ISSUE BRIEF

Technology, Georgia Tech, and the Future of Learning

An Interview with Charles Isbell

April 9, 2019

Kevin M. Guthrie

ITHAKA S+R

Ithaka S+R provides research and strategic guidance to help the academic and cultural communities serve the public good and navigate economic, demographic, and technological change. Ithaka S+R is part of ITHAKA, a not-for-profit organization that works to advance and preserve knowledge and to improve teaching and learning through the use of digital technologies. Artstor, JSTOR, and Portico are also part of ITHAKA.

I invited Charles Isbell, Professor of Computer Science at Georgia Tech to join me at the October 2018 Bowen Colloquium, a forward-looking gathering of college and university presidents and other leaders. In addition to his work in Artificial Intelligence, Professor Isbell is the Associate Dean in the College of Computing responsible for overseeing Georgia Tech's Online Master of Science in Computer Science (OMSCS). Our conversation covered a wide area, from the unsustainable costs of traditional modes of instruction to his thoughts on the longer-term impact of artificial intelligence and data science on the academy. This published interview includes highlights from our conversation.

Unsustainable cost of traditional methods of instruction

Guthrie: Methods of instruction that rely on small classes with an instructor are effective, but the constraints of the notorious Baumol/Bowen cost disease have made that methodology too expensive for all but the wealthiest institutions, and is therefore not sustainable at many places. How are colleges and universities going to find ways to "bend the cost curve" and increase the productivity of the education process?

Isbell: Georgia Tech's OMSCS offers one example of how this might be done. The OMSCS has just reached its fifth year and is doing extremely well. The entire student tuition for the degree, under $7,000, is a fraction of the cost of the program delivered on campus and yet the students receive the same credential and cover the same material. Tuition revenue has been sufficient to cover the costs and invest in improvement of the courses and the program. The reason that it works is because the marginal cost of adding students is extremely low, and more than 6,000 students have enrolled in the program during its history. It would not work if there were only 500 students. Another good thing is that these are generally students who would not have the opportunity to come to campus. So we are reaching more people, not substituting one group for the other.[1] Even though Georgia Tech received substantial funding from AT&T to capitalize the program, this was only necessary in the first instance because there would have been too much political risk for a public university to invest in such a speculative program in advance. With the evidence now available to point to success, investments in these programs have proven that they can pay for themselves.

[1] Joshua Goodman, Julia Melkers, and Amanda Pallais, "An Elite Grad-School Degree Goes Online," *EducationNext* 18, no. 3 (2018), https://www.educationnext.org/elite-grad-school-degree-goes-online-georgia-tech-virtual-masters-increase-access-education/.

Do the online courses that are part of this degree deliver good learning outcomes?

Guthrie: The reported learning outcomes for the online students that complete their OMSCS degrees are every bit as good as for the on-campus students. Why do you think that is?

Isbell: For one, the content delivered in lecture or other broadcast formats is equally as good, and in some ways better because the students can watch the video multiple times, or review it at their own pace. Similarly, there are a set of questions that all students ask that can be easily addressed once for everyone. I've been able to "teach" over 3,000 students very effectively.

Guthrie: What about the more unusual questions and the other kinds of logistical and administrative support those students need?

Isbell: The program has assembled a large number of TAs. A workable ratio that has emerged from experience is approximately 50 students per TA. The program benefits substantially from the fact that the best students in the course in one semester are eager to serve as TAs in subsequent semesters, creating a self-sustaining body of assistants, and maintaining institutional memory. Another factor that has played a very important role in student success is the development of a community among students taking the course. Of course, such communities play valuable roles in student success on campus as well, but the development of a strong community has to be actively managed in the online environment, and that takes energy to enable it. As professor, you have to provide some of that motivation, so you are not only curating the course materials but operating in the manner of a politician to inspire the students, while the TAs and associated infrastructure provide students with the necessary more personalized support. It is also the case that a core group of students often self-organize learning communities within the courses, which is especially effective. Those communities are important. One clear lesson we have learned is that students who end up isolated generally do not fare well in the online environment.

Improving educational technologies

Guthrie: Developments in technology point to the possibility of new forms of machine-assisted learning. Increasingly it will be possible to rely on machines as "tutors" that use data tracking student progress to recursively improve the quality of the knowledge and assistance provided to students. What have you seen in your experiments at Georgia Tech?

Isbell: We've used an AI bot that substitutes for a TA to answer standard questions. This bot, whose pseudonym is Jill Watson, does very well with the students. The answers are accurate and instantaneous. Jill Watson has received some of the highest rankings among TAs! We will see more and more of that kind of machine assistance to handle triage and answer standard questions, and the students are going to be totally comfortable with that. In fact, some students will prefer asking a question of the machine than reaching out to a human TA or instructor who they fear may be judging them.

A growing need for lifelong education

Guthrie: One reason that these programs work is that they provide educational opportunity to people who have not been in a position to leave jobs or in other ways stop their lives to pursue a master's degree full-time.

Isbell: Yes, that's very true, and with the fast pace of change and the need for people continuously to develop new skills, there will be a growing number of people with the need for this kind of education. Given the changing demographics in our country, this is a large market of potential students, much larger than the market for undergraduates. This point is important because the opportunity for improving productivity comes from enrolling a larger number of students.

Balancing the curriculum

Guthrie: The demand for data and software related skills among students is increasing dramatically. Even at some institutions that have traditionally delivered a strong undergraduate liberal arts education, the largest majors have become computer science in a very short period of time. Are institutions prepared for this?

Isbell: Just as every company is now a technology company, every major will be a data-driven major. By 2025, you will not be able to get a bachelor's degree without a deep immersion in data science, whether you are a history major or a computer science major. Unfortunately, we have far too few professors prepared to teach data and computer science to this growing number of students, not to mention professors in humanities and social science fields who are well prepared to integrate data sciences into their curricula. There is no way to address this growing need for faculty to instruct ever larger numbers of students without productivity gains. It is likely that institutions that have developed the expertise and infrastructure to deliver these kinds of courses will need to partner with other institutions to make these courses available. That will be difficult because it will hit the tenure processes, departments, and faculty budget lines. These are not processes that move swiftly, but the changing needs of the marketplace require more well-equipped graduates soon.

Post-Interview Reflections

These kinds of developments I discussed with Professor Isbell place universities in the position of having to compete at a scale that is larger than a single institution. In the area of teaching and learning, one response to this approach will be for some universities to grow much larger to pursue productivity gains through online learning of the kind that Georgia Tech is realizing. A second approach might be to address issues of scale through specialization and collaboration. Some universities might take responsibility for developing a high quality online version of a course while other universities will use that online course and supplement it with local instruction. It may also be that certain courses in fields amenable to online instruction will be delivered almost exclusively online.

How likely is this to happen? Over the course of the last two decades, I have seen how the digitization and distribution of content has had a powerful impact on research and scholarship. We have enabled research and learning in ways that were simply impossible before the advent of digitization and network technologies. The same cannot justifiably be said for the teaching process, where despite the potential to deliver many aspects of the traditional course in digital form, many of the same classroom procedures remain in place, placing a premium on local attendance and low student-to-faculty ratios. Change eventually will come to these environments as well, since many of the same forces that have impacted distribution of scholarly work also impact teaching and learning, especially as videos have moved to the network.

Professor Isbell and I also had the opportunity to look beyond the classroom to the university research enterprise where new areas and types of research are being created by the ability to capture, store, and analyze massive amounts of data. Like access to great research libraries in the 20th century, or access to the transcribed texts of the monks in the 6th century, access to massive amounts of data is essential to conducting cutting edge research in an increasing number of fields. The most significant challenge facing research universities in this area is gaining access to these stores of “Big Data” and the resulting competition for faculty who want and need to conduct research using those data.

That competition for faculty is having an impact. Professors are leaving the academy for jobs in industry, not only because of the potential to earn more money, but also to have access to the resources and data necessary to work on the most interesting intellectual problems. Top graduates of PhD programs are also choosing the commercial world for

the same reasons. With the insatiable need for data to feed the machine learning algorithms and to pursue answers to challenging problems in new ways, universities are finding themselves struggling to gain access to the raw materials essential for creating knowledge. Universities will need to collaborate with each other and the private sector to develop, maintain, and/or gain access to the enormous datasets that are required to engage in the new forms of machine learning and artificial intelligence. Because of the scale of this challenge, it may well be that intermediaries will be needed to help facilitate these collaborations.

In any event, at the heart of the changes in teaching and research are the faculty themselves. As described above, universities are hard-pressed to retain the best faculty, but they must rise to that challenge in order to continue to fulfill their missions to create and advance knowledge. In addition, those same faculty must take a greater role and responsibility, as people like Professor Isbell are doing, to experiment and lead their institutions further into the digital age. It is essential that universities take advantage of network and information technologies to educate more people at lower costs. It is not simply a matter of reducing tuition, it is a matter of increasing the number of educated people who are prepared to contribute to a changing society and economic environment. In our conversation, Professor Isbell shared an insight that when people think about the future, they "tend to overestimate the impact in the short term, and underestimate the impact in the long term." Change is coming, perhaps slower than we expect, but I hope that our higher education institutions move just fast enough to be prepared for the impact we are inclined to underestimate.