"Calculus: A Modeling Approach"
Student Telephone Interviews
December 2, 2013

INTRODUCTION

In the summer of 2013, the ACM piloted its first online course, an applied calculus course co-taught by two faculty members from Macalester and St. Olaf colleges. The course was designed with a goal of bringing the best of classroom teaching at liberal arts colleges to an online setting, and was aimed at social and natural science majors interested in using quantitative tools in their disciplines. As part of the evaluation for the pilot, the ACM desired interview data from all students who enrolled in the course (n=18), so as to learn as much as it could about the strengths and weaknesses of the course from the students' perspectives.

The following report summarizes the findings from the interviews, and as it is the final report it renders obsolete the preliminary report which was delivered on September 25, 2013. The substantive findings from the preliminary report were confirmed in the final analysis. In general, the interviews provided a more detailed explanation of comments and ratings collected in the course evaluations administered by the faculty members. In addition, the interviews also probed issues related to attitudes about online learning, especially with regard to expectations for the course and likelihood of taking other ACM organized online courses in the future.

METHODS

A structured interview guide was designed by the evaluator in consultation with ACM staff. The guide queried students' motivations for enrolling in the course and their initial expectations about the course; their prior encounters with calculus, online courses, and the technologies used in the course; their enrollment experiences and sources of information about the course; their experiences and attitudes as students during the course; and their overall evaluations and recommendations for improvement of the course (see attached interview guide).

Recruitment for the interviews was conducted by email, with a maximum of four email requests for participation. The evaluator conducted a total of 12 interviews from September 6-27, 2013. The interviewees represented six different ACM colleges, were predominately female, and had freshman, sophomore or junior status at their colleges. As a set their majors included both humanities and social science disciplines. Male students were less likely to elect to participate in an interview, as were students from Lake Forest College. Consent for including interview remarks in the report was obtained verbally from

the students, prior to commencing the interviews. All participants were assured their comments would not be directly attributed by name and that the reporting of the findings would emphasize the consensus of the comments in the aggregate. The evaluator took notes during the interviews. Shortly after all interviews were completed the evaluator compiled the notes and identified common themes as well as points of departure.

This report is the formal analysis of the interview findings. To better insure the confidentiality of the participants, quotations have been kept to a minimum and no participant characteristics (such as gender or institution) are associated with quotations. The report is organized to align with the interview guide. The first section reports on the students' motivations for enrolling and their expectations about the course, while the second section addresses how they learned about the course, the experiences they had during enrollment, and their preparedness for the course content and for using the course-related technologies. The third section delves into the specific experiences students had during the course, in terms of completing the requirements and relating to other students and the instructors. The final section addresses their overall evaluation of the course, their likelihood of recommending it, and their suggestions for improving it.

MOTIVATIONS AND EXPECTATIONS

Most students enrolled in the course to fulfill a requirement at their home institution of taking college-level calculus as a pre-requisite for courses in their major or for a graduation requirement: "I had to satisfy a requirement at college, and could do this course instead of taking one during the school year. The fact that it was online was beneficial because there is no summer school at [my college]." Many reported that their enrollment decision was based on their assumptions about the convenience and scheduling flexibility an online course would offer. As one student reported, "It was really convenient to do in the summer, because I have to take other courses with labs during the year. I was going to be home working, so all I had to do was work around that schedule." Several also thought their on-campus options for completing calculus would be much more difficult: "I needed calculus for my economics major . . . and I heard that the course offered at my school is difficult. So, I wanted to do over the summer somehow." Another student remarked, "As a double major . . . I have lots of requirements and not much time to complete them. Taking calculus in the summer would be easier than taking five classes next spring."

When asked what they would have done had this course not been available, about one-third of the students said they would have taken it during the summer at a local institution: "I would have taken it at a university in my home city or at a technical college in my home city. I *had* to do it this summer." Another one-third would have taken it during the academic year at their home institution, and the final third were unsure or

would not have taken calculus at all (a few of the students were taking it purely as an elective, rather than to fulfill a requirement): "I'm not great at math, so I probably would have taken a lower level statistics course at my school."

None of the students who enrolled had previously taken an online course in college, and most thought it would involve more independent learning and fewer opportunities for contact with other students and the professors: "I thought it would be more free, but it was very scheduled. I thought it would all be on my time, but there were some requirements that made it very scheduled." Another commented, "I thought it would be more individualistic." A third interviewee said, "I expected very little interaction with peers." Many reported that the level of interpersonal engagement enhanced the learning in the course, they also found the scheduling of such opportunities to be difficult to manage given other demands on their time during the summer (see section 3, below).

Students were mixed in terms of how difficult they thought the course would be. Some expected it to be relatively easier than many other courses because it was an introductory course, whereas others thought it would be very challenging because of the subject matter. One had expectations that it would be more difficult than it was because it was offered by the ACM: I expected it to be challenging because the ACM is held in high regard, academically. One student remarked:

> "It was a significant time commitment even though it was an online course, but it was also more interactive than I anticipated. There was more time talking to the professors and students than I expected. I also thought it would be more different from a traditional class than it was."

Enrollment and Communications

Students came to learn about the availability of the course through many different avenues. About half initially learned about the course via emails or flyers on campus. One student reported, "It was emailed out to all students at college. Our registrar sent out the email." A few learned of it through word of mouth from faculty or staff members on their campus, or from parents. For example, one interviewee said, "My mom teaches at the college . . . and is very involved in academic affairs, and [she] heard about it and told me, and then I saw campus flyers." A different student said that her parents contacted her about the course. Another reported, "I spoke with a professor about online calculus courses and he suggested this one. There were also posters around campus that I saw before that."

In general, students would have liked more information about the course during registration, or at least prior to the first day of class. One student reported that her anxiety about mathematics contributed to her desire for more information:

> "I used the website. Communications were pretty good. I would have liked more. I submitted an application and got an email that said I was accepted. But there were no other personal communications. I looked at a sample lecture and the requirements. I felt a little unsure but went ahead and registered. I didn't know the workload or structure. More personal contact would have helped me feel more comfortable signing up. I have some anxiety around math, so some reassurance would have been helpful."

Those who knew about the website found it helpful, and about half the students had all the information they needed. However, several students had questions that they could not find answers to on the website, such as when they would be notified of being accepted, how much their out-of-pocket costs would be, whether the course would count for specific distribution requirements on their campus, what costs they would incur if they dropped the course. Only a few did not know the website was available.

In general, students felt they were academically prepared for the course. As one interviewee stated, "I think the way the course was structured in terms of content, it was accessible. I had not taken math since my senior year of high school, but the way the professors explained the material was easy for me to understand." Several remarked that their prior calculus coursework prepared them to be successful in the course: "Yes, in terms of math, I'd taken calculus in HS so I was very well-prepared for it. Some of it was review for me." A few thought that a prior college-level mathematics course would have been helpful. "I wasn't personally well-prepared for it. I should have taken pre-calc in college."

Most found the technological approach easy to adapt to as part of the experience. "The technology was good. I'd used Piazza in another course, so that was fine and really helpful." Even those who had no prior experience with the software used seemed to adjust relatively easily. Comments from students included: "It took a few days to understand Piazza and how to respond to people and expectations." "The technology was hard to get used to, but not awful." "It was a little overwhelming to have everything on different websites. At first it was difficult to figure out." "The technology wasn't incredibly difficult to understand. And they did a nice job."

The most frequent challenge students met with was in learning RStudio: "RStudio was tedious and while helpful, it was kind of hard to plunge into using very formulaic syntax." Another student remarked, "Rstudio is a hard to use program. They gave us a book on it as well as calculus book, and told us to learn the program. I figured it out." A

third stated, "RStudio was a little challenging, and you needed to get the syntax exactly. I tried using it on three computers in my house. With my Mac, some of the programs, the way they were written didn't always translate to a Mac." A fourth reported, "Rstudio was very challenging and super hard to learn how to use it because it is a different language. The tutorials didn't have enough time to discuss it."

COURSE-TAKING EXPERIENCES

When students compared this online course with their prior on-campus course-taking experiences, they found both benefits and drawbacks to the online platform. They appreciated the intimacy of the online tutorials and the anonymity that Piazza provided for posting questions. Student remarks included: "I could ask questions anonymously which really helped. We put pressure on selves to out-perform others at [my college]. But not with an online course." "I got a lot more one-on-one attention. [My institution] is not a huge school, but I'd never been in a class setting with three people, like I was with the video chats, which I really appreciated and liked." "It's difficult to meet with professors in person on campus, but I knew at my scheduled time I would have a chance to ask any questions of the professors." "I interacted more with classmates than with any other math course because of the message board format. I've never talked that much about math with classmates and that was very helpful."

Another student found the rhythm of the online course to me more suitable to learning calculus:

> "One of things I thought was advantageous with the online format was the ability to start and stop lectures. If I miss a point I can be derailed for the rest of the conversation. But online I could start and stop and review. And it was all presented in little chunks: 10-14 minutes, then problems and a quiz. Little bits of information are easier to process than a 90-minute class without a break."

A few remarked that the course functioned in ways that are highly comparable with on-campus settings:

> "In some ways it was very similar to an on-campus course . . . The material was approached the way it would have been on-campus. The way Piazza was used was more effective than an on-campus course. It was even better. The video chats were really good and made it feel like an on-campus course because of so much communication, and that as far as possible in an online course, it didn't feel like one."

> "I actually know that the course on campus uses Piazza and RStudio. So it just seems similar to the way math is taught on campus, except for being in a classroom three times per week. It was a very similar experience."

However, they also recognized the value of obtaining immediate answers to questions during on-campus office hours and the camaraderie that is ignited when students and faculty meet each other face-to-face. One interviewee remarked: "On campus I would have had more face to face time with professors. But they did a good job." Similarly, a different student commended, "The professors had office hours but, it's different when you can walk down to the professor's office and can get help directly." Another said, "I think I prefer taking classes in person' I just like interaction and that comes more naturally than when seeing a picture on a screen." While another commented, "Discussions with Piazza were a little more forced. Asking questions and having them answered and discussed in a class setting would have been easier. I wouldn't have had to log in and type out questions and make time out of my day for it." These comments all seemed to boil down to missing the quality and potential richness of interactions with others: "Interaction student to student, which as good as it was, it's always nice to sit with someone to do homework and talk and to help each other review."

For a few students, the rhythm of on-campus math courses is preferable: "On campus it's more regular—daily—this course was every other day. I like the structure of daily."

The support students received from faculty was cited frequently during the interviews as a highly beneficial and appreciated aspect of the course. The following comments are representative of the those remarks: "They were really helpful, I asked questions and they responded quickly." "[The professor I most interacted with] was enormously helpful and very nice." "There were always ways to connect, get help, and get questions answered." "Both instructors were amazing, very helpful, open to my questions and to scheduling different times [to speak with me]."

The tutorials, in particular, were called out by many students as very helpful:

> "I liked the tutorials a lot because they gave us the opportunity to ask questions that were more difficult to type out. It's more effective tot talk about things, to talk through problems, and the professor gave all those involved a chance to talk to each other, and help everyone out all at once."

> "I think they were pretty effective. At times we, as students, didn't bring enough to take up whole period, so the professors would review something with us if we didn't have questions. It helped keep me on track with homework and questions. In

other courses it can be easy to fall behind. This scheduled time to check in with professors helps and makes it feel more like a traditional course in a classroom."

While all indicated that the tutorials enhanced their learning the content in the course, many disliked the inflexibility of these sessions, and a few thought the rigidity of the tutorial schedules were inconsistent with a major benefit of an online setting, namely, studying according to one's own schedule. The necessary lack of flexibility for this component of the course, combined with its daytime scheduling, created logistical issues for several students. The about half of the students commented on this facet of the course:

"I thought I would have own time to work on it, but not really because of the times that were set by the instructors' schedule. But I was in a different country in a different time zone and that was challenging."

"The times were not flexible or sufficient for accommodating summer jobs. I contacted one of the professors early on when a conflict arose. He said, 'look at other times.' When I asked, 'is there another way to be involved?' the professor said 'no.' It was kind of upsetting."

"I was working in Madison part-time, a 40 minute drive for me, and it made video chat timing difficult, until I found a coffee shop at which to do them."

"That was hard for me. I worked 50 hours per week, and I was working during the video chats, as a nanny. And the professor had to deal with kids in the background."

"They were all right in middle of day, which was when I was supposed to be at work, and a lot of students who are working over summer don't have an hour chuck of time in the middle of the day."

In fact, one student reported dropping the course because of the tutorial schedule: "On the application it asked whether I was working, and I said I was working 40+ hours per week. But the tutorial group sessions were only scheduled for two days and only during working hours. These tutorials were not explained until after we'd paid money. The times of the sessions were not publicized on website."

Students reported that the IT support was adequate, although few gave examples of needing it, especially after the first week or two of the course. One student indicated that the technical capabilities of the course exceeded expectations: "Usually when there is a tech course there is a problem. But there were no problems with this online course." In general, the various programs that were used to administer the course (Moodle, Piazza, the

online lectures and video tutorials) were all viewed as easy to navigate and each contributing in some way to the course's learning outcomes. "We had a book on Rstudio; Piazza is just a basic blog, and if there was a problem we could always ask a question on Piazza."

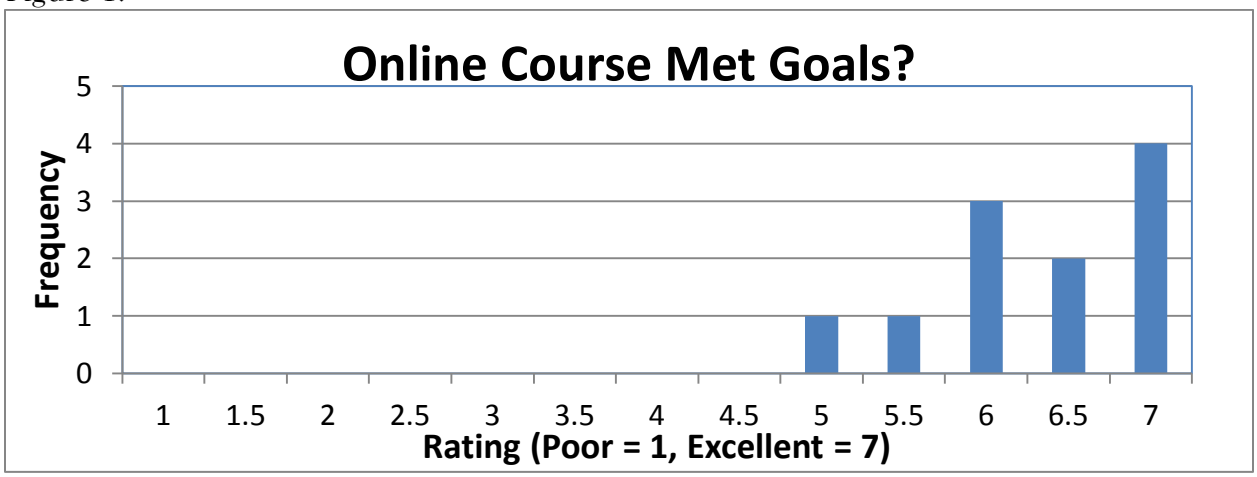
A few students reported prior familiarity using Moodle or Piazza on their campuses, and everyone had good things to say about their utility for this course: "I think Piazza was best, allowing more student communication and allowing us to answer each other's questions." One student recalled, "It gave us a chance to use Piazza in an effective way, not as a bother. At first I thought 'Oh no, Piazza was so annoying in last course I took,' but I answered other's questions, and asked my own question." Another echoed this sentiment: "I really liked Piazza. All . . . discussion board courses don't work as well. It can be redundant when have in-class discussion." The most common difficulty encountered was with RStudio, as was discussed in the prior section.

By far, the most effective aspect of the course for the students was the "real world" application of calculus. This was cited time and again when asked what was most helpful to their learning. For example, one interviewee commented, "A lot of the questions and homework problems were real life problems and situations that were economics-based, which is my major." Another was pleased to realize: "The examples really showed how calculus could be applied to situations I'd never thought about it being in. In high school it was not applied, but with added application it became more real and useful. I could see myself using calculus in future for something." Another had a similar revelation: "I loved the fact that they used real world examples. I like to learn that way anyway. Sometimes when take math courses, you think: how would I apply it? Why is it important? They were really nice and used examples so I could see how to apply it in these sorts of situations." Likewise, a different student remarked, "I think the fact that the examples weren't just variables, they were looking at simulations like a ballgame, or measuring directions, climbing a mountain, valleys, so applying it to the outside."

In terms of suggested improvements for the course, a few students thought the book could be improved, but many had no suggestions outside of greater flexibility around the online tutorials.

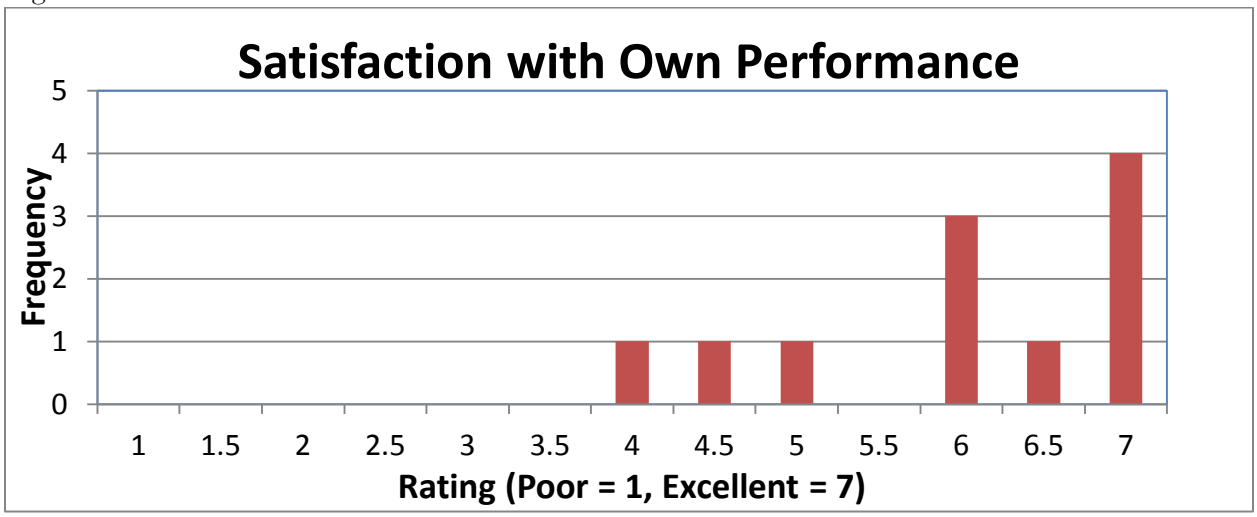
In rating the course on how well it met its goals on a 1 (weakest) to 7 (strongest) scale, most students gave the course ratings above the midpoint (see Figure 1). Six of the eleven students who completed the course provided ratings above a six, indicating a very strong feeling that the course met its goals.

Figure 1.



These ratings were consistent with the above-midpoint ratings students gave their own performance in the course (see Figure 2).

Figure 2.



Those students who gave themselves lower ratings did so in recognition of the greater time or attention they could have devoted to the course to increase their grade. For example, one student admitted, "I could have looked at homework prior to tutorial sessions, and I could have—for the quizzes—I could have spaced them more evenly, instead of piling them up four per day." Another reflected, "Piazza—I could have used it more effectively. The professors were really nice and provided practice problems and answer keys to get extra time with the material, but I didn't do them." Another said simply, "I could have participated more."

The counterbalance to the self-recognition that they could have exerted more effort in the course is the fact that nine of the eleven interviewees who completed the course reported working at least part-time, four reported working full-time or more for pay, and a few reported a rather frenetic pace. Examples include the following:

- "I was crazy busy. I had an internship and was working."
- "I was working in Madison part-time, a 40 minute drive for me . . . playing soccer, going on family vacations, and athletic training."
- "I was working 50 hours week. During the last two weeks of class we went to Ireland. A last minute family vacation trip."
- "I led a vacation bible school, taught Sunday school, tutored at a literacy network, volunteered at cat shelter, visited hospitalized people, worked 10 hours/week at fair trade store, and took a watercolor painting course."
- "I was overseas with my family and travelling quite a bit, and sometimes didn't have internet in places I was. There were expectations that I would go out with my family and meet family members. I was also taking a GMAT course."

Despite all of these competing demands, in retrospect students thought that they were able to find a balance between their course demands and their other responsibilities: "It added more work to my summer, but I was able to manage my time well in terms of working and completing assignments." Another remarked, "The videos were only 15 minutes, so I could squeeze that in if had half an hour, and I had most evenings free."

Overall Evaluation and Recommendations

In general, students would recommend the course, primarily because of the flexibility it provides combined with the personalized contact between students and faculty that was facilitated by the technological components of the course. For example, students made remarks such as:

- "Yes, I would recommend it . . . especially to a math student, economics student, or social science student."

- "I would recommend the course, particularly to those similar to me, especially those who are science/social science based."

- "I would recommend it . . . and the professors also, because I really like them. There is so much involvement and interaction that's unexpected, while still having the flexibility of an online course. It is as close as it could be to a satisfying on-campus course, while being online and still very flexible."

- "I would say yes, because it really is a liberal arts experience, where you meet professors and they give you lectures and students help you and you help students."

- "Yes, I definitely would [recommend it]. It's a lot more approachable for non-math majors, for a calculus course. And for people—recognizing that everyone works different hours—for a lot of people the time would be very convenient. There are things due several times during the week, but you just need to turn them in before a certain date. You get a lot more attention than if you took calculus at a community college during the summer. There are not a lot of introductory calculus courses with only three people talking to the professor at one time."

When asked to identify the characteristics of potential students who would be most successful in the course, interviewees mentioned those who have the ability to schedule around it during the summer, and who are well-organized, self-motivated, and who don't consider mathematics a personal strength:

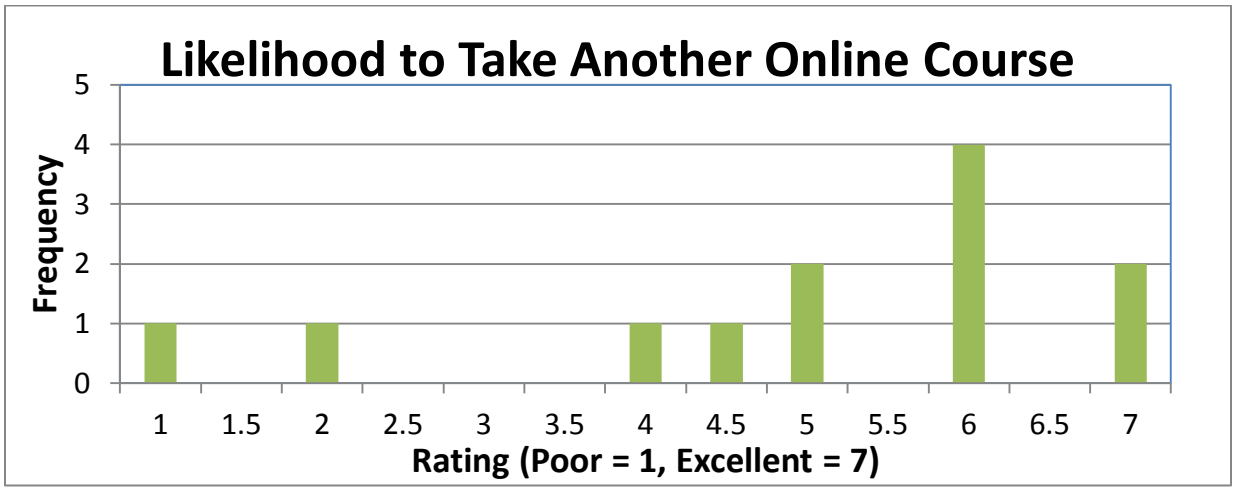
> "People who are self-motivated and organized, because there are a bunch of deadlines to remember for homework and checkpoint quizzes, so they have to be really prepared for that and to not have someone telling them every day what to do. And, those with a willingness to try different technologies and to go into the course with an open mind."

> "Those who are pretty motivated, because you are on your own and not surrounded with classmates. Those who are independent because it is based on you own efficiency. And then, anyone who is scared of calculus or apprehensive about taking a regular math class, because they made it very approachable."

> "The lectures can be very long, so they need to have good focus. When watching something on computer you tend to have a shorter attention span than when in class."

Students indicated they were moderately likely to take another course designed such as this one, depending on the course content/subject (see Figure 3). Most said humanities courses would not be a good fit for this platform. For example, one interviewee commented: "It was perfect for a math course, but I really like in-class discussion, so I could imagine a class where more open-ended discussion is important it might not work as well." Another remarked: "Because I have so many courses to take it's really nice to do one in this format, not during the school year."

Figure 3.



A few of those less likely to take another online course indicated they had very few courses remaining for their undergraduate degree, or few that would lend themselves to an online format.

Interviewees also provided a variety of other comments and suggestions for the instructors and administrators of the course. These included the following:

- "I really like interacting with students on Piazza. It might be helpful to have a picture with profile. Aside from those who I had tutorials with, it was anonymous, and a photo would help me know who was who and help to create community."
- "Thank the instructors because they were very patient with the video chats."
- "If you are asking people to apply, there should be an automatic response email, with more info about the course IMMEDIATELY. Give them information as soon as they apply so they can make an informed decision about their ability to meet the course's time requirements."
- "I thought that even though I was working 40 hours per week, if I was accepted I would be able to complete the course. But I wasn't informed about the requirements for the timing of the tutorials until much later, and by then I had paid money and could not complete the course."

CONCLUSIONS

Overall, the findings from the student interviews should provide assurance to the ACM that courses administered exclusively in an online setting can satisfy student expectations for a quality educational experience when instructors deploy available technological resources to create a more personalized online course-taking experience. Indeed, this course may serve as important evidence that online courses *can* deliver education in ways that are not all that different from that which is the hallmark of the liberal arts experience: regular student and faculty interactions, low student to faculty ratios, and intimate peer-to-peer learning groups.

In addition, among ACM students there seems to be some appeal to taking a portion of the undergraduate coursework over the summer, when students have greater flexibility in their schedules. One could expect that other courses designed with a similar format, (weekly lectures, problem sets, and tests or quizzes), would meet enrollment requirements if offered online during the summer months. The success of these offerings will depend on the technological savvy of faculty and the support they and their students receive to adeptly negotiate the digital tools required to bridge the gap between the highly personal on-campus experience at liberal arts colleges and the anonymity of the online learning environment. However, as processing speeds, computing power, and software development continues to forge new ground in the coming years, the provision of high quality online courses will no doubt get easier to manage from both student and faculty perspectives.

Although few students enrolled in this course had had previous experiences with online courses, they approached this opportunity with preconceptions about how much the course would enable individualized learning "at their own pace." As options increase for students to learn in online settings during their secondary and post-secondary years, ACM will need to make a concerted effort to differentiate its online courses from the "traditional" online experiences, so that students are prepared for the amount of synchronous learning in which they will be expected to participate. This and other course requirements and expectations should be communicated frequently and through many different channels in order to compare with the on-campus enrollment experience, which provides for easy interactions between students and faculty prior to and during enrollment periods.

Finally, given the complexity of students' lives at ACM institutions, combined with the need for many students to work for pay during their summers, the instructors of future online courses should consider options for synchronous learning sessions at a variety of times, including outside of a normal working day (i.e., 9 a.m. – 5 p.m.). The number of working students may increase in coming years, especially as tuition costs increase and

families hear more about the need to control student loan debt. Given the lack of flexibility built into most of the on-campus course scheduling options, online courses may find they attract greater numbers of students when efforts are made to build upon the appeal of flexible course times.

APPENDIX

Assessment of ACM Online Course
Calculus: A Modeling Approach
Student Interview Guide
September, 2013

Purpose: As part of ACM's evaluation of the pilot online course "Calculus: A Modeling Approach" students who enrolled in the course will be interviewed to learn about their experiences and opinions. Specifically, the interviews will result in learning more about the strengths and weaknesses of the course as perceived by students (and relative to the course goals), as well as exploring the students' recommendations for course improvement. "ACM Online Applied Calculus Course"

1. Introduction (1-2 minutes)

   [Insert informed consent language here]
   Used for reporting to presidents and deans, possibly a conference paper. Confidential and reported on anonymously.

   As you know, I've been asked to serve as an external consultant for the ACM to help them evaluate their recent online course offering, Calculus: A Modeling Approach, which you enrolled in this past summer. I'm contacting all students in the course to ask them about their experiences and opinions. Nothing we talk about today will be personally attributed to you. Rather, I'll be reporting on my findings from all the interviews in the aggregate, and drawing conclusions based on my summary of all the interviews I conduct. Our conversation should take about 30 minutes. Do you have any questions?

First, I'm going to ask you a few questions about your motivation for enrolling in the course.

2. Motivations and Expectations (5minutes)

   - Why did you choose to enroll in the course?
     - *[Attempt to discern importance of content (calculus) vs. platform (online) in decision-making]*

   - If you hadn't been able to enroll in this course, what would you have done?
     - *Probe for: not taken a calculus course? taken a course elsewhere?*

- Have you taken a previous course online? Did that influence your decision to take this course?
    - What did you expect this course to be like?

3. Enrollment and Communications (5minutes)

Now I'd like to ask you to recall the time period when you were enrolling in the course . . .

- How did you first find out about the course?
- Did you find the communications about the course prior to and during the enrollment period informative and sufficient?
    - *Probe for website use (http://www.acm.edu/off_campus_study/Summer_2013_Online_Calculus_Course.html).)*
- Were you sufficiently well prepared to take this course, both in terms of its content (specifically, with regard to your prior knowledge of mathematics) and its platform (in terms of your ability to learn the instructional technologies used in the course)?
    - *Probe for clarity of communications about preparation/pre-requisites*
- Was there any additional information that you would have found useful during the enrollment period that you couldn't obtain or obtain easily?

4. Course-taking Experiences (10-15 minutes)

Next, let's turn to the experiences you had while taking the course.

- How did your experience in this on-line course compare with your experiences taking on-campus courses at your college?
    - What did you like better about this course?
        1. Video tutorials—3 students : 1 prof
        2. Discussion without faculty mostly
    - What do you like better about on-campus courses?

- [*If appropriate]* How did this course compare to other online courses that you have taken? What did you find was better or worse?

This course was designed to be a liberal arts college version of an online course in that it enrolled a small number of students and provided structured opportunities for close interaction between faculty and students.

- Did you feel you received enough support from the faculty to successfully complete the course?

- How would you assess the tutorials, in terms of their ability to promote interactions between faculty and students?

I'd like to learn next about your reaction to the instructional technologies employed in the course, such as Moodle, Piazza, and video tutorials.

- Did you find you had adequate technical support for the technologies used in the course?

- Did the technologies used facilitate your learning the content in the course?

- Piazza was employed for the course as a way to facilitate your learning, by helping you learn together with your fellow students. How would you assess the value of Piazza as it was used in this course?

As you think about the goal of the course, you may remember that the overarching goal was for you to "acquire a toolbox of mathematical techniques that will be useful in your chosen discipline… and the inspiration and confidence to use the tools" to solve the kinds of unstructured problems you would encounter using calculus in applied fields, such as economics or biology.

- What about this course was most helpful for your learning calculus?

- Are there ways either the course design, or the way the course was taught, could be improved to better support your meeting this goal?

    - *Probe for appropriateness of technologies, difficulty in learning content, availability of assistance when needed, etc.*

- Overall, how well did the course succeed in meeting its goals for you, on a scale of 1-7, with 7 meeting all goals and 1 meeting very few goals, if any?

- Were there things you could have done to improve your learning relative to this objective?

- Were there other demands on your time this summer while you were taking this course?

    - *Probe for taking other courses, working for pay, working at an internship*

- How well do you think you were able to balance the course demands in addition to other things that were competing for your time and attention?

- How satisfied are you with your performance in the course, on a scale of 1 to 7?

5. Overall Evaluation and Recommendations (5 minutes)

- Would you recommend this course to another student?
    - Why or why not?
    - What advice would you give another student enrolling in this course?

- What are the characteristics of those students you think would be most likely to succeed in this course?

- Are there any improvements to the course that we haven't yet discussed which you would like to see implemented before it is offered again in the future?

- How likely are you to take another online course like this, if it were offered, on a scale of 1 to 7, with 1 being "very unlikely" and 7 being "extremely likely"?

- Is there anything else you'd like to share with the ACM or the course instructors about this course or about other online courses that might be offered in the future?

Thank you so much for taking the time to speak with me. If anything else occurs to you after we hang up, please feel free to send me an email and I'll be sure to amend your comment to the interview notes. Have a good evening!