[SQUEAKING]

[RUSTLING]

[CLICKING]

JUSTIN REICH: OK, congrats on turning in paper number 2, for those of you who've turned in paper number 2. And for those who are wrapping things up, good luck. Your next assignment is very, very open-ended. Paper 3-- you just get to pick what you want to do.

Kind of the only restriction on it is, like, you can't turn in this assignment in another class. You can't have same paper in two classes. But other than that, there are very, very few guidelines on what you could do. I am particularly enthusiastic about anyone who picks an assignment that is connected to things they're already working on.

So Kent should totally do something about MacLea. I don't know what that is, but probably no one has ever asked him, write 8 or 10 pages about what it is you're trying to do there, or do some more research that helps inform what you're doing, or design your next steps, or whatever it is. But that would be a great project for Kent.

And even if Kent is-- even if his UROP is to build MacLea or whatever, it's totally fine to have something that's very adjacent to that. I've had doctoral students who did part of the literature review that they have to do for writing a chapter of their dissertation or something, and that was great.

So any of the-- I mean, you could also pick something that is completely unrelated to what you're working on, just a thing that you're interested in exploring further. Anything is fine. But part of the assignment is figuring out what it is that you want to do.

OK, what we want to try to do then today is talk about two of these as-yet intractable dilemmas that you've read about. So in the first half of the book and in the course, we talked about these three genres of learning and scale, tried to emphasize to you that these genres have predictable characteristics, they have semi-predictable impacts in school settings, and that their impacts are almost never transformative.

They have the potential to be useful, and to some extent, there's a kind of ongoing disappointment. Think of all of the amazing things that we've developed from radio, filmstrips, television, videos, personal computers, the internet, instructional tutors, online communities, all these different things. And none of them have really blown the walls off school.

School is still kind of school. And in a lot of cases, it doesn't educate people as well as we'd want to. So what are some of the reasons why these technologies don't have the transformative impacts that we keep hoping that they will?

And the four as-yet intractable dilemmas-- the goal of this part of the book is to say, we know a bunch about why they don't do all the things we want them to do. We know some of the challenges that occur across these different genres. So a thing like Scratch, a MOOC, an instructional tutor, Khan Academy-- they might be really different in some dimensions, but a lot of times they still stumble across these same problems.

Some of this is me writing, like making an argument to the field. Hey, if we want to do better in the future, we're going to have to figure out how we deal with these four things. We're going to have to understand these problems and how they operate, and then we're going to have to do better with them.

So today, we'll talk about the curse of the familiar and the edtech Matthew effect. And then we'll talk about the trap of routine assessment and the toxic power of data and experiments. Why don't I give you a minute to chat amongst yourselves? This was from a couple of weeks ago, but turn to the person next to you.

Talk to this person about what you remember of what the curse of the familiar is, why it would be a problem, what kinds of things get stuck in the curse of the familiar, and what kinds of strategies seem to exist that might help us get past that? Turn to the person next to you and just externalize what you remember about all this. Ready? Go.

All right, come on back. What are some things you discussed that seemed core to the definition? If you were to quickly summarize the curse of the familiar, what are some key ideas?

AUDIENCE: The idea of taking an old idea and repackaging it so that it appears to be something new that really isn't. I think we talked about the idea of Quizlet versus flashcards. It's basically the same technological premise, but you're just digitizing it.

JUSTIN REICH: And what's the virtue of doing that?

AUDIENCE: I guess people will think it's new and maybe even be excited by that, but there's no real change.

JUSTIN REICH: Good. What do people want to add to just that particular idea?

AUDIENCE: I was going to say, it kind of stems from this idea that these new inventors just have a lack of knowledge of what's come before them. And that's kind of where it can stem from.

JUSTIN REICH: That can be a problem, yeah. Sabrina, what were you going to say, and then, Gloria?

AUDIENCE: I was going to say how they take these new technologies, and instead of revolutionizing them, they just bend it so that it fits how it-- old institution still continues to [INAUDIBLE].

JUSTIN REICH: I like that. We take things, and we make them fit in existing institutions.

AUDIENCE: Yeah, I was going to say that education and learning is very risk-averse. So people don't want their kids to be the ones experimented on. So when things are repackaged, it's still like, oh, we know this works because it's been done before, but it's still new.

JUSTIN REICH: Good. All right, so I'm sensing-- which might be appropriate-- a little bit of a negative vibe on the people who are doing these kinds of things. But if we wanted to celebrate folks who take technologies that digitize existing practices, what's the virtue of that approach? What's good about it?

AUDIENCE: I can carry a million flashcards in my pocket.

JUSTIN REICH: Yeah, good. And everyone knows what to do with them. Quizlet might be the most widely adopted piece of education technology software used in American secondary schools. That's awesome. If you want the thing that people will use, there's some good evidence that you have to give them something they're familiar with.

AUDIENCE: And also, you mentioned that you can have a million different flashcards in your pocket, but you can also have a million different flashcards from other people sharing ideas globally.

JUSTIN REICH: Yeah, yeah. So we can take this idea of a flashcard, and we can tweak it a little bit. We can do some of the things that digital technologies are good at. We can make it scaled. We can make it shared. We can make all this kind of stuff, with always running into the hard limitation of, how much can you improve schooling by improving flashcards?

Flashcards are-- I mean, the joke I tell often is, if you got all of the world's experts together and were like, what does education really need? What do we really need to go to the next level? No one would raise their hand and be like, there's a huge dearth of flashcards. We need to dramatically improve flashcard technology.

There's plenty of index cards. There's like there's plenty of pencils. Flashcards are-- it's not an obvious thing to revolutionize. Also, I mean, I think if you talk to Andrew, he wouldn't tell you this was a thing to revolutionize education. This was just a useful thing for me to study French that other people found useful and that I could sell.

I mean, these kinds of technologies are like the square boxes. It fits in the school. That's a virtue. We can only benefit from technologies that fit in our institutions. Our institutions are risk-averse, and they're conservative, and they have a bunch of constraints. Yeah, Mari.

AUDIENCE: I think one point also that the chapter made is that it's a phase where people use it in ways they're familiar with, and then, after a while, they're able to use it in more revolutionary ways. So the benefit of having something that they already know how it works is that they can use it long enough to get to that point where they might feel comfortable using it in a way that hasn't been used before.

JUSTIN REICH: Great. That is one of the two ideas that I've proposed, with not great research evidence behind them, that might be a way of getting past the curse of the familiar, that you introduce things in schools that have a kind of familiar structure to them but open them up in ways that go somewhere else. I don't think there's a lot of evidence that Quizlet has been able to do that.

Quizlet gives you flashcards. Actually, I just took a screenshot of their website right now. Quizlet is more than flashcards. If you have to say that you're more than flashcards, you're probably just flashcards. You're special pleading there.

All right, you all have described this part of the curse of the familiar. What would be some key ideas of the flip side of the curse of the familiar? What are the challenges you run into if you make something that's really new and novel?

AUDIENCE: Maybe, just going back to what was said earlier, people don't want their kids to be experimented on. When something's new, it's not proven to be successful yet. And it's obviously replacing something else that maybe isn't the most accessible, but in some cases, it's there because it is teaching someone something. So there's this idea that if you introduce something new, you have no evidence to back up whether or not it will actually be beneficial.

JUSTIN REICH: Good. So people are risk-averse. You used a phrase-- it was like, we know this thing in schools teaches someone something. There might even be a lower threshold of acceptability, which is something like, we know this thing works in schools.

Sometimes a thing works in schools because people learned something. Sometimes it works in schools because kids are quiet and well-behaved and busy and other things like that, like not even really learning. If you've kept hundreds of adolescents in a building safe and for a day, you've kind of made school work at one of the baseline levels of it. So there's practices that we would consider baseline, not because they teach, but because they work to do the other things that we ask schools to do. Yeah, Mari.

AUDIENCE: I think we also talked a little bit about fear, which is part of the risk-averse aspect, not only from families, but the students themselves, the professors, the teachers, as well. And it was also an aspect of-- I don't know. I would put it as credibility because even students, if something is too different, they're going to feel like, oh, this is not serious enough. I would rather just have a lecture because this is something I've seen being done before. So they don't--

JUSTIN REICH: And you know how to do it. There's a bunch of people who go into school that are like, look, there's a deal here. You tell me to do things that I know how to do, and I will do those things. Sometimes in lower-performing schools, that can be expressed as, give me a set of tasks that I understand how to do, and the day will be quiet and function.

Or in high-performing schools, it can be something like, give me a set of tasks that I know how to get an A on, and I won't have my parents call you and cause difficulties and things like that. But it's the same kind of deal. New routines break up that arrangement, and students can be some of the most conservative stakeholders in these systems.

People can come in and be like, look at this new, awesome thing we might have us try. And they'll be like, I don't know how to get an A doing that. Why don't we go back to the thing that I know how to get an A doing?

Early on in the days of MOOCs, there were a handful of people that were trying different things, and there would always be learners that would show up in these somewhat novel enterprises being like, this isn't real learning. This isn't serious learning. Why don't we get back to what we were supposed to be-- it's like, my god, it's optional. No one is making you be here. If you want something else, there's zillions of these courses being developed. I think there's something in the chapter on MOOCs about that. Yeah, Armon?

AUDIENCE: I think teachers can also get overwhelmed by introducing an entirely new, novel idea while teaching.

JUSTIN REICH: Especially if that novel idea-- what if you have to change the curriculum? What if you have to change the schedule? What if you have to change your grading arrangements? A new technology can-- if it's actually changing the way teaching happens, it's probably trying to simultaneously change a whole bunch of things that are going on, which can be stressful, which can be difficult.

AUDIENCE: So a lot of teachers have to prepare students for a certain exam at the end of the school year, whether it's the standardized assessments or AP exams, and they can't really afford to go off trail and maybe stick with what they know because that's what gets the results.

JUSTIN REICH: Which means that different parts of school systems have different amounts of flexibility to try really new things. One of the fun things about being a history teacher in Massachusetts is that, until this year, when we just launched an eighth grade civics assessment, there was no standardized assessment. I mean, there has been some SAT IIs in history, AP US history, and things like that, but they're usually not the centerpiece of people's efforts.

And so history, social studies, electives for seniors, and then anything in the co-curricular domains-- theater, arts, dance, physical education-- a lot of times, those are places where you can do really different kinds of things. The mathematics sequence is often a place where you're like, oh, boy, this really better work, not only because people need to do well in math, but if you don't get eighth grade math, ninth grade math is really hard. If you don't get Earth science, you might still be OK in physics or something like that because they're just sufficiently different and so forth. So the stakes in different parts of schools are different.

There's an old saw in any kind of education development that the elementary school curriculum is pretty locked. There's just some reading and math and a handful of other things people need to do. The high school curriculum is pretty locked because they use tracks and exams and things like that. And middle school is maybe the most open-ended space, so quite a few new products for education will find themselves in middle schools, not because 12-year-olds are a particularly great group to embrace new ideas or something like that. It's just, that curriculum is more flexible in some ways than others are.

So we have this example of Quizlet. I feel like the connectivist MOOCs that we talked about before are the quintessential example of, here's some really cool ideas, some really cool technologies, potentially very different, solving some very meaningful problems that higher education had not figured out good ways of solving, and were essentially rejected by the higher education system-- a spark of interest for a little while, and then people are like, this is weird. This is different. What we're doing is fine. And all this stuff kind of died.

So the question then is, are there strategies that would get you past the curse of the familiar? Are there things that you could do in developing products and services that would let you use technology to do really different kinds of teaching and learning? And I think there are two strategies that have some evidence behind them that they might work.

One of them, Mari alluded to before, which is, build a technology that starts somewhere familiar and goes to a different place somehow. You enter it, and you're like, I know what that is. And then you're like, whoa, I could do these other kinds of things, too.

The second crucial idea is something around cultivating professional communities. The easy part of scaling online technologies is getting people to download stuff. It's not that difficult to get an app on people's machines, on schools' machines. It's not that difficult to get millions of YouTube views or other kinds of things like that.

What's really hard is not scaling technology, but scaling community. How do you get groups of educators to share the ideas for new practices with other people? But there are a couple of organizations that have done a demonstrably good job of not only scaling their product, but scaling the ideas, the pedagogies, the new ideas underneath that.

So the two I like to talk about are Scratch and Desmos. They've probably made the most progress on this. Scratch maybe has never achieved a familiar place to start, but they have thought a lot about entry points, about how you get people in. Seymour Papert had this famous line that you want technologies with low floors and high ceilings. Yousef referred to it a few times ago. You want something that is pretty easy to get people into and also things that they can really do awesome stuff later on.

Sometimes the Scratch people have also talked about narrow entryways. You want people to get into the software-- get into the platform, have some more clear ideas about what to do with a few things, and then go other places. For a while, Scratch was experimenting with these micro worlds, where you would get a smaller set of blocks, a smaller set of sprites, and they would be connected to what they thought young people would be interested in.

So I think there was a stand-up comedy micro world. There was a fashion micro world. There was a dance micro world. It was like, don't learn everything about Scratch. Just learn enough to make there be a little stand-up comedy routine or to make there be a little dance or things like that. So you have a set of sprites that are relevant to that. You have a set of blocks that are relevant to that. And once you learn that smaller part, go into more complex things.

A thing that I think Scratch has done a very good job of is scaling community, is basically saying-- is acknowledging that if educators just download Scratch into their machines, that is not enough to get over the curse of the familiar. They know exactly what happens when people who don't understand the pedagogy of Scratch download Scratch. And you heard Yousef talking about it. They just turn it into a recipe book.

So instead of having it be this place for computational creativity, you see all the students in lockstep, all building the same greeting card, or all building the same roller coaster, or whatever it is. So they have all kinds of programs that are developed for educators. They have a World Scratch Day, where people get together. They have Scratch educator meetups. They had, for a while, Minutes with Mitch, which were Mitch Resnick giving short talks about ideas and things. And Natalie's Notes-- they have other kinds of projects and tools and things like that.

A big part of them is meant to get scratch educators connected with each other. If you-- and a few studies have done this. If you interview teachers about how they adopt new pedagogies, the number one answer they will give you is from other teachers. The main reason why a teacher is willing to try a new practice is because they see that practice working in somebody else's classroom, ideally someone who teaches in a place like them, in a grade like them, in a subject like them, that's near them.

What that means is that any of these kinds of curriculum change, technology change problems are really peer learning problems. You have to figure, out how do you get teachers to share with one another? That is just immensely more complicated than it is to get software to be disseminated widely.

It's particularly difficult in most places in the world in education, definitely in the United States in education, because there are weak professional-- the professional organization level of education is really weak. If you were like, man, I want all of the emergency room doctors to do something different and better, you'd be like, oh, let's go to whatever it's called, the American Academy of Emergency Physicians or something like that.

If you wanted all the pediatricians to do something different, you'd go to the American Academy of Pediatricians, and you would convince some senior steering committee of the American Academy of Pediatricians that we're going to do this new practice. And they would be like, yes, this is a good practice. Let's all do that. And then that group has a *Journal of Pediatrics,* and all the pediatricians read it, and you can get people, even though there are thousands and thousands of pediatricians in the country, you can get them to be like, OK, this is a new and better idea.

Education does not have that professional organization level. There's no authoritative body that says, this is a good way to teach second graders, or this is a good way to teach math or reading. We have teachers unions which organize teachers in a bunch of places in the US, and they sometimes have a professional learning role, but usually not this kind of authoritative one. There are organizations like the National Council of Teachers of Mathematics or the National Council of Teachers of English, and they sort of have some things that are like this, but they're very weak compared to other professions and other kinds of things.

How many of you use Desmos in schools? OK, a lot more now. This is way more than you would have said five or six years ago. Desmos was originally developed as a graphing calculator. Its earliest functions were just, we're going to make a TI-84 available on every machine for free.

And one of the brilliant things they did was they got, instead of consumers to pay for it, they got testing companies and publishers to pay for it. And what that meant was-- I mean, that was the way they could make a high-quality project available for free, without ads, without subscriptions, without costs to the education system. And of course, for anybody who's used a TI-84 before, you look at something like this, and you're like, yeah, I know what to do there. I'm going to start teaching in equations, and it's going to start graphing them for me.

I mean, for those of you who grew up in affluent environments, replacing a TI-84 might not be a big deal. But there are lots of households and lots of families where an $80 cost, $120 cost is a big deal, a real obstacle to kids' education, schools where they just have TI-84 and boxes, and they hand them out at the beginning of class and put them back in the box at the end of class and things like that.

But you could give just this to lots of math teachers and lots of students, and they would be like, great. I totally know what to do with this. And then on top of that, there was all kinds of other crazy things that you could do with Desmos.

One of the things they do every year is have an art-- maybe they still don't do it, but for a while, they would have art competitions, where you have people who create drawings using graphs and things like that. I don't know. What were the kinds of things that you did with Desmos that were very different from a graphing calculator, for those of you who raised your hands?

AUDIENCE: I think this is something you could do on a graphing calculator but that was made so much easier was just seeing just different versions of the same graph simultaneously or being able to slide the coefficients and the variables.

JUSTIN REICH: Yep. And so modeling is a term that a lot of math teachers might use to describe that. You can look at the same equation across a range of parameters and things like that.

AUDIENCE: Sometimes we had TI-- was it TI-83? So it's a lot easier to input stuff into Desmos when compared to traditional calculators.

JUSTIN REICH: Yeah. So some of it, it just made some efficiency gains. They just figured out some ways of doing some mathematical inputs that are a little bit easier if you learn them on a keyboard than on a number pad. Hmm?

AUDIENCE: Finding intersections of two polynomials-- you just click on it, as opposed to, let's go through the directions of how to find it on your graphing calculator. Go left, go right, go-- it's so much less bandwidth.

AUDIENCE: And just to add on to that, I think I heard somewhere, I don't remember when, but some technologies like ChatGPT are like extremely bad for beginners because it distracts them. In this case, I literally made this analogy the other day. I think it was just yesterday. I was talking to somebody about this class, and I said, a calculator, sometimes, if you don't know how to use it, it'll be more distracting than helpful to you. And for some people, Desmos was easier in my classrooms than a traditional graphing calculator.

JUSTIN REICH: Yeah. If you lower the barrier to learning the interface-- learning the interface is not useful to anyone. What's useful is doing math. And if the barrier to learning the interface is high, then you're spending a bunch of your math time not doing math. You're doing user interface on 1980s era calculators.

I mean, yeah, the calculator-- calculators are a remarkable piece of technology. They cost, like, $0.50 to make or something like that, and they sell them for $100 because they have a regulatory lock-in because you get the testing companies to agree to mandate them, and then the curriculum companies have to mandate them, and then Texas Instruments can charge $100 for something that should be a lot less.

All right, so what are some things that Desmos did to try to get folks excited about some of the other capacities in Desmos is, in addition to promoting the technology of Desmos, their leadership promoted alternative approaches to teaching mathematics. So Dan Meyer, who is the chief academic officer of Desmos, he did a bunch of teaching in low-income schools and in schools with a bunch of kids who would have been pretty turned off to math, thought a lot about, What kinds of pedagogies really engage students? and came up with this framework he called 3 Act Math.

It was very media-based. So he would take a picture of himself shooting a basketball. So you'd watch a video of him shooting a free throw, and about halfway through the shot, he would stop it. And that's all the video that you would see. Actually, I'll give you my favorite example of it.

Do you remember in geometry, you are always encountering hexagonal fish tanks and things like that? You're always encountering these shapes that would never exist. So he found a hexagonal fish tank and gets a hose and holds the hose on top of the fish tank and just makes a video of 30 seconds of just water filling up.

And usually when he shows this video, at some point, some kid is like, how long is this going to take? And he goes, exactly. And then you stop the video there. But these videos inspire a natural curiosity. How long does it take the fish tank to fill up? Will the basketball go in?

And then what he does-- that's the first act, sort of setting up some kind of problem. The second act is trying to figure out what's going on in the setting. So students have a chance to ask a bunch of questions.

How far away was this person from the basket? How high is the basket? How fast is the ball moving? What is the arc? How big is the fish tank? How wide is the fish tank? How tall is the fish tank? What is the angle on each side of the fish tank? How wide is the hose? How much water is coming out of the hose? All these kinds of things.

Some of these details Dan or other teachers will give to their students, and some they won't. And then they agree on a question, or the teacher imposes a question. OK, the question is going to be, how long is this going to take to fill up? And I'm going to give you these pieces of information.

Now, because it's a real-world environment, it's actually kind mathematically impossible to determine the exact answer to these questions. The amount of water that's flowing through the hose through a municipal water system is not a completely predictable amount that's coming out every time. He'll give some measurements of the tank, but the tank probably wasn't measured to the hundredth of a millimeter or something like that.

So students start creating models. They say, all right, well, I think it's going to be this-- here's what I know. And sometimes, there's a little instruction. Oh, so to figure this out, you're going to have to calculate the area of a hexagonal solid. OK. Here is the formula that you need to do that, and here's why it'll work. And then you figure out these other things.

So then the third act is Dan will show the video again, and the water will be pouring into the tank, and the water will be filling up. Usually he accelerates it so it goes a little bit faster. And he puts a clock in the corner of the video.

Now all of the students have made some kind of prediction about when they think the tank will fill up, but it's pretty much impossible to predict exactly. And he's got great videos of kids watching these Third Act videos where you see, ah, ugh, like their time they predict to go off. And then at some point in the middle of the video, a third of the class cheers, yeah, because their time was roughly or something like that. And it's just this great moment to be like, typically when you get an answer right in math class, you don't stand up and cheer and stuff like that.

But there's a few key features of the pedagogy. First of all, one thing he talks about is it dials up the math slowly. So an exercise like this starts at a level of intuition and questioning that, even if you don't really understand polynomial functions or complex geometry of solids well, you can still ask basic questions about it. You can still make observations about what's important.

And then you ratchet the mathematics up slowly until you get to the point where you're working with particular equations, and functions, and numbers, and those kinds of things. And that it's impossible to be right-- everyone in the room is just trying to be the least wrong that they can and making a series of assumptions, which hopefully get more and more reasonable as kids get more and more proficient mathematically, but will never be perfect.

So Desmos is a tool-- hopefully you can see how a tool like the slider that [INAUDIBLE] described before might be quite useful in building mathematical models of how long it takes to fill up a tank with a hose and other kinds of things like that. Dan Meyer has given talks at math conferences in all 50 states. He goes around to places all the time.

Probably even more important than Dan going to all 50 states to give talks is you can still go to math conference-- probably this year, you could go to a math conference in all 50 states, and someone will be giving a presentation on 3 Act Math tasks because not just Dan, but other mathematics educators have taken up the mantle of these ideas. Probably in those talks, they'll explain how you can use Desmos for doing these things.

And so all of a sudden, you have not just a new technology to do math, but you have a whole community of people that are sharing new practices of how to do it, just like in Scratch has a whole community of people who are trying to say, let's not just teach computer programming as puzzle-solving. Let's teach it as computational creativity and things like that.

I want to emphasize to you, I mean, these are like powerful, powerful strategies for changing teaching and learning, and they're super hard, and time-consuming, and energy-consuming. They require charismatic leaders. They require really good ideas. They require technologies that fit with pedagogy.

They require convincing educators, these risk-averse educators who you described who are preparing their students for math tests, here's a better way of doing this. Nuke a part of your geometry solids unit and try this new thing. So there's a whole lot that goes into it.

But those, I think, are the two key strategies for how we might get past the curse of the familiar. Start with the familiar and then go new places and think about not just scaling technology, but scaling community, cultivating professional communities. What observations or thoughts or questions do you have about those ideas? Yeah, Omar?

AUDIENCE: Sorry. I have a spoiler to my essay, but I did mention that-- I'll be as vague as possible-- the target that I was recommending my technology to actually had the infrastructure implemented like five years before COVID. And they started doing a lot of professional teaching within the entire district. So by the time COVID came around, they were ready for distance learning without necessarily preparing for that. And they just happened to have the resources necessary because everybody was involved.

And I remember, there would be teachers having separate meetings just to talk about what went well, what didn't go well. And then I was one of the volunteers during the last accreditation self-study, and I was in there listening to what happened during the pandemic. This was-- I don't know-- at the end of COVID. And then they were recruiting for that self-study. But I was able to listen in on that, and it was really cool to see the community that the teachers had built up.

JUSTIN REICH: Yeah. It is impossible to change teaching practice in schools without communities of educators teaching and learning with one another. Every instructional improvement problem in a school is, in some dimension, a peer learning problem. And you can imagine how many education technology startups have, as one of their first five hires, someone who's really good at facilitating peer learning amongst educators? No one, right?

You need someone who can-- you need a front-end person, and a back-end person, and someone who knows pedagogy, and a marketing guy, or finance guy or lady, or something like that. They're just organizations that are not intuitively equipped for those kinds of things.

When Andy was starting Quizlet-- I mean, he's a high school-- he doesn't know anything. He just knows how to make flashcards online. And part of what their organization needed to build over time was people who could interface with schools, not just to sell to schools, but to help them think about, what could different look like here? Where do we fit into practice? How do we train teachers or have students become better at using these things?

AUDIENCE: I feel like this whole talk is about how difficult this can be. And even with these two ideas that you've brought up, this still requires a lot of people buy-in and just other people supporting it. It makes me think about how difficult this can be for schools that aren't out of public schools.

And even you have your charter schools that then have their own set of curricula. And if you're trying to really gain this type of support nationwide, if you have this whole subset of schools that are avoiding your technology, it can make things really hard, thinking about-- because I had written my paper-- it's my high school, which was a Catholic high school in Philadelphia.

And those schools don't do anything to try and improve schools because they are just struggling to keep kids in the schools. So thinking about trying to improve a system that can't even look that far is really interesting, too, of, those teachers don't have time to cultivate that professional community because they're just trying to cultivate a school community.

JUSTIN REICH: I mean, almost every school has a certain amount of time to do professional learning amongst faculty. That's baked into most schools. But there's only one block of that. That is what you'll use to improve your assessment practices, to address chronic absenteeism, to deal with violence in schools, to take on a new state initiative about sex education, to do a dozen different things that might come along.

I mean, Omar described the school that, five years before COVID, happened to decide that online learning, distance learning was a good thing for them to work on. But it might have been equally reasonable for them to work on phonics instruction, or executive functioning, or any one of a dozen other things that helps improve schools. So yeah, thinking about, what are the resources that institutions have to make themselves better and to make the kinds of changes that are needed for new practices to work?

AUDIENCE: We talked a lot about cultivating professional communities. But do you think that the professional community, also with teachers, for example, cultivating that is enough? Or do we also need to cultivate the students' communities, as well? Because I was surprised when reading the chapter that students themselves sometimes are also afraid or concerned about using this new technology.

JUSTIN REICH: Yeah. So I mean, it's exciting to hear what Omar talked about, about bringing students in on these kinds of change initiatives. It would be interesting-- almost every edtech company has some kind of ambassador program, which is hiring a group of teachers to be the folks who go to these conferences and share what they're doing with other people. I don't know of any technology company that has a student ambassador program.

I mean, one reason is that the teachers stay, and the students leave, which is good. That's what the students are supposed to do. You probably have to be a certain age to be useful doing-- a first grade ambassador would probably do some interesting things but is not that helpful for what they can accomplish.

But I do think that, generally speaking, school systems change agents tend to underestimate students as potential partners because when you get them really engaged, they can be transformative in institutions. When students get together and be like, oh, we should do this, sometimes that's when faculty light bulbs go off and go, you're interested in that? Absolutely. Let's do it.

AUDIENCE: I'm asking because I met this girl. She's doing her master's at the Graduate School of Education in Harvard. And in Brazil a few years back, she was supposed to start giving an entrepreneurship course to middle-schoolers. And she wanted to use Figma to do it very interactive, experiential. And teachers were completely closed off to the idea.

And then she simply bypassed them and started reaching out to the students, and they loved it. And it worked so well that the excitement from the students convinced the teachers themselves to actually give it a go because if there's one thing they have in common is they're really concerned, and they care about students. So she ended up even giving a TED Talk about how she believes this whole transformation is going to come from students.

JUSTIN REICH: Yep.

AUDIENCE: So that's why I was interested in-- I think we do that less than we could.

JUSTIN REICH: Yeah. The exact nature of the technology matters, too. The more the technology-- the more the business model of the technology has some kind of freemium or introduction kind of model-- I don't know. If you wanted to implement something with robotics in a school, and the robotics kits are expensive, it's pretty hard to be like, hey, kids go get your own robotics kits, and we'll go around the system. Somebody needs to buy the robotics kits.

Part of what makes-- like the example you gave of Figma works is that Figma has a built-in freemium model as a consumer product that educators can piggyback on to try those things out. But yeah, I mean, I would say anybody who has a change strategy in schools, if your students are part of that change strategy, it's pretty likely to be better than if they're not.

AUDIENCE: Yeah, related to that, I know that Wolfram Technologies, which created Mathematica, has a student ambassador program that I did in high school. So you present at their conference and, yeah, I don't know, talk about all your friends and host webinars and things. So yeah, that's one example of that.

JUSTIN REICH: No, I had not known that. And again, yeah, Wolfram is in a pretty competitive space of different kinds of mathematics software where, absolutely, cultivating student preferences could totally make a difference. All right, let's talk about another-- let's do another one of these challenges, since I'm trying to double up this week, which is the edtech Matthew effect, which is really supposed to be here somewhere. Ah, this is the one I used. OK.

Here are three variants of mythologies that people have about technology and schools. One is that edtech will destroy the system. We've talked about how that probably won't happen. And instead, new technologies domesticate education.

Actually, that article that Yousef shared-- I thought it was Mimi Ito and I who came up with this metaphor, particularly Mimi. But that article that Yousef shared of Seymour Papert responding to Tyack and Cuban had a very similar framing of what schools-- I don't know if they exactly used the word domesticate, but it's pretty close. New technologies don't come in and blow up schools. Instead, schools take new technologies and go, OK, you fit here.

People are always hoping that new technologies-- a word they really like is democratizing. I think people like the word democratizing because you're not exactly sure what it means, but it sounds pretty good. It would be better to have more democracy. But it's like, is that cheaper? Is that more equal? Is that more just? Is that better?

I'll show you in a bit, we really have pretty good evidence that new technologies disproportionately benefit the advantaged. They disproportionately benefit people with the financial, social, and technical capital to take advantage of new innovations. So people are always hoping, like, oh, this new thing, it'll be distributed for free on the internet. The people who are good at finding free stuff on the internet are affluent people with good internet access, with discretionary leisure time, with parents who went to college, all of those kinds of things.

So this is a figure that I use to describe the edtech Matthew effect-- but I'll say it again-- that in educational systems, especially highly unequal ones like the United States, we assume that folks from higher socioeconomic backgrounds have better educational outcomes, generically, than folks from low socioeconomic outcomes. And the hope is that, through technology innovation, everyone will learn. But maybe we can build things that particularly help this group. When people talk about democratizing education, this is basically a graph of what they mean.

What actually happens, though, is probably something like this, which is that new innovations disproportionately benefit people who are already affluent. And a thing which is tricky about this is they probably help everyone. There are not a lot of education technologies that we build that really make things worse. Maybe there are, but typically they just help advantaged people more than they help disadvantaged folks.

So when we studied massive open online courses, the democratizing rhetoric was very active. Udacity, for a while, their tagline was "democratizing education" or something like that. And we're like, eh, that's pretty unlikely to happen, I think.

So we did these kind of cool studies where-- all these studies were based on the fact that when edX was founded. and you had to register for it, someone was like, let's get people's addresses. So people would type, free form, their addresses into edX. Why did anyone collect their addresses? I've never learned. Were they going to mail them something? I don't know. But we had their addresses.

Through the magic of residential segregation, if you know someone's address, you can make a pretty good guess about how affluent they are, or what their education level is, or something like that. There are these units that are called census block tracts, which are something like the 1,200 homes that are nearest yours. And wherever you live, the average median income of the 1,200 homes around you is pretty close to yours. And we might not be exactly right, but if you do it over hundreds of thousands of people, it works out pretty well.

So this is a graph of people's average median income at different ages. This is all of the people in the United States. And these are the people who sign up for HarvardX and MITx. So for sure, there were people from every possible income bracket that you imagined who had signed up for Harvard and MITx courses. But at every age level, a typical HarvardX or MITx participant is going to be wealthier than a typical US resident.

This is a kind of study called a case control study, and it comes from epidemiology, where you're comparing a particular group to a whole population. And it's usually used for people who get viruses. So for folks who hated MOOCs, we were basically treating MOOC participants as if they had a virus, and they thought that was pretty funny.

This is the amount of education that their parents had. And so clearly, the people who signed up for HarvardX and MITx are more educated than the typical population. What was the question you asked?

AUDIENCE: I was just saying, I love how there's someone who's under 20 with over $90,000 in median--

JUSTIN REICH: In the income of the census block tract.

AUDIENCE: OK, so it's not an individual.

JUSTIN REICH: Yeah, yeah. It's not like there are a bunch of loaded 16-year-olds--

AUDIENCE: I want to take that.

JUSTIN REICH: --who are taking our courses. No, but if you were 15 or 16 or 17, and you were taking a HarvardX class, it was very likely that you were-- you were much more likely to be from a census block tract with a much higher average median income than comparable.

AUDIENCE: [INAUDIBLE]

JUSTIN REICH: Yeah, yeah. I mean, you can also figure-- it's not that people become poorer. They move to crummy college neighborhoods, and then their livelihood improves over time until they get old.

AUDIENCE: I also like the subtitle.

JUSTIN REICH: The long, boring subtitle. It did have a long, boring subtitle. It meant something. What was this? This was the odds ratio of-- these were the odds that you were-- oh, if you had a parent who graduated from college, this was the odds that you were more likely to complete a class.

So for particularly people who were the youngest-- so actually, for old learners, some of their socioeconomic characteristics seem to be less predictive of whether or not they would be successful in a class, which you might assume to mean something like, by the time people are 40 years old or something like that, your initial family upbringing maybe matters less for the people who are signing up for this class.

But for really young folks, if your parents graduated from college, you were way more likely to complete the class than if you signed up, and your parents had not graduated from college, presumably because you lived in a household in which you both had more support at the time that you were taking the class, and you had grown up with many more academic and financial supports than other kinds of people.

And I mean, MOOC organizations at this time were telling stories like we mentioned before, like the Boy Genius of Ulan Bator, about all these people who are-- far flung places who are taking courses and being successful. And all of that was true. There were people from every walk of life, from all corners of the world who were really successful.

It was like MOOCs opened a door, and a handful of people who definitely would have not have access to higher education before walked through that door. But the vast majority of people who walk through the door were already educated, already affluent people. So maybe there's a way that you could describe that as democratizing, but it didn't seem particularly democratizing to us.

This was my doctoral research, which I'll summarize quickly. So just like today, there's all these ideas like, man, AI is going to transform education. And just like 10 years ago, there was all these-- oh, man, MOOCs are going to transform education. In 2007, 2008, 2009, it was social media that was going to transform education. It was blogs, and wikis, and peer production.

It sounds silly now, but believe me, at the time, people thought-- so we did this kind of cool study where we knocked on the door of a company that let you set up wikis. At the time, it was called PBworks. And we were like-- maybe it was called PBwiki and then changed to PBworks. And we were like, can we have a list of all of your education-related wikis? And they were like, yeah, sure.

In theory, it's something that we could have scraped from their website, but they just handed it over. So that was pretty cool. Now we had 200,000 wikis that someone had labeled as education-related. And these weren't wikis like Wikipedia, that everyone would work on. They would be like a class, or a school, or something like that would foster these wikis.

So we took 1% of them, and then I hired a small army of research assistants to figure out what they all were. So we like labeled the characteristics of them. We did this private investigation work to figure out what school they were from. And then if you know something about a school, you know what neighborhood it's in and how many of its students are eligible for free and reduced-price lunch and what its racial divisions are. You can know all kinds of demographic characteristics.

One of the things that we focused on was whether or not they were Title I schools, where a certain percentage of students were eligible for free and reduced-price lunch, and those who are not. And we basically identified like four different types of wikis that people created-- things that just didn't work, like someone created it and then never updated it, threw it away or whatever. That's fine.

Things that were teacher-centered, content-delivery devices-- so things that were basically just like simple websites. So in some respects, definitely what you did not want wikis to be. The other one was individual student assignment or portfolio, like something an individual student made, and then a collaborative multimedia assignment or workplace.

So the first thing that we figured out is that the vast majority of wikis either didn't work or were teacher-centered, content-delivery devices. This is a kind of curse of the familiar example. If you give to people this never-before-seen tool to do collaborative writing, schools will use it to just broadcast things to students or to make students turn in their assignments with it. They're very unlikely to do the thing that wikis were supposed to do.

But they were more likely to fail in Title I schools, and they were a little bit more likely to have some kind of student component in it in the non-poor, more affluent schools. So all of these things were free. They were freely accessible on the internet, all the kinds of things like that. But you could see, from their very beginning, schools that had more resources were going to be able to use them in more interesting, more student-centered kinds of ways.

We'll skip that one. Oh, this is one of my favorite pieces of research that's an example of this. So we make kids take this test that we've discussed before, the National Assessment of Educational Progress. And when we make them take the test, we also make them take a survey.

And in 2011, kids took a math test, and we asked them questions like, do you use a computer for drill and practice in math? Do you use computers for simulations and applications? And you can ascribe a few things from this. We're more likely to have students do drill and practice kinds of things than we are to have them do simulations and applications and things like that.

I don't know. This would be like IXL, and this would be like Geometer's Sketchpad or Desmos. We make Black students do drill and practice things more than white students. We make poor students do drill and practice things more than non-poor students. When we give people access to new technologies, even if they have equitable access to the technologies, they often have inequitable access to different kinds of opportunities with them.

So one of the papers that I assigned to you was one of my very favorites by a guy named Paul Attewell called "The First and Second Digital Divide." And his argument is that the digital divide was originally conceived as an access divide. Who has computers, and who doesn't? Who has broadband, and who doesn't?

But even if you could snap your fingers and give everyone the exact same access, there would still be a digital divide of usage. There's evidence that people from low-income backgrounds are more likely to use technology for drill and practice kinds of things, rather than creative things. And they're more likely to use it with less adult mentorship and support than more affluent folks are.

But the funny thing, when I read this 2011 summary, was I was like, man. It was like having the experience of reading a plagiarized paper. You're like, I swear I've read this exact same study before. This is what a Apple MacBook looked like in 1996. This is what it looked like in 2011, so 15 years of pretty good technological progress. But these are the same findings from 1996.

And as you can see, the numbers are exactly the same. We asked these kids these questions 15 years apart. If you see any difference in the numbers, they're probably statistically insignificant. It's just a little bit of variation in the sampling. But essentially, I mean, this was-- 1996 to 2011 was a pretty big decade and a half for technology and math. And we made almost no change in the fundamental ways that young people were being able to access and use technology.

Does that argument make sense to you? Totally striking pair of findings there. But Ulrich Boser did not plagiarize from Wolenski. They just had the same findings. Yeah?

AUDIENCE: Out of curiosity, is there a lot of difference between public schools and charter schools or private schools in the US-- somehow those things happen in real life?

JUSTIN REICH: Yeah. There can be-- those things have enormous different gradations in the United States. So Dana was talking about Catholic schools in Philadelphia. Those are, strictly speaking, private schools. But they might be serving some of the most low-income neighborhoods and families in Philadelphia, where a Catholic school in inner city Philadelphia might have more in common with its public neighbor than it does to Sidwell Friends or something like that, a super elite private school, which might also be in Philadelphia, but might as well be in a whole different world.

So to some extent, tax status or organizational status can be related to those kinds of things, but not necessarily, because we have public schools that serve that serve-- a public school in an extremely wealthy neighborhood might have more in common with a private school than it does with another public school in an inner city neighborhood.

This was a cool study that was done looking at three schools that had adopted a whole bunch of technology. So they had roughly the same levels of access. They had bought the same kind of stuff. They were all in the Bay Area. These aren't real names-- Heathcliff Academy, which is a private, mostly wealthy, mostly white school; Sheldon Jr. High, which is a public, mostly middle-class and Asian-American school; Cesar Chavez Middle School, public, mostly working class and Latino.

And again, they had all bought roughly the same amount of stuff. Each kid had a laptop. The laptop was connected to broadband. Of course, they're going to be differences, some access differences in the really wealthy places and the more working-class places, but trying to find not striking differences.

But what Matt found was that the way people discussed technology was quite different. So at the mostly white Heathcliff Academy, playing around with technology was viewed as essential. So if there were kids who were goofing around with *Minecraft* and stuff, that was encouraged. Oh, you're playing around. You're hacking. You're doing all these kind of neat things.

Whereas in the mostly middle-class, Asian-American school, goofy hacking applications of technology were considered threatening. It's like, oh, this is a risk to your education. This is a risk to your progress. Whereas in the mostly working-class Latino school, there wasn't encouragement or discourage-- it was just considered irrelevant. People weren't really paying attention to what they were doing.

So again, the idea here being is that here are three institutions that had roughly similar levels of technology access, but the faculty and community gave very different cultural messages about what playing around with that technology meant. And for the kids who were already advantaged, they were encouraged to play, and hack, and goof around, and things like that. But for the kids who were not already advantaged, they got different messages from their community about the values of those technology.

Yeah, this is another myth pair, the idea that technical and economic barriers are what keep people out, that if we could just get people the stuff, they would have great education with technology, whereas instead, it's social and cultural exclusions which can often be the hardest. We've talked in the class before about connected learning, some of these ideas about, how do kids do informal learning in their own communities and other things like that?

Some of the things that the connected learning researchers are most worried about right now is that as America's polarization increasingly is expressed on social media, more and more kids feel uncomfortable communicating and expressing themselves there. And white, affluent dudes are the least likely to feel threatened in those spaces, and kids with all kinds of different marginalized backgrounds are the ones who are more likely to withdraw from posting their fanfiction, to sharing their art on DeviantArt, on other kinds of things like that.

Basically what they saw was, in recent years, again, across all kinds of ages, and racial groups, and backgrounds and things like that, a withdrawing from public learning on social media, but a withdrawing would seem much more pronounced from people from marginalized backgrounds than they did from people from more affluent backgrounds. And all of those kids have more access to technology than they've ever had before. But there are social and cultural exclusions that are keeping them from learning experiences in ways that are new.

OK, what can we do about this? This is one of the most frustrating problems to talk about because I feel like the problem is extremely well-understood. This is one in which I feel like the evidence-- we can say for sure, if you build a new edtech thing, it is very likely to disproportionately benefit the affluent, especially if you're not attentive to all to how these issues operate. We should not assume that new generative AI tools are going to democratize education. They just are very unlikely to do that.

But then you might say, well, all right, A, there are some things. You read some studies of things like ASSISTments and Carnegie Learning that seem to disproportionately benefit people with low prior achievement in mathematics. What are they doing right? What are technologies that disproportionately benefit the learners who are furthest from opportunities?

And I would say, that, we don't know very well. The research on how to fix this problem is more novel, is more nascent. But here are a few things that maybe would be promising directions to explore. So one, think about technologies that align home, school, and community. If affluent kids automatically get an educational support infrastructure from their homes and families, from their college-educated parents, and stuff like that, how would you build technologies or technology infrastructures that help all parents do more of this stuff?

So Family Creative Learning is a super cool project by a woman named Ricarose Roque who got a PhD here who basically was trying to figure out, how would you help boys and girls clubs, after-schools support parents in doing a better job helping their kids use Scratch? All right, so we know kids of software engineers are the most likely folks to use Scratch, but what if we just helped all of the parents support kids doing Scratch?

So she would do these multi-generational programs in after school, YMCAs, boys and girls clubs, and stuff like that. You bring parents and grandparents in. You feed them dinner. You break the parents and the kids up. You each teach them something about computers. You put them back together and share their projects and stuff like that. And that seems pretty cool.

How do you make it so that the kinds of things that you're working on with technology align with young people's interests? So this was a photo from a project that was done at Georgia Tech trying to help more African-American males in the Atlanta area get involved in computer science, computer programming. And this was a researcher who found that a lot of these kids were really interested in video games, and they were interested in the problems in the video games-- bugs, glitches, and things like that.

She was like, cool, let's make a little QA testing company. And so she got a bunch of kids. She helped them interface with companies to do QA testing. They were called the Glitch Game Testers because the language that they used for bugs in that part of the world was glitch. And as kids got more engaged in this program, she would then help them like take AP computer science and stuff like that and translate into academic programming. But the idea was to find out what kids' entry points look like into these issues and try to build up from there.

Similar, I think, this is like the heart of connected learning. How do you connect to the interests and identities of young people? I mean, part of what Scratch was doing with micro worlds is being like, who is intuitively interested in creative programming? Maybe not every kid.

But what kinds of kids could we get with hip hop dance? What kinds of kids could we get with fashion? What kinds of kids could we get with stand-up comedy? How could we offer a broad array of interests that could draw people in to what we're doing?

A study that I would love to do one day is to think about, how do edtech companies reduce cost in ways that disproportionately benefit those who are furthest from opportunities? A funny thing to think about is, what happens when you make something free? So MOOCs, for the most part, were free. OpenCourseWare, for the most part, is free. But those things probably disproportionately benefit the affluent. They're free things, but they're better for rich people.

There's actually a whole sociology of this. It connects to swag bags at the Oscars and things like that. People are always giving rich people free stuff, which doesn't seem like it makes sense. But there are certain kinds of things-- Desmos is the bottom example here.

The TI-83, 84 was a real barrier to mathematics learning for families. And Desmos reduced that cost to zero. Now $120, calculator is not a huge burden for an upper-class family, not a huge burden for a middle-class family. It's a big burden for a working-class family. And so you're saving money for the families for whom that barrier is most relevant.

Another one of my favorite projects-- has anybody ever heard of OpenStax? They did this cool thing where they realized something like half of all higher education enrollments are in 20 classes. Just about everybody who's taking a college class this semester across the entire United States is taking sociology 101, pre-calc, macroeconomics, microeconomics, chemistry, US history, psychology, economics, algebra.

I mean, there's a long tail of zillions and zillions of other classes that we offer in higher education, but almost everyone is in these 20 classes. They were like, let's just pay really smart people a bunch of money to write good textbooks and then give them away for free. So for somebody who's coming to MIT, and you're paying $50,000 a semester or whatever it is you're paying, $120 chemistry book is not a big deal.

If you go to a community college, and the entire chemistry course costs you $120 to register for, $120 textbook is a huge deal. It's just doubled the cost of your credit hours of education in that class. So taking that $120 and bringing that to zero, that might really matter a lot. That could save people a meaningful amount of money that will help them advance in their community college education or other sorts of things like that.

So this idea that you could look across the education system and be like, what are specific cost barriers to family that we we use technology to drive down those costs in ways that affluent people might benefit from but probably won't notice, but community college learners, lower-income, working-class families might really benefit from?

A thing that we experimented with a lot was trying to target the needs of subgroups. Did I talk about these experiments when we talked about MOOCs, how we put all these little interventions in at the beginning of MOOC courses to get people to-- some nodding heads. It's in the books there. We designed a whole series of interventions that were trying to increase the sense of belonging or increase the sense of well-being from people who might perceive themselves as being from minority backgrounds.

And we thought they worked for a while, and then we weren't sure that our interventions were working. But it's an interesting thing to think about. What kind of-- if you're trying to serve people from a wide range of backgrounds, and you know that some people from those backgrounds might not have the same level of support at home or might not have the same-- might experience stereotype threat or other kinds of things like that, what kinds of interventions could you design to address those needs?

Another thing to think about is, where could you target supports across someone's educational trajectory? This is another sad story of things that we thought worked for a little while and probably don't. But still, the problem is real.

Ben Castleman worked at this school in Providence called Met. And they were charter school, and they did a pretty good job getting kids into college. But one of the things they observed, which totally broke their heart, is that they would get kids into college, accepted to college, and then they wouldn't show up in the fall.

You're part of four-year, 12-year educational system, which is trying to get kids into post-secondary education, and you succeed. They have an application letter. And some fraction of them don't arrive in the fall. They ended up calling that summer melt.

And part of it is, if you are the first person in your family to go to college, then figuring out FAFSA, figuring out course enrollment, figuring out moving on campus-- if you come from a family where you're not first generation, your mom and your dad, just explain all that stuff to you and figure it out, and you get through it. But each of those obstacles-- and there are a few of them to showing up on campus. And each of those was enough.

So they designed these technologies that basically sent little text message nudges to kids all throughout the summer. Have you figured out your financial aid? Have you registered? Have you-- other kinds of things like that. And for a little while, it looked like those nudges were working, and then people reproduced at larger scales, and this particular intervention doesn't seem like it's actually working.

But it was at least a good idea of being like, let's think about people's educational trajectory from the transition points you have between middle school, and high school, and college, and post-secondary, and lifelong learning, and things like that, and where there might be transition points that affluent folks just breeze through, but folks from working-class families find more struggles with?

Probably the biggest challenge that education technology has is, things that really work in education often are tailored to their particular context. But usually, what software developers are trying to do is build a thing that works anywhere. I mean, that's a real tension. That's a real problem.

There's some cool examples of this. I think you could think of the Open edX platform as something kind of working on that. So there's one, big software platform, and there are a couple of-- edX is a big organization that offers MOOCs everywhere. But there are dozens of local MOOC operators that offer in their particular country, in their particular language, in topics that they think local folks will be interested in. One of them is Edraak, which is run by the Queen Rania Foundation, which focuses on offering Arabic language classes to folks in Jordan and areas surrounding Jordan.

And you could just imagine, well, OK, so they can take edX. They can make sure it supports right to left reading in Arabic. They can do whatever else you need to make the Arabic interface work better, offer courses in Arabic, find out what people in the Arabic world would want to be able to do. And they're using the same base software as everyone else. But that software is customizable to serve particular notions and areas.

And the idea is you might be able to apply all of these different kinds of thinking all across a project's life cycle. So as we were giving these talks to people who fund technologies, to venture capitalists, to philanthropists, to technology developers, to the big FAANG kind of companies that have publishers, who have a bunch of things underneath them, who are saying, what are all the strategies you might try when you're funding a company to get the right people at the table?

Lots of times, when we fund education technologies, the only people who make those choices are affluent people who went to private school and stuff like that. How would you get more people from more diverse backgrounds to be able to do that? And so forth and so on through all of the different programs.

So in some ways, it's disappointing that there aren't better answers. It would be nice to give a lecture like this and be like, we totally know what to do to make education more equitable. But we don't have that. But we have some really clear, I mean, in my mind, just definitive evidence that when people build education technologies, if they don't center the needs of marginalized communities, it will disproportionately benefit the affluent.

You can pretty much guarantee that as an outcome for almost anything that comes along. And there's lots of interesting work to be done and things to explore to figure out, how could we learn more about being more intentional about building things that serve a diverse range of folks?

And then so I won't see you-- I will see you each individually next week to talk about your projects. And then the following week, we'll talk about the next couple of as yet intractable dilemmas, the trap of routine assessment and the toxic power of data and experiments. So very nice to see you this week, and I look forward to seeing you individually next week. And enjoy your long weekend.