Collins, E. D., & Sujitparapitaya, S. (2014). Case study: Using MOOCs for conventional college coursework. *Distance Education*, 35(2), 178–201. doi:10.1080/01587919.2014.917707.
- Fischer, G. (2014). Beyond hype and underestimation: Identifying research challenges for the future of MOOCs. *Distance Education*, 35(2), 149–158. doi:10.1080/01587919.2014.920752.
- Hill, P. (2012). Online educational delivery models: A descriptive view. *Educause Review*, November/December, 47(6), 85–97. Retrieved from <http://www.educause.edu/ero/article/online-educational-delivery-models-descriptive-view>.
- Jaggars, S. S., Bailey, T. (2010). Effectiveness of fully online courses for college students: Response to a department of education meta-analysis. *Community College Research Center*, 1–16. Retrieved from <http://files.eric.ed.gov/fulltext/ED512274.pdf>, February, 2015.
- Koutropoulos, A., Gallagher, M. S., Abajian, S. C., Waard, I., Hogue, R.J., Keskin, N. Ö., & Rodriguez, C. O. (2012). Emotive vocabulary in MOOCs: Context & participant retention. *European Journal of Open, Distance and E-Learning*. Retrieved from <http://www.eurodl.org/?p=current&article=507>
- Kennedy, J. (2014). Characteristics of massive open online courses (MOOCs): A research review, 2009–2012. *Journal of Interactive Online Learning*, 13, 1–16.
- Larreamendy-Joerns, J., & Leinhardt, G. (2006). Going the distance with online education. *Review of Educational Research*, 76(4), 567–605.
- Lin, H. (2013–2014). Going to college online? A PEST analysis of MOOCs. *Journal of Educational Technology Systems*, 42, 369–382.
- Liyanagunawardena, T. R., & Williams, S. A. (2014). Massive open online courses on health and medicine: review. *E-Learning and Medical Education*, 16. Retrieved from <http://www.jmir.org/2014/8/e191/>
- Macleod, H., Haywood, J., & Woodgate, A. (2015). Emerging patterns in MOOCs: Learners, course design and directions. *TechTrends*, 59(1), 56–63.

- Meister, J. (2013). How MOOCs will revolutionize corporate learning and development. *Forbes/Leadership*. Retrieved from <http://www.forbes.com/sites/jeannemeister/2013/08/13/how-moocs-willrevolutionize-corporate-learning-development/>
- Michael, J. (1991). A behavioral perspective on college teaching. *The Behavior Analyst*, 14, 229–239.
- Milheim, W. D. (2013). Massive open online courses (MOOCs): Current applications and future potential. *Educational Technology*, 53(3), 38–41.
- Pence, H. E. (2012). When will college truly leave the building? If MOOCs are the answer, what is the question? *Journal of Educational Technology Systems*, 41, 24–33.
- Radoiu, D. (2014). Organization and constraints of a recommender system for MOOCs. *Scientific Bulletin of the Petru Maiu University of Tirgu Mures*, 11, 55–59.
- Robbins, J. (2013). The ethics of MOOCs. *Inside Higher Education*. Retrieved from <https://www.insidehighered.com/blogs/sounding-board/ethics-moocs>, July, 2015.
- Rowley, S. H. (2015). Northwestern launches new MOOCs in health care, business. Retrieved from <http://www.northwestern.edu/newscenter/stories/2015/03/new-moocs-launched-in-health-care,-business1.html>, July, 2015.
- Skinner, B. F. (1958). Teaching machines. *Science*, 128, 969–977.
- Skinner, B. F. (1961). Why we need teaching machines. *Harvard Educational Review*, 31, 377–398.
- Stadtlander, L. M. (1998). Virtual instruction: Teaching an online graduate seminar. *Teaching of Psychology*, 25(2), 146–148.
- Stansbury, M. (2015). Is there more to a MOOC than its completion rate? eCampusNews. Retrieved from <http://www.ecampusnews.com/top-news/mooc-course-completion-973/>, November, 2015.
- Stein, K. (2013). Penn GSE study shows MOOCs have relatively few active users, with only a few persisting to course end. Penn GSE Press Room. Retrieved from <https://www.gse.upenn.edu/pressroom/press-releases/2013/12/>, March, 2015.
- Tett, G. (2013). Welcome to the virtual university. Retrieved from <http://www.ft.com/cms/s/2/3bc52f0c-6b38-11e2-9670-00144feab49a.html>
- Yeager, C., & Bliss, C. (2013). CMOOCs and global learning: An authentic alternative. *Journal of Asynchronous Learning Networks*, 17(2), 133–147.