Ask Me Anything About MOOCs

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■ *In this article, 10 questions about MOOCs (crowdsourced from the recipients of the AAAI and SIGCSE mailing lists) were posed by editors Michael Wollowski, Todd Neller, and James Boerkoel to educators Douglas H. Fisher, Charles Isbell, and Michael Littman.*

Massive open online courses (MOOCs) and high cost online courses (HCOCs) have become extremely popular for students around the world, but are they the right choice for the future of AI education? The editors of this special report crowdsourced questions about MOOCs and HCOCs and selected the top 10 questions. They were then posed to educators with unique and relevant experiences to lend their perspective on the issues raised by those questions.

The Educators

Douglas H. Fisher, associate professor of computer science and computer engineering at Vanderbilt University, has done extensive work on adapting MOOCs to the bricks-and-mortar classroom. He was the founding director of the Vanderbilt Institute for Digital Learning. Fisher detailed his experience in several published articles (Fisher 2016, Bruff et al. 2013).

Charles L. Isbell, Jr., senior associate dean and professor at the College of Computing, Georgia Institute of Technology (Georgia Tech), was integrally involved with developing a successful online program (HCOC) that was recently mentioned in the *New York Times* (Carey 2016). He detailed some of his work in the proceedings of the Third Annual ACM Conference on Learning (Joyner, Goel, and Isbell 2016).[1]

Michael L. Littman, a professor at Brown University developed an online machine-learning course, together with Isbell. He gave an invited talk at the Fifth Symposium on Educational Advances in Artificial Intelligence (EAAI-14) about his experience teaching this online course.

Michael Littman and Charles Isbell

Isbell and Littman have worked closely together and engage in a dialog through which they answer the questions. To preserve the value of their dialog, as well as the value of Fisher's richly referenced responses, we are separating their contributions. We begin with Isbell's and Litman's dialog and then present Fisher's responses.

Preamble

Michael Littman: First of all, let me say that it's an honor to participate in this discussion. I've taught three classes on Udacity's platform and, last time I checked, the classes have over 100,000 person enrollments. Most of these enrollments are for the Introduction to Algorithms course I taught (originally offered as Crunching Social Networks) by myself. The other two classes, Machine Learning and Reinforcement Learning and Decision Making, I taught jointly with Charles Isbell.

Charles Isbell: These latter two classes are part of Georgia Tech's Online Master of Science in Computer Science (OMSCS), and among the most popular. It's also worth mentioning that while they may have fewer students enrolled than Michael's other course, the students who have taken our courses actually complete the material (you know, unlike Michael's other course)!

Michael Littman: Well, you don't know that. I've heard from a few students who have taken my algorithms course.

Charles Isbell: Few divided by 100,000 is equal to zero for sufficiently large values of zero. Also, they take CS7641 and CS8803 for a grade toward a degree. We know exactly how they did and how their performance compares to students taking the same courses on campus at Tech. We know they do well and they learn a lot. And there are a lot of them! We have just under 4000 students at the time I type this. Plus, they get to experience the scintillating dynamic of the two of us talking to each other.

Question One

> What are some activities that work well in the context of MOOCs and high cost online courses (HCOCs) and that may not work well in the context of a brick-and-mortar class?

Charles Isbell: I'm afraid I have to reject the premise behind using *high cost* as the alternative to *massively open*. OMSCS is priced so that students can obtain a master's degree in computer science for a fraction of the price of an on-campus program … a low fraction at that: $6600 for an entire degree at a top 10 program.

Michael Littman: Maybe they are saying that it's a high cost relative to free.

Charles Isbell: Perhaps, but even a dollar is infinitely more expensive than is free. So, under that interpretation, the *high* has no meaning at all. I'm asserting that you can't interpret *high cost* without a comparison frame and I think the on-campus course makes a good comparison frame, especially given that the rigor is the same.

Michael Littman: Fair enough. But, I don't think you answered the question.

Charles Isbell: Fine. One structure we use in our classes is to have one of us act as the "teacher" in each lecture and one of us act as the "student." It allows the real students to watch a kind of proxy, and keeps both of us on our toes. It's good to be the student because you don't actually have to prepare (you know, just like on campus). It's good to be the teacher because you can ask the student to answer the questions for you. It's really win-win.

Okay, your turn: what do you think are some activities that work well?

Michael Littman: One of the things that surprised me about the MOOC experience is that, even though the class size is potentially a lot larger than an in-person lecture class, it can feel much more intimate. We can adopt a conversational tone. We can ask the student a question and wait patiently while she works out an answer. We can provide feedback on that answer. It's a lot more like we're talking directly to each student.

Hey, wait a second, how did you get to be the "teacher" for this interview?

Charles Isbell: I'm a senior associate dean. Plus, as the "teacher," I don't have to answer your question if I don't think it is pedagogically significant. Please be less disruptive. Thanks. Let us move on.

Question Two

> How do you engage students in MOOCs and HCOCs with the course and the materials?

Charles Isbell: Did I mention that they are all taking it for a grade?

Michael Littman: One of the things we try to do in our classes is provide concrete examples and working code whenever possible. It's important for the concepts to be made tangible. A nice thing about the MOOC format is that students can dive into a demo and the lecturers will wait patiently for them to be ready to move on. Also, an advantage of the teacher-student format we use is that the "teacher" is forced to slow down and react when the "student" feels there's been too big of a jump in the presentation.

Charles Isbell: Sometimes we don't get it right and end up speaking to each other as experts. Still, the students tell us that they love when we try to (re-) discover concepts as experts. They feel really drawn into the discussion. In any case, we're a lot closer to getting the pacing and level right than we would if we were teaching solo. More to the point, we couldn't re-create this experience in person, certainly not over a semester. Michael's snowed in half the time.

Question Three

> A criticism of MOOCs/HCOCs is that they do not offer qualified feedback on challenging assignments. Do you see a way to resolve this issue?

Michael Littman: We've addressed this issue by providing qualified feedback.

Charles Isbell: … and challenging assignments.

Question Four

> Have you had issues with academic integrity when offering your course as a MOOC/HCOC? How have you mitigated concerns of academic integrity?

Charles Isbell: Again, it's important to have a comparison frame. Academic integrity violations in OMSCS have been lower than for our on-campus course. That's possibly due to the population of students we've tapped into for OMSCS, but it does show that it is not a necessary feature of online classes that academic integrity concerns dominate. Actually, we use proctoring services for exams that take over one's computer and camera, and require identification (ID) verification. It's even harder to cheat than it is to vote in some states.

Question Five

> How is learning different with MOOCs or HCOCs versus traditional classrooms?

Charles Isbell: I don't understand the question. Do you?

Michael Littman: Not really. Maybe I'd say the learning can be the same, but online you have lots of opportunity for more control as a learner — though, you do have to work harder to manage your social network within the class.

Question Six

> What are lessons you've gained from MOOC/HCOC teaching that you believe are important for all teachers to understand?

Michael Littman: I don't understand the question. Do you?

Charles Isbell: Not really. Maybe I'd say that the lessons are the same as on campus: be as engaging as you can be, and provide a learning environment that helps the student. Put as much energy into the online process as you do on campus, and take advantage of the tools.

Question Seven

> Where do you see the future of MOOCs and HCOCs? Are they here to stay? What will be their likely target audience?

Michael Littman: Yes, I think MOOCs are becoming established as an important tool in the higher-education kit. To me, MOOCs fill a similar niche to textbooks: they gather an expert's perspective on a subject and make it available to a much wider audience. In the context of my on-campus reinforcement-learning course, I now have the students watch our online lectures and then use class time to dive deeper into topics that the students are struggling with. It's a potent combination.

Charles Isbell: Early on, a lot of people made dramatic statements about how on-campus teaching would be eliminated by this technology, but we're not seeing that at all. Indeed, if you look at the population of students we have in OMSCS, you get a sense of what the potential really is. Our OMSCS students are older and more established than their on-campus counterparts. Broadly speaking, OMSCS appeals to people who are looking for a way of enriching their educational background but have strong constraints, say family, work, or geography. A recent study by Harvard and Georgia Tech[1] demonstrates that our students would not have pursued degrees elsewhere by and large if this program wasn't available. But those who are pursuing this degree are doing as well as their on-campus counterparts. That's a pretty big deal.

Michael Littman: If anything, I see MOOC-based delivery growing in the years to come.

Charles Isbell: I agree. Like Michael, my on-campus students use the freely available version of our material along with my in-person lectures. They often quote things I've said back to me … mainly because I use the same jokes.

When I'm waxing philosophical, I like to say that we're not interested in living up to the hype that surrounded MOOCs, but we are interested in living up to the promise.

Question Eight

> How can MOOC or HCOC be blended with a brick-and-mortar class? For example, could a MOOC be used

effectively to build prerequisite background, or give extra practice for students? Will such a blend increase or decrease participation in the brick-and-mortar class? Will such a blend improve overall performance of the brick-and-mortar class?

Michael Littman: Yeah, that happens naturally ….

Charles Isbell: … if for no other reason than the students use the material available to help themselves whether we intended them to do so or not.

Question Nine

What are the most significant challenges of teaching a MOOC/HCOC, assuming it is already set up?

Charles Isbell: I have two answers for this question. The first is that it hasn't been a problem because the material we teach is more stable than we like to pretend. In contrast, the second is that even if the material is mostly stable, we still have to be concerned with maintenance. That maintenance can come from the desire to reference more recent events, de-emphasize topics that are losing favor in the community, or simply improve the presentation. It does take some effort to do such updates. In some ways, the MOOC format makes it harder. Editing a slide or lecture notes is a lot easier than rerecording and reediting a video file. We need to find ways to keep the content fresh without a significant continual investment in video production. It's a potentially difficult and expensive problem.

Michael Littman: I hadn't noticed.

Charles Isbell: Mmm hmm. A more interesting case is what happens when the person who created a MOOC leaves and another person has to come in to oversee the course.

Michael Littman: I hadn't noticed.

Charles Isbell: Mmm hmm. Well, so far for us, it's been pretty smooth. The students seem to take it in stride.

Question Ten

What are the top three technology capabilities that would significantly improve the MOOC/HCOC professor/student experience and outcome?

Michael Littman: Dynamic content. As a reinforcement-learning researcher, I was drawn to MOOCs as an opportunity to turn teaching into a sequential decision-making problem where the student is the environment and the MOOC is the decision maker. The MOOC needs to figure out what path through the material will lead to the best learning outcomes. As a MOOC instructor, my job would be to give the system the raw material to construct optimized lessons. I don't think it's a coincidence at all that machine learning and AI people like Daphne Koller, Andrew Ng, Peter Norvig, and Sebastian Thrun were the pioneers of this technology. Nevertheless, this vision has been harder to achieve than people thought and new technological ideas are needed to make it work.

Charles Isbell: Production effort. Creating an exciting and polished class is a lot of work. OMSCS invests a tremendous amount in professional video production people to capture and edit the material to make it as accessible as possible; nevertheless, there's a lot more that can be done to really make these videos exceptionally powerful. We need to find ways of getting the best end product possible within the practical bounds of how much we can invest in it.

Michael Littman: I wish I had more time to do more classes like this. Maybe there's a way of making more of us?

Charles Isbell: Well, you can always have kids.

Michael Littman: I did that, but mine are not interested in teaching AI MOOCs.

Charles Isbell: Students, then?

Michael Littman: Yes, good idea. Maybe we need a way of teaching more MOOC teachers to help raise the bar.

Charles Isbell: That works. Maybe this interview is a step along the path toward getting AI experts to know more about how MOOCs are made.

Michael Littman: And that will help increase the pool of teachers. Nice!

Charles Isbell: That seems perfect. Go!

Douglas Fisher's Responses

We now present Douglas Fisher's responses.[2]

Douglas Fisher: MOOCs are often not massive any more, but often self-paced. It is regrettable that the acronym SPOC has been used to represent a small private online course, because it better suits *self-paced online course*. I use SPOC as representing a self-paced online course.

Question One

What are some activities that work well in the context of MOOCs and high cost online courses (HCOCs) and that may not work well in the context of a brick-and-mortar class?

Douglas Fisher: What MOOCs and SPOCs enable are cross-cultural discussions; cross-institution discussions; cross-institution teaching; and cross-institution group assignments or projects. See the Report on the CCC-CRA Workshop on Multidisciplinary Research for Online Education (Fisher and Fox 2013), with references to cross-institutional initiatives, and witness the collaboration between Michael and Charles as an example of across-institution teaching, which I believe would be harder in a strictly brick-and-mortar, nondigital setting.

Question Two

How do you engage students in MOOCs and HCOCs with the course and the materials?

Douglas Fisher: I've never taught a MOOC, but I have engaged in helping students on the discussion

boards of a SPOC when my campus students were going through the SPOC as well. See the Boots-on-the-Ground Campus Instructors for Open Self-Paced Courses article (Fisher 2015) and follow-up and predecessors post to that (Fisher 2014; Fisher 2014a). In short, I can play the role of a "boots-on-the-ground" instructor in a SPOC created by someone else.

Question Three

> A criticism of MOOCs/HCOCs is that they do not offer qualified feedback on challenging assignments. Do you see a way to resolve this issue?

Douglas Fisher: There is considerable research on grading open-ended assessments, such as essays at scale (look at the Learning@Scale conference), but to this I would add MOOCs can produce TAs at scale (students who have gone through a sequence of MOOCs may return to grade for the initial course in the sequence) for incentives that may be nontraditional or traditional forms of compensation (Fisher 2015a). By increasing the numbers of qualified TAs, one can increase the quality of feedback on assignments. Most likely, however, improving feedback will be through human TAs at scale, interacting with intelligent computational methods, like clustering of student answers. I think it's often the case that humans and AIs beat either alone.

Question Four

> Have you had issues with academic integrity when offering your course as a MOOC/HCOC? How have you mitigated concerns of academic integrity?

Douglas Fisher: The students themselves are remarkably good at holding each other accountable, or so it seems (Fisher 2015b). I also worry about the implications for instructors (Fisher 2014b) — in a public-facing course the implications of not citing another instructor's educational material are higher stakes.

Question Five

> How is learning different with MOOCs or HCOCs versus traditional classrooms?

Douglas Fisher: Whether there is a cohort or not seems critical in the ability and motivation of students to move through a SPOC — this is where campus cohorts of students and instructors can help — we can be the cohort that an insulated, languishing SPOC learner needs.

Question Seven

> Where do you see the future of MOOCs/HCOCs? Are they here to stay? What will be their likely target audience?

Douglas Fisher: My primary interest is in blended learning models, where I use SPOCs to support campus courses and my campus students and TAs help the campus-unaffiliated SPOC students.

Question Eight

> How can MOOC or HCOC be blended with a brick-and-mortar class? For example, could a MOOC be used effectively to build prerequisite background, or give extra practice for students? Will such a blend increase or decrease participation in the brick-and-mortar class? Will such a blend improve overall performance of the brick-and-mortar class?

Douglas Fisher: I think of a SPOC as a multimedia textbook (with caveats [Fisher 2013]), where the lecture and assessment materials help me "flip my classroom." But I have also long suggested MOOCs to satisfy prerequisites or otherwise get up to speed over summer in advance of taking the campus version or for independent studies. Recruiting great TAs from MOOCs for my campus course is another possibility that intrigues me (Fisher 2013a).

Question Ten

> What are the top three technology capabilities that would significantly improve the MOOC / HCOC professor / student experience and outcome?

Douglas Fisher: A CRA/CCC report that I coauthored gets at much of this (see Fisher and Fox [2013]), but the one that excites me most are course-management platforms that allow me, as an instructor, to "flip a switch" that opens aspects of my campus course (for example, syllabus, videos, auto-graders, discussion forum) to a variety of outside-of-class communities, ranging from the larger Vanderbilt community, to possibly include alums, to Nashville, and the world. Such platforms, still only imagined, would allow communities to overlap on the materials that they can access and the services that they receive, while both protecting campus students from public scrutiny to the degree that they desired, and exposing campus students to alum, regional, professional, and international perspectives.

Notes

1. See the article by Goodman, Melkers, and Pallais (2016) for more information on online delivery and increased access to education.

2. Fisher did not respond to question 6.

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Doug Fisher is an associate professor of computer science at Vanderbilt University. He was founding director of the Vanderbilt Institute for Digital Learning, overseeing MOOC production at Vanderbilt University from 2013–2015. Fisher's teaching and research includes artificial intelligence, notably computational sustainability, cognitive modeling, and computational creativity. Fisher served as an National Science Foundation (NSF) program director from 2007–2010, overseeing NSF initiatives in artificial intelligence, including machine learning, knowledge representation, and multiagent systems.

Charles Isbell is a professor and the senior associate dean at the College of Computing at Georgia Institute of Technology. His research interests are varied, but he mainly focuses on machine learning and decision making in the presence of thousands of other intelligent agents, including humans. His work has been featured in the popular media as well as in technical collections, where he has won two best paper awards in this area. Isbell also pursues reform in computer-science education. He was a developer of Threads, Georgia Tech's structuring principle for computing curricula, and is one of the coarchitects of the new online MS degree in computer science.

Michael L. Littman, professor of computer science at Brown University, carries out research in machine learning and decision making under uncertainty. He has earned multiple awards for teaching and his research has been recognized with three best-paper awards and two influential paper awards. Littman has served on the editorial boards for the *Journal of Machine Learning Research* and the *Journal of Artificial Intelligence Research*. He was general chair of ICML 2013 and program chair of the AAAI 2013. He is codirector of Brown's Humanity Centered Robotics Initiative and a Fellow of AAAI.

Michael Wollowski is an associate pofessor in the Computer Science department at Rose-Hulman Institute of Technology. He obtained his Ph.D. from Indiana University, developing a complete and diagrammatic logic for planning in the blocks world. Wollowski's research interests focus on AI education, reasoning in natural language processing, and the internet of things.

Todd W. Neller is a professor of computer science at Gettysburg College. A Cornell University Merrill presidential scholar, he received a B.S. in computer science with distinction in 1993. In 2000, he received his Ph.D. with distinction in teaching at Stanford University, where he was awarded a Stanford University Lieberman Fellowship, and the George E. Forsythe Memorial Award for excellence in teaching. A game enthusiast, Neller has in recent years enjoyed pursuing game AI challenges, computing optimal play for jeopardy dice games such as Pass the Pigs and bluffing dice games such as Dudo, creating new reasoning algorithms for Clue/Cluedo, analyzing optimal risk attack and defense policies, and designing logic mazes.

Jim Boerkoel is an assistant professor in the Computer Science Department at Harvey Mudd College where he leads the Human Experience and Agent Teamwork Lab. Boerkoel received his B.S. from Hope College (2006), and his M.S. (2008) and Ph.D. (2012) in computer science and engineering from the University of Michigan under the supervision of Ed Durfee. Prior to joining HMC, Boerkoel worked as a postdoctoral associate with Julie Shah of the Interactive Robotics Group at the Massachusetts Institute of Technology. In 2017, Boerkoel was recognized with an NSF CAREER award for his project Robust and Reliable Multiagent Scheduling under Uncertainty. More broadly, his research interests include automated planning and scheduling, multirobot coordination, human-robot interaction, and AI education.