

Canine Theriogenology for Dog Enthusiasts: Teaching Methodology and Outcomes in a Massive Open Online Course (MOOC)

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ABSTRACT

A massive open online course (MOOC) in canine theriogenology was offered for dog owners and breeders and for veterinary professionals as a partnership between the University of Minnesota and Coursera. The six-week course was composed of short video lectures, multiple-choice quizzes with instant feedback to assess understanding, weekly case studies with peer evaluation to promote integration of course materials, and discussion forums to promote participant interaction. Peak enrollment was 8,796 students. The grading policy for completion was strict and was upheld; completion rate for all participants was 7.5%. About 12% of participants achieved a grade of over 90% in the course, with those who had any deficiency mostly missing one quiz or assignment. Ninety-nine individuals were enrolled in a for-cost, credentialed pathway, and 50% of those individuals completed all required course components. Pre- and postcourse surveys were used to demonstrate that learning objectives were met by the participants and to identify that lack of time to commit to study was the biggest impediment to completion. Positive aspects of the course were active engagement by participants from all over the world and the ability of this university and instructor to reach those learners. Negative aspects concerned technical support and negative feedback from some participants who were unable to meet course requirements for reasons beyond the control of the instructor.

Key words: educational methods, outcomes, reproduction

INTRODUCTION

Educators have long wondered how best to provide materials and instruction for learners at distant sites. Distance education has evolved in association with changing technology from correspondence courses that relied heavily on postal distribution and return of materials, through dissemination of information by radio or television, to the current use of computer technologies ranging from Websites as simple repositories for information to use of video conferencing and facilitation of discussion groups around the world.^{1,2}

Widely available coursework managed through the Internet has been available since 2003. Massive open online courses, or MOOCs, have been available only since 2008, and only in the past year or two have a significant number of such courses have been available. The term MOOC was coined by George Siemens and Stephen Downes at the University of Manitoba. Professors at Stanford University were the first to offer a suite of courses; Stanford offered three courses through its computer science department in 2011, with some of those professors starting their own company, Udacity, to support them. Harvard University and the Massachusetts

Institute of Technology joined forces to create yet another company, EdX.² A third company, Coursera, was started in 2012 and currently boasts 74 global university partners, providing a wide variety of MOOCs in the arts, business, computer science, education, engineering, law, life sciences, mathematics, media, and other categories. The majority of these courses are offered in English, but courses are also offered in Spanish and French, and a small number are offered in other languages. Coursera has enrolled more than 4.3 million students, with almost 16 million course enrollments.³

The goal of these courses is to provide education to anyone in the world who has access to the Internet, helping them in their careers and expanding their personal networks.⁴ The size of these courses precludes personal interaction of the instructor with each student, making the quality of the material provided and interaction among students even more important than in the average online course. Participants cite the great value of interaction with peers as they learn information through interaction, described by one individual as “learning through the back channels.”^{5(p.35)} The intent is to integrate the connectivity of a network of engaged individuals, the facilitation of an expert, and a body of resources to help

the group develop a better understanding of a given topic.⁶

Massive refers to the enrollment, which in most courses is more than 1,000 and in some courses is in the hundreds of thousands. *Open* generally refers to cost; these courses have historically been offered free of charge to anyone with an Internet connection. Coursera strongly supports the availability of coursework for free, even asking instructors not to require texts or otherwise make complete participation in the course difficult for enrollees who are at an economic disadvantage. *Open* can also refer to use of open-source software, free access to information, students and instructors open to a new way to teach and learn, or an open schedule and syllabus in some MOOCs.² *Online* refers to the Web-based format. There is no expectation that handwritten materials will be required as coursework or graded by the instructor, and course resources are available electronically.

Two general kinds of MOOCs have been described, cMOOCs and xMOOCs.² cMOOCs are connectivist MOOCs. The course has a set topic, but the course schedule and syllabus are very fluid, with every expectation that the participants will determine what they want to study and will guide each other in review of those materials. xMOOCs are broadcast MOOCs and more closely resemble traditional online courses, with presentation of course materials through various media and varying assignments and assessments. To date, the author is aware of only two MOOCs offered in veterinary medicine, an equine nutrition course offered by the Royal (Dick) School of Veterinary Studies at the University of Edinburgh in January 2013 and the course described in this article.

To date, these courses have not been offered for credit through the university sponsoring the course. In a survey of professors who had offered MOOCs, the majority felt that online courses should be integrated into the traditional system of credits and degrees.⁷ Institutions have not embraced this type of coursework because of concerns about proctoring and instructors' inability to assess learners' competence directly. Participants in courses offered through Coursera can earn a Statement of Accomplishment by meeting the specific criteria set by the course instructor. Coursera also offers participants a process to identify themselves through a proctoring system called the Signature Track; this may increase the value of the Statement of Accomplishment because the individual is known to have earned it. It bears a cost for the participant.

The University of Minnesota partnered with Coursera early in 2013 with the intent of providing as many as five MOOCs. The university's goals in participating in this fairly new form of education were to explore the potential of new technologies for broad-based national and international audiences and to improve access to education through the University of Minnesota for professionals and lifelong learners. It was hoped that these MOOCs would expand the university's reach and reputation, enhance knowledge of this kind of online training among the faculty members, and create course materials that could be used for other online courses and for blended courses offered at the University of Minnesota.

Faculty members interested in participating submitted their ideas to the provost's office. Those faculty members chosen to provide MOOCs in the first round were generally more experienced teachers and had some experience and materials for online teaching, which helped the university and Coursera prepare courses on a fairly tight timeline. This article details the creation, running, and outcomes of a broadcast MOOC titled "Canine Theriogenology for Dog Enthusiasts," which was offered over 6 weeks in the spring of 2013.

MATERIALS AND METHODS

Theriogenology is a very specific topic within veterinary medicine that is not covered in all veterinary school curricula, making it a subject potentially of interest to those in the veterinary profession and to laypeople, especially dog breeders and fanciers. Topics covered in this MOOC were those identified as being of greatest interest to dog breeders, as determined by a survey of dog breeders at various educational venues in which the instructor had participated, and those disease conditions most commonly seen in veterinary practice, as determined by a survey of practitioners.⁸ The course outline generally followed that of a text written by the instructor for dog breeders; this text was recommended but not required for the course.⁹ Course-level learning objectives for all participants were as follows:

- to use knowledge of dog anatomy and reproductive biology and physiology to answer questions about reproduction in the bitch and stud dog, including breeding management and diseases of the reproductive tract.
- to seek understanding about controversial topics related to dogs and reproduction (e.g., spaying and castration) and discuss the science behind them, with a goal of understanding different perspectives and why people disagree.

The university provided the instructor with resources to ensure quick creation of a high-quality course. These resources included librarians for management of copyright issues and assistance with links to resources; an instructional designer to ensure attention to the concerns specific to the creation of a course that would not permit direct engagement of the instructor with each student; an information technology professional to assist with construction of the course site and course materials and to act as an intermediary with technical professionals from Coursera; videographers for creation of video lectures; and money for a teaching assistant. The instructor identified a third-year veterinary student with great interest in theriogenology who was hired as the teaching assistant for this course. The university created a tracking system that was used during creation and implementation of the course to capture the number of hours of effort and kind of work performed.

The course design was based on principles espoused by Quality Matters and other agencies that review online courses for efficacy in instruction. The grading policy and deadlines were prominently posted. A "Read This First" document was posted, leading students through the course

Table 1: Course schedule with topics and learning objectives

Week	Topic	Learning objectives: At the end of this session, the student will be able to
1	Female dog anatomy: The estrous cycle	<ul style="list-style-type: none"> • Describe the normal reproductive anatomy of the bitch. • Explain why it is more difficult to perform reproductive diagnostics in the bitch than in other species. • Describe physical, behavioral, cytologic, and hormonal changes for each stage of the estrous (heat) cycle of the bitch. • Explain differences between a menstrual cycle and an estrous cycle.
2	Breeding management: Pregnancy and whelping	<ul style="list-style-type: none"> • Explain methods for determination of ovulation day in the dog. • Describe timing of breeding relative to ovulation for different types of breeding and semen. • Discuss pros and cons of various pregnancy diagnosis techniques in the bitch. • Describe the normal sequence of parturition (giving birth) in the bitch. • Identify when dystocia (difficulty whelping) is occurring.
3	Female dog reproductive tract disorders	<ul style="list-style-type: none"> • Describe the basic pathology and clinical signs associated with common diseases of the uterus, vagina, and mammary glands in the bitch.
4	Male dog anatomy: semen collection and evaluation—artificial insemination	<ul style="list-style-type: none"> • Describe the normal reproductive anatomy of the male dog. • Describe normal testicular descent. • Describe semen collection by manual ejaculation. • Explain performance and significance of findings for the components of a semen evaluation. • Describe types of semen, types of insemination, and variation in timing with each for artificial insemination in dogs. • Explain variation in conception rate with natural service and artificial insemination in dogs.
5	Male dog reproductive tract disorders	<ul style="list-style-type: none"> • Describe the basic pathology and clinical signs associated with common diseases of the testes, penis, and prostate in the male dog.
6	Contraception and sterilization of female and male dogs	<ul style="list-style-type: none"> • Differentiate contraception from sterilization. • Describe current techniques for contraception in dogs. • Explain benefits and detriments of gonadectomy in dogs.

materials, explaining what the course would and would not cover, and explaining assignments and assessments. There were multiple links to guide students to course materials; for example, the Discussion Forum for a given week could be accessed either through a link on the left under Discussion Forums or in the materials for that week. The course was 6 weeks in duration, with a general overriding topic and two segments within that topic each week. Each segment consisted of a short video lecture, supplementary videos if appropriate, and course notes. A multiple-choice quiz was used to check for understanding at the end of each segment. Other assignments and assessments included a case study for each week and, for advanced students, a Further Discovery question; these are described later. Learning objectives for each week were posted in the introduction for that week (Table 1).

Materials used for the MOOC included course notes, video lectures, narrated videos demonstrating techniques or physiological phenomena, assignments, and assessments. For course notes, the instructor used notes that had been prepared for courses in the veterinary curriculum and for continuing education for practitioners. Course notes were rewritten to ensure understanding by the lay audience, and a digital glossary was created.

Lectures were provided as short (20 minutes or less) videos. Video lectures had been prepared by the instructor for use in the veterinary curriculum; the lectures and accompanying PowerPoint slides were reviewed and altered as needed to ensure understanding by a lay audience. Resources were provided by the university to permit recording of these video lectures with high production values, incorporating PowerPoint slides and visual representation of the instructor to ensure exposure to important details of material presented while maintaining audience attention.

The instructor had over several years created a set of instructional videos demonstrating techniques (e.g., semen collection and insemination) and physiological phenomena (e.g., contractions during labor). These videos had historically been used during lectures in the veterinary curriculum, with the instructor providing narration in real time as they were shown in class. For this course, narration was overlaid as an audio track so the narrated videos could be posted on the Website and viewed as participants wished. The instructor also identified videos that were publicly available on the Internet (e.g., normal canine breeding behavior and normal whelping).

Assignments were intended to promote review of course material for both segments in a given week and

continuing review in subsequent weeks. A case study was presented each week, and the participants were asked what advice they would give or information they would provide. Students posted this response in a specific tool within the course Website. After the deadline for submission, students would reopen that tool and would be provided with answers from two colleagues to review. The intent was not for students to grade each other but rather to provide for each other an idea of where their answers agreed or differed and what follow-up questions they would ask. The intent was to provoke thought through peer review, recognizing that there might be broad differences in knowledge between those answering and reviewing. The instructor read a sampling of submitted case studies each week and responded with a general assessment as an announcement to the whole class. Peer reviews were not readily available for the instructor to read. There was also an optional assignment each week, titled "Further Discovery," that was a question peripherally related to topics discussed that week that would require review of outside sources to answer. Participants were provided with a video lecture created by the veterinary school librarian showing them how to access free veterinary literature and talking them through different kinds of materials (primary research studies and review articles in the peer-reviewed literature vs. lay articles). A sampling of submitted responses was read by the instructor, and a model answer was provided for participants at the end of each week.

Assessments consisted of multiple-choice quizzes after each segment. Quizzes varied in length from two to four questions, and immediate feedback was provided, showing the correct answer with an explanation of why various foils were correct or incorrect. Participants could take each of the quizzes as many as 100 times. Order of the questions varied at each iteration of a given quiz to promote the students' reading the questions and not just memorizing the answers in order.

The grading policy was explicit. To achieve a Statement of Accomplishment, participants had to complete all 12 multiple-choice quizzes with correct answers for all questions, had to submit all six case studies, and had to review 12 case studies as a peer reviewer.

Discussion forums were available for introduction of participants, to encourage formation of study groups, to directly inform the instructor of problems with course materials, to directly contact Coursera with technical concerns and, for each week of the course, for general discussion of course content. Students were informed that not all questions posted on the weekly discussion forums would be answered, but that the instructor and teaching assistant would survey the forums and would post information twice weekly to ensure clarity of course materials presented and to address concerns or misunderstandings brought forward by a large number of participants.

Precourse and postcourse surveys were generated by the team at the University of Minnesota. The study was approved by the Institutional Review Board. The precourse survey was open to all participants as they enrolled. The postcourse survey was sent only to those who had filled out the precourse survey. Questions con-

cerned demographic information, information about past education and personal goals for taking the course, and specific information about theriogenology. Statistical analyses included chi-square testing and the paired *t*-test. Significance was set at $p < .05$.

RESULTS

The instructor's time investment was 21 hours for preparation of the course materials and 32 hours to run the course. The teaching assistant spent 120 hours helping to manage the course. The instructional designer spent 12 hours; the videographers, 20.5 hours; and the information technology specialist, 66.5 hours. The veterinary librarian spent 20 hours and the university librarians about an additional 2 hours, and there was at least 1 hour of input from personnel at the University Center for Teaching and Learning. Total effort was 295 hours.

Peak enrollment was 8,796 students. Enrollment increased by about 2,000 in the first several days of the course and fell to just below 8,000 by the end of the course. Participants were astonishingly engaged and supportive of each other's learning. Only once did the instructor have to intervene to remind participants to be respectful of each other in the discussion forums. The instructor and teaching assistant posted information twice weekly to address commonly asked questions or to provide content of interest that was not in the course, and they regularly monitored the discussion forum for a given week to address misunderstandings and guide participants to course content or to the correct discussion forums. The teaching assistant found three things most beneficial about her participation: the enhancement of her learning by the in-depth review required as she answered questions, the ability to help others learn the material, and the ability to build relationships with dog breeders early in her career.

The primary concerns involved technical support and the apparent inability of some participants to meet deadlines. The concern about technical support arose from misunderstandings between the University of Minnesota and Coursera regarding which entity would be providing what kind of technical support, for example navigation concerns versus problems with the software platform. This concern was resolved quickly as the misunderstanding became apparent. A relatively small but quite vocal group of participants misunderstood the effect of time zone on deadlines, waited until too near the deadline and then had technical concerns precluding their ability to submit assignments, or claimed ignorance of the grading policy. The instructor felt that the grading policy was fair and had been very clearly described and also felt that it would be unfair to alter the grading policy after the course had started and presumably after some participants had left the course because of their inability to achieve a Statement of Accomplishment. Similarly, some participants asked for the discussion forums to remain open well after the course was finished to permit them to read through material at their leisure. The Coursera platform had no means for discussion forums to remain open without the ability for individuals to post or add new threads, and the instructor had concerns about

unmonitored discussion; for this reason, the discussion forums were closed. The teaching assistant's three greatest concerns about the course were basic technology concerns with the Coursera platform, as described; having to take care to provide science-based responses and not anecdotal responses; and having to take care not to answer questions about students' specific animals, so as not to dispense veterinary advice for animals she and the instructor had not seen.

Of the 8,796 students enrolled in this course, 656 (7.5%) earned the Statement of Accomplishment; 1,060 (12.1%) achieved more than 90% in the course, with those who had any deficiency mostly missing one quiz or assignment. Ninety-nine individuals were enrolled in the Signature Track, and 50% completed all required course components.

The precourse survey was completed by 3,504 participants for a response rate of 39.8%. The majority of the respondents were female (81.1%), and the mean age range was 36–40 years, with one respondent younger than age 18 and 10 respondents older than age 60. On average, participants knew one other person taking the course.

About half of the respondents lived in the United States (55.0%). Other countries or areas of the world that were represented included Africa, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Ecuador, Egypt, England, Estonia, Europe, Finland, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Korea, Lithuania, Macedonia, Mexico, Nepal, the Netherlands, New Zealand, Norway, Pakistan, Paraguay, Peru, the Philippines, Poland, Portugal, Romania, Russia, Scotland, Serbia, Singapore, Slovakia, Spain, Sweden, Taiwan, Thailand, Ukraine, Uruguay, Venezuela, Vietnam, and Wales. Seventy percent of the respondents spoke English as their native language. Respondents had heard about this specific course via Facebook (31.2%), e-mail (12.8%), and newspaper, radio, television, and Twitter. Most (87.2%) had never enrolled in a course at the University of Minnesota and did not consider themselves to be prospective students.

Four hundred respondents (12.3%) had a degree or significant work experience in veterinary medicine, 26.3% had some coursework or experience, 34.1% had explored the subject independently, and 26.4% considered themselves new to the subject. Five hundred seventy-six respondents (16.4%) were in the veterinary profession, with 30.2% veterinarians, 35.2% veterinary technicians, and 34.5% veterinary students. Other participants included dog breeders (37.9% of total participants) and dog owners who were not breeders (25.9%). The rest of the participants claimed no affiliation.

When asked why they had chosen to take the course, the responses with which participants most strongly agreed were "[I have a] general interest in the topic" and "I think taking this course will be fun and enjoyable." Other responses with which participants were more likely to agree than to take a neutral stance or disagree were "Traditional courses are too expensive," "I was interested

in taking a course with this professor," and "This course is offered by the University of Minnesota." Responses with which participants were more likely to disagree than to take a neutral stance included "This subject is relevant to my academic field of study," "I am not geographically close to educational institutions," and "[This course will help me] to make professional connections."

The majority of respondents (57.1%) were taking only this course, with some students taking as many as five other courses (online or face to face) concurrently. For 58.0% of the respondents, this was the first online course they had taken. Students reported having an average of 10.3 hours ($SD = 9.0$) available weekly to dedicate to online course work. The majority of respondents (81.7%) intended to complete the entire course and achieve the Statement of Accomplishment.

The postcourse survey was completed by 554 of the participants who had completed the precourse survey, for a response rate of 15.8%. Of these respondents, 57.0% stated that they completed as much of the course as they had intended, 10.1% completed more than planned, and 25.6% completed less than planned. Of 138 people responding to the question, 130 (94.2%) stated that they found the course useful even if they had not completed as much as they had intended. When asked what factors kept them from completing the course, those most commonly cited were that the time commitment exceeded their ability and that they got behind and could not catch up. On a scale ranging from 1 (strongly disagree) to 5 (strongly agree), respondents disagreed or strongly disagreed that they did not complete the course because they "lost interest on account of the subject matter" ($M = 1.4$), "lost interest on account of presentation and assessment style" used ($M = 1.6$), or "began taking another course" ($M = 1.5$). Participants disagreed or strongly disagreed when asked whether reducing time commitment needed to take the course ($M = 2.4$), making the course material easier ($M = 1.7$), making the credential more valuable ($M = 2.2$), or making the course shorter ($M = 1.8$) would increase the likelihood of participants completing the work. Similarly, respondents did not feel that unfamiliarity with technology used in the course ($M = 1.3$), problems with Internet connectivity ($M = 1.3$), computer problems ($M = 1.2$), time zone issues ($M = 1.2$), family responsibilities ($M = 1.8$), or work responsibilities ($M = 1.9$) significantly affected their ability to complete course work.

Respondents agreed or strongly agreed that the instructor presented the subject matter clearly; that the instructor and material provided feedback to improve course performance; that they had a deeper understanding of the subject matter as a result of this course; and that their interest in the subject matter was stimulated by the course (Figure 1). The majority of respondents spent 5 hours or less per week on the course. Of 169 respondents who had taken other online courses, 64 (37.9%) reported that they had learned more from this course than from other courses, and 49.7% reported that they had learned about the same as in other courses. From that same subgroup, 34.9% reported that this course was easier than other courses they had taken,

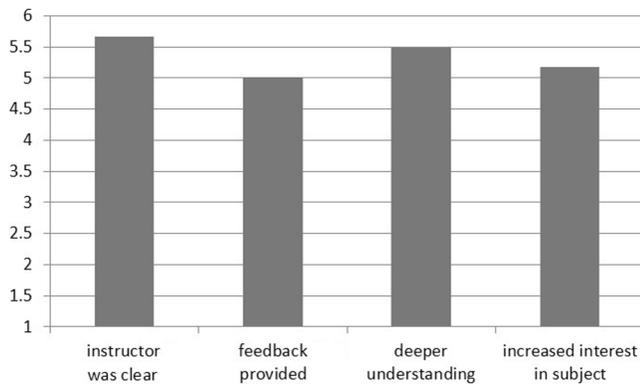


Figure 1: Participants' evaluation of instructor and course on a scale ranging from 1 (strongly disagree) to 6 (strongly agree)

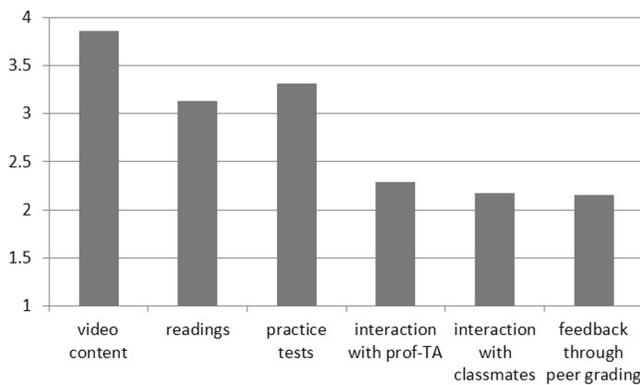


Figure 2: Participants' evaluation of the value of various course offerings on a scale ranging from 1 (not at all) to 4 (large degree)

47.6% reported it to be about the same level of difficulty, and 17.5% reported it to be more difficult.

When asked to what degree the various components of the course contributed to their learning, respondents rated the video content highest, followed by the multiple-choice quizzes and notes, with interaction with instructor and peers rated lowest (Figure 2). In general, participation and use of course materials declined over the course (Tables 2 and 3).

There were multiple Discussion Forums available to participants. In Discussion Forums, new conversations were introduced as threads. Participants could start a new thread or respond within a given thread, or they could view the posts without responding.

The Introduce Yourself forum was a place where students could identify themselves and their interests. That forum had 1,722 threads. The instructor was contacted by some people who were hesitant to post anything in this forum because of concerns about activists using the list in negative ways, and they were assured that they did not have to post anything in this forum to participate in the course.

Table 2: Number of viewings of video course content

Name of video	No. of viewings
Searching the literature	1,310
Video lectures	
Week 1	8,132
Week 2	5,493
Week 3	4,322
Week 4	3,680
Week 5	3,262
Week 6	2,975
Vaginal cytology sample collection	3,848
Ultrasound for pregnancy diagnosis	2,531
Contractions	2,509
Delivering a puppy	2,572
The placenta	2,477
Manual ejaculation of the dog	1,834
Vaginal insemination	1,667
Transcervical insemination	1,596
Surgical insemination	1,562

Table 3: Number of assignments submitted

Week	Activity	
	Quizzes submitted	Case studies submitted
1	5,957	2,402
2	4,308	1,713
3	3,589	1,415
4	3,129	1,224
5	2,830	1,120
6	2,605	824
Total	22,418	8,698

The Course Materials forum was a place where students could post specific concerns about the course content, including mistakes identified or concerns about feedback provided, and could ask for clarifications of the grading policy or teaching methodologies. Some such requests came through Coursera and were directed to the instructor; several of these involved a request for continuing education credit for the course. There were 75 total posts, 47 of them in the final week, mostly concerning how participants would know whether they achieved the Statement of Accomplishment. Participants identified several typographical errors and one major mistake in a PowerPoint slide and gave good suggestions about images.

The Technical Feedback forum was monitored by Coursera to detect concerns about the platform. That forum had 821 posts.

The Study Group forum was created to help participants find each other if they wanted to participate in a study group; it had 29 threads. Study groups proposed included those from specific areas (participants from

Table 4: Number of participants posting in and viewing the weekly discussion forums

Week	No. of unique people posting	Posts	Views
1	1,481	1,403	18,225
2	827	938	9,517
3	353	468	6,547
4	245	442	5,073
5	135	244	3,526
6	100	833	7,442

Table 5: Number of participants posting and viewing responses to Further Discovery questions

Week	Posts	Views
1	289	4,671
2	196	2,328
3	49	1,135
4	17	365
5	41	494
6	21	487

Arizona or the West Coast, global Chinese, Greek, Hellenic, India, Montana, Wisconsin), those with specific language requirements (Spanish, French), those with specific occupations or roles (Health Tested Puppies From Conscientious Breeders, homeschool groups, members of the Student Doctor Network, veterinarians), and those with specific dog breeds (Alaskan malamute, Australian cattle dog, Brittany, cairn terrier, flat-coated retriever or gun dogs, German shepherd dog, Irish wolfhound, Labrador retriever, nihon ken (native Japanese breeds), Nova Scotia duck tolling retriever, standard poodle, weimeraner).

There was a Discussion Forum for each week that was intended to be a site for student interaction on the topics for that week. All weekly discussion forums were open throughout the course, and despite numerous reminders that the instructor and teaching assistant would not be monitoring sites once a week had been completed, participants continued to post on those sites. The number of unique individuals posting or commenting for each week was generally lower than the number of posts, and the number of views was much higher than the number of posts every week (Table 4).

The Further Discovery forum was available for those students who wanted to make an extra effort and search the literature to answer a question in detail, incorporating material from throughout that week and earlier weeks if appropriate (Table 5). The majority of participants who posted information in the Further Discovery forum did not perform a literature search or provide a detailed answer.

Comparing responses on pre- and postcourse surveys, chi-square tests revealed no significant difference between genders, native and non-native English speakers, and US and non-US residents with respect to proportion of the course completed. An independent-samples *t*-test also revealed no significant difference between students of different ages in proportion of the course completed. Similarly, chi-square tests found that participation did not vary between individuals living in and outside of the United States as a result of unfamiliarity with the technology, Internet connectivity problems, family issues, or work issues. However, the chi-square analysis found that individuals from outside the United States reported a significantly greater negative impact because of computer issues ($p = .03$) and time zone issues ($p < .001$) than did individuals from inside the United States.

The pre- and postcourse surveys included a set of nine theriogenology-specific questions. Respondents were asked to rate the following statements on a scale ranging from 1 (strongly disagree) to 5 (strongly agree).

- I know what theriogenology is.
- I am generally knowledgeable about canine theriogenology.
- As a dog breeder, I have ready access to a veterinarian who is knowledgeable in canine theriogenology.
- I am knowledgeable about breeding management in bitches.
- I am knowledgeable about reproductive management of stud dogs.
- I am knowledgeable about reproductive tract disease in female dogs.
- I am knowledgeable about reproductive tract disease in male dogs.
- I understand the pros and cons of spaying and castrating dogs.
- I believe all dogs should be spayed or castrated if they are not intended for breeding.

Using a paired-samples *t*-test, it was found that scores for seven of the nine questions rose significantly from the precourse survey to the postcourse survey (all $ps < .001$). Those that were unchanged were those pertaining to access to a veterinarian trained in canine theriogenology and attitudes regarding universal spay or castration of nonbreeding dogs (Figure 3).

DISCUSSION

MOOCs are not well recognized as academic achievements, for either the student or the instructor. In one survey of instructors who had taught MOOCs, all reported that the work was done on top of their regular duties and happened during their personal time.⁷ The time reported for preparation ranged from a few dozen to more than 100 hours.⁷ One individual reported more than 420 hours of faculty time and 180 hours of staff time to develop a course.¹⁰ Reported time spent running the course averaged 8–10 hours per week in one survey.⁷ Preparation and running time for this MOOC was at the low end of these reported ranges. This may well have been because of the specific choice of faculty members

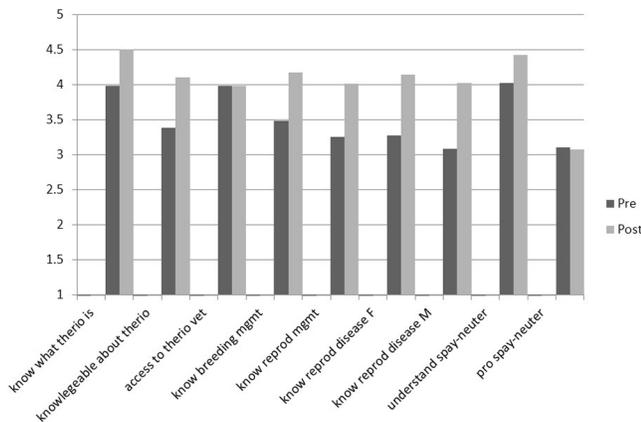


Figure 3: Pre- and postcourse self-assessment of knowledge and attitudes in theriogenology on a scale ranging from 1 (strongly disagree) to 5 (strongly agree)

with experience in and materials for online teaching and the provision of human and financial resources. Suggestions from the literature for faculty members interested in teaching a MOOC include the following:^{10,11}

- Asking for assistance from people with expertise in instructional design and technology
- Not worrying about video production, which one investigator reported as not being a factor in students' experiences or satisfaction
- Keeping videos short and providing assessments to ensure understanding; these can be embedded within the videos or be a separate assessment
- Avoiding references by date to course materials, including assignments or assessments, because students may access materials out of sequence
- Making course expectations and the grading policy very clear
- Encouraging student interaction.

One classification scheme separated learners into categories on the basis of their patterns of interaction. Completers are learners who complete the majority of the interactions in the course and are, therefore, most similar to students in a traditional course. Auditors watch video lectures but rarely complete assessments. Disengagers do assessments at the beginning of the course but then show a decrease in engagement, usually within the first third of the course. Samplers watch some videos and complete some assessments at varying periods throughout the course.¹² Completion rate for a given course always includes completers and may also include learners from the other categories, depending on the grading policy, which makes comparison of completion rate between MOOCs difficult. Reported completion rates vary from 2.6% to 12.5%.^{2,7,10} Completion rate for this MOOC was 7.5% with a very strict grading policy and would have been just over 12% had the grading policy been relaxed to include those described as completers.

Poor completion rate has been a criticism of MOOCs, with many voicing concerns about student learning if so

few complete the course. One publication suggested that as many as 50% of participants may be in a class as auditors or samplers.¹³ Many of the participants in the canine theriogenology course were veterinary professionals, including some theriogenologists who were sitting in on the course to see what their breeder clients were learning and instructors who wanted to take a MOOC to help inform their decision regarding teaching their own online course. This may have increased the number of non-completers in this course. Because the participants are not paying for the course, there may be a tendency not to prioritize coursework. Note that completion rate in the canine theriogenology course was much higher for those in the Signature Track than for all participants. While teaching the course and reviewing the literature, it became clear to the author that one could easily artificially increase completion rate but that one could not do anything to encourage participation other than to provide a well-designed course. This is a huge change for veterinary educators, who are used to working with highly dedicated students.

Participation decreased over the course, and participants did not provide any information regarding what specifically could be done to help increase participation. One study identified lack of familiarity with the technology used as an impediment, but that was not true in this course.¹⁴ One study evaluating use of mobile devices for learning demonstrated that participants liked the independence and ability to participate at times most convenient to them.¹⁵ Not all course materials can be accessed on the Coursera platform using mobile devices, and this may be one improvement in the platform that would increase participation.

The author found it interesting how many posts were viewed compared with how many posts were made, and how many of those posts were made by a relatively small group of participants. This mirrors findings in other studies using social media for teaching.¹⁶⁻¹⁹ In one study, students cited as reasons for not posting lack of self-confidence, access to posts at times not conducive for response, and posting of responses by other participants that incorporated what they might want to say.¹⁶ It is valuable for instructors to be aware of this invisible participation, which may be a valuable component of learning for some students.

One of the goals of the University of Minnesota in offering this MOOC was to extend its reach and reputation, and that goal was well achieved with participants from around the world. This matches the experience of others who have taught MOOCs, one of whom stated, "Every single faculty member has the opportunity to extend their reach by one or two or three orders of magnitude."^{7(p.5)} The majority of these participants had never taken a class and never expected to take a class at the University of Minnesota, suggesting that this was a unique way for that institution to provide education to these individuals.

Participants in this course were very focused on achievement of the Statement of Accomplishment, especially those who had signed up and paid for the Signature Track.

Concerns about credentialing include the level of competency demonstrated through the assignments and assessments possible in such a large course and the inability to ensure students are doing similar work, especially in MOOCs with more fluid course content.² Individuals who have put in significant time and effort may want to let others know that they have completed coursework from a prestigious institution or may want to receive credit for those courses if they attend face-to-face courses at that institution. Current efforts to provide some sort of credential include programs such as the Signature Track program in Coursera and badge programs. The primary request received in this course was for continuing education credit, which is handled differently by profession and, often, by state.

Despite the relatively low response rate for pre- and postcourse surveys, the overall large number of students in this course permitted evaluation of acquisition of learning objectives. Although knowledge of specific topics cannot be assessed at the level of detail possible in smaller courses, it is clear that, by means of self-assessment, participants who responded to the survey did demonstrate increased knowledge of the topics covered.

The author hopes to offer this course again in the future. Things that will be changed with future iterations include the following:

- Opening and closing discussion forums weekly, unless Coursera can meet a request for the discussion forums to remain open as archives with no new threads, comments, or further postings so that students have access to the information but oversight by an instructor is not needed
- Slightly relaxing the grading policy to better reflect behavior permitted in face-to-face classrooms, as exemplified by the definition of *completer*
- Adding an open-book final examination as one measure of assessing knowledge of specific topics.

CONCLUSION

MOOCs offer an opportunity for outreach to people all over the world by experts in a field and for facilitation of group discussion by participants with varying degrees of knowledge and experience. It may be that instructors in this type of course need to use different techniques than those they have used in face-to-face or blended classrooms, including amplifying (drawing attention to important ideas), curating (arranging course materials to guide understanding), aggregating (clarifying discussion and content), filtering (helping participants to exclude non-significant information), and staying present (providing oversight).¹³ Historically, college-level instructors have often been hired primarily to provide research or service and have taught as a condition of their employment with no particular training or recognition of merit in their teaching. One MOOC provider, Udacity, has stated that it will choose instructors on the basis of their teaching and projected a future in which the most learned and entertaining instructors will be offered work and remuneration for their teaching expertise in this particular format.⁴ It may be that MOOCs are in the

midst of a hype cycle, defined as movement from a technology trigger over time through a peak of inflated expectations into a trough of disillusionment, then up the slope of enlightenment to a plateau of productivity. When asked whether MOOCs are worth the hype, 79% of 103 professors who had taught MOOCs responded in the affirmative.⁷ The verb *hype* is defined as “to promote . . . [an] idea intensively, often exaggerating its benefits.”²⁰ As with all educational methods, completion of learning objectives by the students is the primary goal. A MOOC is one method of achieving that goal, with the great benefit of doing so for thousands of participants who may otherwise not have access to a given instructor or body of material. Universities may benefit from promotion of such an educational methodology.

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