PHILIP PEARCE: Yes, so I think that the real difference between when you guys first ran the course, which I think was in 2015, and now when I run the course, is that Jen has helped to develop this online MITx platform. Now it's really a flipped classroom course. So it has this blended learning aspect to it where the students complete online reading before they attend the classroom hours. And then in the classroom, we really go through examples, worked examples, where the students can apply the theory that they've learned while they did the online reading. I think this is the key thing that you guys and Jen and myself really saw the course being when I started teaching it.

JEREMY ORLOFF: So how do you ensure that they do the online reading?

PHILIP PEARCE: So the online reading has many examples where the students can attempt something, attempt a question. And 10% of the grade for the course, is given to them for getting these questions right. It's a small incentive, just to make sure that they complete the online questions. And of course, we get feedback data to know how many students do those questions. And it's relatively easy to check to make sure that student do them.

JENNIFER FRENCH: So that the way that the online notes are structured is that they are hosted on the MITx residential platform. And so all of the reading, there is no text book. All of the reading is online. And there are questions interspersed between the text. And so it's these questions that are really depending on the text before IT, which tell us if the students have been doing the reading because they can't answer these questions without actually attempting this work.

I think some of the parts that were really useful about using digital tools in having students interact with the content were, one, is that we use the sketch response tool, so we could actually have students draw pull diagrams and pull zero diagrams. And they could get automatic feedback on whether or not that was correct. We could also have them sketch responses to a system and get feedback on that.

The other thing that's nice is that it really makes some of those simple examples that you often have to spend a lot of time in class doing, we can now do those

online, and have the student get immediate feedback, see the answers. These are things that maybe it's not worth doing in class when you have someone like Philip who's there. And instead now he can spend his time working through the really complicated examples and giving the scaffolding and fading to help them do much more interesting problems than on the homework.

PHILIP PEARCE: Yeah, I agree actually and that's another way that I really see this course as maximizing the kind of utility at the time that the students spend with me and with each other. So we go through more involved examples where they have to really stop and think about things, rather than the kind of rote examples, where you just really make sure that you understand a specific little concept.

JEREMY ORLOFF: So do they-- do the students turn in homework in this course?

PHILIP PEARCE: Yes. So the way it works is in terms of them getting a grade is we have the online lectures in which they have to answer questions. And we give that a small-- 10% of their grade is from the online examples. And then we have problem sets in which they have to answer slightly more involved questions. And they're handed in once every week. And then we also have a midterm and a final exam.

JEREMY ORLOFF: So one of the great virtues of having online questions, in my opinion, is students get immediate response to their answers as opposed to waiting a week or something and getting their homework turned back to them. And, of course, who needs to get the bad news. They don't the sheet to see where their mistakes were. And with an online setting, one of the great advantages is students see right away whether they understand something or not.

JENNIFER FRENCH: Yeah, I agree. And then I think also a lot of the literature shows that it's actually when you're first learning something, that that immediate feedback is the most useful. And actually when you're doing more complicated things, sometimes then the immediate feedback is less helpful. And so that actually really is built into the way the course is run.

One thing also that we do is that we actually have a problem set checker for the homework. So they actually know before they even turn it in if their answers are right.

PHILIP PEARCE: And that's something that we decided to add in this time that we taught the course, this time I taught the course. So in the previous times I taught the course, some of the feedback that we got from the students was that they would like to have even more online examples. And one of the things that we did to rectify that is that we made this-- or Jen implemented this problem set checker, so that the students at the end of each lecture could see the problem set and answer the questions and get some immediate feedback on them.

JEREMY ORLOFF: And by the lecture, you mean the online unit that they were going through?

PHILIP PEARCE: Yes, exactly, exactly. So after they've done the online reading, they can also see the problem set and answer the questions and get them checked.

JEREMY ORLOFF: Another great I think about the online version is the way the Mathlets get integrated into the course, very seamlessly integrated into the text.

JENNIFER FRENCH: I agree because I think that one of the things that is hard for novice students is to interact with the Mathlets because they were really designed both as a student-facing tool, but also an instructor-facing tool, really to demonstrate things in lecture. And so for a student who doesn't know what's going on, sometimes it can feel like there's just too much going on, too many sliders, too many buttons. And so instead, we can embed it in the web page, and then have really guided problems and guided activities that help them understand how to interact with it, and to help them figure out what they should be looking for, and what are the real responses of interest.