[SQUEAKING]

[RUSTLING]

[CLICKING]

JUSTIN REICH: All right, let's just talk about games a little bit. So you're learning journal assignment was, what are the learning games that you all played in your youth or your contemporary times? We heard Omar has talked with us a couple of times about his passion for typing games and the importance of them in his middle school experience. But what other kinds of games are memorable to folks in their growing up for learning or otherwise? Yeah, Emily,

AUDIENCE: I did, like-- there was this game, like *Game 24,* or something. It was like, you'll have--

AUDIENCE: *Math 24.*

AUDIENCE: Oh, *Math 24.*

AUDIENCE: Yeah, I'm not a fan.

AUDIENCE: Yeah, you have four numbers on a card, and then you're supposed to add, subtract, multiply, or divide however you want to get to the number 24.

AUDIENCE: Did you do it online or in the cards?

AUDIENCE: No, in the cards.

AUDIENCE: Yeah, that was in elementary school.

JUSTIN REICH: All right. Cool. This is it? No, we don't know.

AUDIENCE: I don't know. I used the-- yeah, those cards-- card game version.

JUSTIN REICH: Oh, all right, spinning these things around. Cool. And where did-- this showed up in elementary class?

AUDIENCE: Yeah, it was like-- they put it in the indoor recess spot.

[LAUGHTER]

JUSTIN REICH: That's great. That's great. What else? What other kinds of games did people play? Sabrina, what was your--

AUDIENCE: None of these count as really, really educational, but I used to play a lot of Coolmath Games as a kid. I had to change [INAUDIBLE].

AUDIENCE: They kind of are.

AUDIENCE: At first, they were, and then you just got to the straight-up flash games.

AUDIENCE: They teach you time management with all my [INAUDIBLE].

[LAUGHTER]

AUDIENCE: They teach you Alt-Tab on the computer when the teacher walks behind your monitor.

JUSTIN REICH: Is *Fruit Ninja* a math game?

AUDIENCE: Oh, my gosh. They also teach you, like, teamwork, with, like,*Fireboy and Watergirl.*

AUDIENCE: Yes, *Fireboy and Watergirl.*

[LAUGHTER]

JUSTIN REICH: Yeah, there is a pretty funny just naming convention of let's call it Coolmath Games. And then maybe parents won't notice. I mean, there's definitely a first glance of, oh, you're playing Coolmath Games. That's probably fine. They're like, no, those are not math games.

AUDIENCE: Categories at the top.

JUSTIN REICH: Yeah.

AUDIENCE: [INAUDIBLE] categories.

AUDIENCE: Numbers, logic.

JUSTIN REICH: Yeah, platformer, block removal. Yeah, I don't know. There's definitely some--

AUDIENCE: Applied math games.

JUSTIN REICH: *Darts,* test your aim in an online multiplayer. OK. *Idle Breakout,* maybe.

AUDIENCE: There used to be those multiplication penguin race games. And you have to answer the multiplication questions as fast as you could.

JUSTIN REICH: Yep, definitely.

AUDIENCE: Yeah.

JUSTIN REICH: Definitely, a-- oh, Math Playground. Yeah, that is another one that I've seen. No, this, I think, is a direct descendant of *Math Blaster.*

AUDIENCE: Play Now.

JUSTIN REICH: Play Now.

AUDIENCE: Playing against--

JUSTIN REICH: Luke and Shamar-- are Luke and Shamar real? We don't know. Let's just see how close this is to *Math*-- yeah, this is exactly *Math Blaster.* And we'll play a little *Math Blaster* later. Good. Good job, everyone. Nice, strong, strong single-digit multiplication skills in the MIT students. I'm very proud of you. Other things?

AUDIENCE: I was saying, in my other class, my [INAUDIBLE] learning class, we're really pushing the boundary of what's considered a learning game. And one-- I grew up playing a lot of board games with my family. And one that I'm right now doing a project on that makes me really realize all the skills that I learned is a board game called *The Resistance.* Have you heard of that?

And I was just thinking about the skills that I've learned from that, obviously, like, how to keep a poker face, how to formulate an argument to back up the claims that I've made, and how to just have constructive arguments about-- between people. So a lot of communication skills, and just life skills that I use to this day that were still just developed in some of those almost role-playing communication games.

JUSTIN REICH: Have any of you ever played *Mafia* or *Werewolf?* This is a derivation of *Mafia* or *Werewolf.* The guy who invented *Werewolf*-- there's a guy who invented *Mafia.* It's not just cultural. It's not like a century old game. It's a guy who now, I think, lives in Newton or Wellesley. He applied for a job in my lab once. He's a Russian immigrant. He grew up in Russia, and then came here. But he was like, yeah, I invented *Mafia.* And I was like, I played that at camp when I was a kid. Nope, it came from a particular moment and things like that. It's kind of cool.

That's definitely a topic I want us to talk about today and is featured in the book, this idea of transfer. What is it that you learned playing *The Resistance* that we might plausibly think you would actually be able to deploy in other non-similar contexts? And what does research tell us about that? Which ends up being a crucial question that the utility and value of learning games hinges around.

If you can get better at lots of things by playing*Minecraft,* if you can get better at critical thinking, if you can get better at teamwork, if you can get better at socialization, then, oh, *Minecraft* sounds pretty cool. If actually playing a lot of *Minecraft* just makes you better at *Minecraft,* then the social utility of *Minecraft,* playing it in schools or for learning experiences, goes down quite a bit. What other games have people played or other things? What was yours, Khalil?

AUDIENCE: So I could generalize myself, but there's a lot of games that rely on coordinate systems as an integral part of the game. And all of these, you could easily draw the parallels of it towards math education with regards to that. The game that is most closely resemble that, I remember, is *Game Over Gopher.* You're just like a carrot zombie, like a versus zombie-like game.

But it relies on you placing-- it tells you, hey, place this at this coordinate, and you have to figure out that quickly. So you have to internalize the idea of the coordinate system beyond just like a slow search, because that's what just gets you so far.

JUSTIN REICH: How quickly will we be able to see the basics of this?

[MUMBLING]

No plot! No plot!

[LAUGHTER]

Oh, I see. All right.

AUDIENCE: Is this a tower defense game?

AUDIENCE: Yeah, essentially.

JUSTIN REICH: Yeah, stupid gopher.

[LAUGHTER]

[MUMBLING]

Cool. The coordinate-- now I've turned the sound off on that. Let's see if this-- let's see if we can find this, *Apple Trek. Apple Trek,* originally released in 1971, also had-- let's get into it. This was the game that I played when I was a kid that had a sort of coordinate system in it, where you just had to shoot photon torpedoes at bad guys.

AUDIENCE: You can press F.

JUSTIN REICH: F will-- thank you. Yeah, good. So you have to sort of fly through-- you're just sort of flying through the universe. And eventually, if you want to shoot the photon torpedo, you have to figure out what the angle is. And fired at 90 degrees, or 70 degrees, or other kinds of things like that. It wasn't a very good gameplay video. But it's an example of a game with a coordinate system from 1971. So that certainly seems like a feature that shows up repeatedly.

AUDIENCE: Could you look up *Odell Fish?* That was, I think, a descendant of that.

JUSTIN REICH: *Odell Fish* game?

AUDIENCE: Yeah. But yeah, it was-- no, there was an older version. There was one from 1986, that it pretty much was just a fish, and you had to not get eaten by the otter. So all you had to do was move up and down. And it was riveting for third graders in the mid '90s.

JUSTIN REICH: Let's see.

AUDIENCE: [INAUDIBLE].

AUDIENCE: Yes. Ah, the memories.

[MUSIC PLAYING]

JUSTIN REICH: I'm not quite getting--

AUDIENCE: [INAUDIBLE] down a little bit.

JUSTIN REICH: It's not-- yeah, it's not letting me-- oh, there.

AUDIENCE: This is the up-to-date graphics, too, guys. Think about that.

JUSTIN REICH: That's good. All right. Are you all too old to-- how many of you had Kahoot! As a central part of your middle school or high school, or even-- we won't out. What's your-- what year did you graduate high school, Jared?

AUDIENCE: 2019.

JUSTIN REICH: 2019. That's cool. Yeah.

AUDIENCE: It was-- we used it a lot in high school, though, like 2015. We used it a lot.

JUSTIN REICH: Pretty substantial. How did it get integrated into classroom experience?

AUDIENCE: I think eventually my school had a program of we just had Chromebooks. And so then that just naturally led to, OK, we already all have our Chromebooks. Do some sort of quiz or whatever. And it gets real intense in the classroom, [INAUDIBLE], obviously.

JUSTIN REICH: People are nodding. You generally think of Kahoot! fondly. That was a good-- I mean, I built similar things in my class when I was a teacher in 2003. I don't know. Somehow I had a *Jeopardy!* setup that was with like a PowerPoint thing, where I just deleted little blocks to show the questions, and then people guessed the answers and stuff like that, so the quiz show format.

I mean, it really is not-- that is a classic example of gamification or chocolate-covered broccoli. There's no intrinsic game mechanic that's in there. That's just like competition over review questions, or knowledge, or things like that. But it ends up being pretty-- I mean, it's widely enjoyed by learners from lots of different backgrounds and things like that.

AUDIENCE: I feel like it stems from just being fed broccoli your whole life. So when you do get that chocolate--

JUSTIN REICH: Chocolate-covered broccoli, like, man, this is great! It's so-- yeah, yeah. No, I think that's right. It's like, man, this is so much better than just doing a review. This is so much better than whatever the typical routine of class is.

AUDIENCE: [INAUDIBLE] how great-- it's like you could write your own custom name or whatever.

JUSTIN REICH: Yeah, yeah. There's those identity components. There's the surprise components.

AUDIENCE: Also, outside of *Jeopardy!* being a group thing, everyone gets to give an answer.

JUSTIN REICH: Everybody gets to give an answer. Yeah, it does some good mechanics. Doesn't Kahoot! have things where on your own display, there's a class-wide leaderboard, but there's your own personal leaderboard? So even if you're getting demolished in class, it just shows you competing against the people who are nearest to you so that there's--

AUDIENCE: It tells you how far away you are.

AUDIENCE: Yeah, like 5 points behind this other player.

AUDIENCE: Yeah, yeah.

JUSTIN REICH: Yeah, yeah. So it's giving you relative-- some-- I mean, like, Peloton and other kinds of things do that, right? I don't know. I don't have a Peloton, but I think as these leaderboard systems across distributed computing environments are developed, they're like, oh, you don't have to compete against-- if you have people compete against everyone, then only one person can win. If you have everybody competing against a small subset, which is not necessarily overlapping with anybody else's subset, then everybody but one can beat somebody in some kind of way. And then you make up some other people, and they can beat the rest of them. Good. Other games that people played that were--

AUDIENCE: I guess related to expanding what a learning game is, most of my youth, I guess, I was in Iran. So you didn't really have the internet bandwidth for online learning games, or anything. And learning games in general were not a thing that I was really aware of until I got to the US. But I guess some stuff that I thought about was one specific one is like-- my parents got me a toy sewing machine that was like functional. And I learned how to sew with that.

And then, generally, just like it was gamification of arts and crafts a lot of times. My mom would give me a bunch of stuff-- be like, go make something with this. And my sister and I are very much perfectionists. So we would always be like, oh, I want it to be like this. And then my mom would be like, OK, well, if you want that, here's some explanation of how you might be able to do that.

And I think a lot of that was, one, obviously, like the skill itself of like I learned how to sew on a sewing machine and stuff like that. But also, a lot of practice of like-- what do you call it? Like, spatial understanding, and how do you write letters on a poster so that they're not all bunched up at one end? And just how to plan a certain space effectively, and things like that.

JUSTIN REICH: Yeah. And what makes that-- what makes that a game to you as opposed to a playful apprenticeship?

AUDIENCE: I guess some of it might be just the stakes. And then I guess it is-- I mean, maybe it was also just a little bit influenced by how it was presented, I guess, of-- if it was just like-- like if it had some pretend aspect, or if it's a competition with my sister, or things like that, I guess.

JUSTIN REICH: Yeah. Famously, there are philosophers who have tried to pin down the word game, and some of them have concluded it's not possible. I think Wittgenstein was one of the ones who said that there really is no way to accept-- to create a definition of game that correctly includes all the things that people think should be included and excludes all the things that people think should be excluded. It's quite difficult to figure out what gameness is and how it relates to sports, or play, or other-- real life, other kinds of activities.

But that's great that those things felt gameful to you. They certainly have a bunch of-- what you describe immediately evokes situated learning kinds of things of, oh, my mom does this thing. And so she gave me a little version of this thing. And then we did some of that stuff. And she gave us some tasks. And we played around with them.

And it is funny how across cultures, across history, young people really like playing at what adults do. I have a great photograph from Maasailand with this little three-year-old Maasai dude who's got a long stick and a set of rocks in the sand. And he's whacking the rocks in the sand because the Maasai are all herders.

And so he just watched his older brothers grow up herding goats, and he knew that he was going to end up herding goats. And there's just a lot of goat herding going on. But a thing that's fun for him is to grab a couple of rocks, pretend they're goats, and start herding them around in the sand. And I think it's funny, because it's relatable. Whatever culture you're in, playing at being older is a big part of youth. Good. Other games that people played? Yeah, Omar.

AUDIENCE: This one might unlock a couple memories, but Starfall was a big part of my childhood.

JUSTIN REICH: No. What's that?

AUDIENCE: I primarily played it during kindergarten and preschool and first grade. Yeah, it's that first link. They added a whole new section. I don't even remember. I don't ever recall seeing that. So they've significantly updated the website. But that was where I really did a lot of reading, intro to reading. And I mean, for me, it got pretty old, pretty fast, but it's very nostalgic nowadays. So that was one of them. And then also, like, Leapfrog toys.

[VIDEO PLAYBACK]

- (SINGING) Ah, ah, ah, ah

Short A makes this kind

AUDIENCE: We had a computer lab. And we'd all go there.

[END PLAYBACK]

And we'd watch these. And it was really cool, especially because we didn't have a lot of computing technology when I grew up at that time. So it was really cool to see this.

JUSTIN REICH: Kind of a special highlight for the day, to be able to do these kinds of things. And I hope that as you think about these kinds of things, think about Kahoot! and stuff like that, that your mind drifts back to what you read in Larry Cuban and his description of the material concerns of teachers, the schedule concerns of teachers, and things like, oh, it's pretty handy to be able to have a bunch of digital books that people find extremely compelling to shove six-year-olds in front of for an hour during the day so you can finish your lunch, or do some grading, or do a little planning and prep for other times of the day.

I don't know if this is well-studied, but I bet Larry Cuban's finding that television and film strips were more likely to be used at the end of the day in elementary schools probably parallels findings that you might have today about when Kahoot! games or other things like this used in the rhythm of the day, and so forth. So yeah, different technologies, but we can apply some of the similar sorts of analytic tools and frameworks to them. Good.

What are some things that I wanted to-- let me talk for you a little bit, and then I'll give you a little bit of a chance to play some games. And then we can talk a little bit about transfer. One thing that I just wanted to draw your attention to that's in the syllabus is for Failure to Disrupt in the Rabbit Hole readings that you're not required to do. One of those links for every chapter is a podcast episode.

And I was thinking about them, because some people who are missing class this week because of Sloan's SIP Week, I was going to recommend those to them as sort of supplementary kind of things. But for this chapter in particular, Scot Osterweil, who developed the *Logical Journey of the Zoombinis,* is one of the guests, and then Constance Steinkuehler, who actually had a job for a while in the US Department of Education, thinking about the role of games in education systems is there.

Probably one of the most fun things about the podcast episodes is that I really encourage the people who came to disagree with me. And so in most episodes, there are claims made about where the book is wrong by very well-informed people on those topics. So Constance Steinkuehler does not agree with me in this episode about the relationship between games and learning and transfer. And it's fun to listen to that.

I think Mitch and Natalie had some disagreements with me about what the learning goals of scratch are in practice. So those can be kind of fun. So I don't know. If you're going for a run or something like that, you need some light podcast listening to. These can be fun episodes, if you're not getting enough education technology in your 3 hours a week with me. There's more to be had.

So the way that this chapter is structured is I call it testing the theory of the genres of learning at scale, which is what you should be-- a big reason for organizing the idea of three genres of learning at scale is I want people to be able to take new technologies and say, oh, that is kind of like this. And if we say, oh, that's kind of like this, then we can say, all right, so we probably know something about its technology.

We probably know something about the pedagogical underpinnings. We can make some guess about research. Like a big thing that I would want someone who reads *Failure to Disrupt* to be able to do is to look at new AI tools and be like, we did not have generative pre-trained transformers that were pretty useful until November of 2022. But the things that we're trying to do with them are going to be similar to other kinds of stuff that we've done in the past. And we should be able to slot the things that we're going to do to them into different kinds of categories.

Games struck me as a good testing place for this, because it's not the case that I think games fit neatly into one of these three categories of instructor-guided learning at scale, or algorithm-guided learning at scale, or peer-guided learning at scale. But I do think that any given game probably fits into one of those categories pretty nicely, or has some of recognizable hybridity across those categories.

So something like *Math Blaster* is kind of an example of you could decide whether or not it's instructor-guided learning at scale, or algorithm-guided learning at scale, or something like that. It doesn't really have a lot of item response theory to it. But it's basically just an autograder. You go in. You're given a type of problem. You practice that problem over and over again. Maybe the difficulty goes up, and you practice another type of problem.

Had any of you ever heard of *Vanished* before? Maybe some of you in the Games for Learning class, did you read about *Vanished?* So *Vanished,* which I write about a little bit in the book, was this really cool project that the MIT Education Arcade did with the Smithsonian Museum. It was sort of-- did anybody watch the television show *Lost?* OK, so a couple nods there. I don't-- have any of you ever participated-- I mean, actually, I don't know.

Are you all aware of what is going on with Kate Middleton right now, where people are trying to figure out why she's not showing up in public and all these conspiracy theories show up about it? And people do these detective work. There's a bunch of things like that, or-- I don't know-- when the Malaysian airline flight crashed and nobody really knew. I don't know. There's something that human beings have that's like, let's all solve the mystery together.

And it gets kind of woven into conspiratorial thinking. It overlaps nicely with fiction, with things like *Lost,* or other television shows that do that. But *Vanished* was basically like an alternate reality game that was played out on the web, where there were codes to break. There were secret messages spread across websites. There were scientific claims that were happening-- other sorts of things. There were messages from the future being beamed back into the past.

And students signed up either as classes or individuals to get the kind of messages that went along. I think the game ran for a couple of months or something like that, but very much a peer-guided learning at scale kind of example-- just a series of puzzles put out there that you collaboratively tried to solve. You had to interact with other people to find.

A big-- these two kinds of games illustrate some of the basic principles that we were just talking about a little bit. *Math Blaster,* so what you did in *Math Blaster* is you took that little character, and you ran it back and forth to get the correct answer. Actually, what was the penguin game that we just played? What was that called? *Penguin Race-Off* or something?

AUDIENCE: Yes, I think so.

JUSTIN REICH: So *Penguin Race-Off* is an example of what sometimes gets called gamification, which is, how do we take a mathematic-- how do we take an intellectual exercise that we think is useful for people and put game elements on it to inspire people to do that activity? What other kinds of software have you played with that takes basically a worksheet activity and adds game elements on top of it?

AUDIENCE: Just kind of thinking about the slide you presented earlier, like Duolingo, kind of.

JUSTIN REICH: Yep, Duolingo has a ton of gamification built into it. I don't know. How many of you-- how many of you use Duolingo, or have used it? Oh, just a couple. So maybe we'll have some more people play around with it. But they have millions of people who are doing little language activities. But a big part of why they're doing it-- like, little language activities are not that inherently fun. But what are the features in Duolingo that try to get people hooked to do it and keep doing it?

AUDIENCE: Streaks.

JUSTIN REICH: Streaks are a big one, which is just a number that you try to increment every day. That's kind of a game.

AUDIENCE: Visual design.

JUSTIN REICH: What kind of elements?

AUDIENCE: Colorful design, interactive design, all of these bubbly feelings to everything in it.

JUSTIN REICH: Yep, yep. So yeah, like creating it and turning it into a playful space. Some of the most important visual elements are when you get something right. There's usually a little flash for sound, a little ding. edX had these big green check marks for a while when you got answers correct.

AUDIENCE: I think another thing that's been a recent development has been their PR. Recently, at least on TikTok, Duolingo has gone unhinged. And the bird's everywhere. It comments on weird things. And every time it comments somewhere, there's a million replies to it. And I think, wanting to be like a part of that community or say, I've done that, is also like a big thing in society today.

JUSTIN REICH: Yeah, good. Mari, who's not here, wrote in-- like, to me, Duolingo, when I think about it, is a classic example of gamification, very instructionist kind of inspired, like let's just put some game elements on stuff. And Mari wrote an essay. It was like, no, actually, this thing is super motivated by situated learning, the way that it makes you-- things like that are like, oh, the Duo bird is out there, and I can have a parasocial relationship with the Duo bird. And it will comment on my TikTok feeds, and I can respond to it, and things like that got me thinking a little bit differently about it. Maybe we keep talking about that.

But yeah, the term of art for this kind of approach is chocolate-covered broccoli, that, basically, this is super boring math to do, but we're just going to pour chocolate on it to get you to try to do more of it. And of course, like the joke of chocolate-covered broccoli is that chocolate-covered broccoli does actually not taste that good. And *Math Blaster* is actually not that fun. It's fun for a little while, and then you're like, oh, I'm just doing division.

Whereas *Vanished* and other kinds of games like it, there's not an as-well-accepted name, but my colleagues at the Education Arcade refer to these games as resonant games. And a key feature of resonant games is that instead of trying to add game elements on top of some kind of intellectual exercise, you're trying to find the playfulness in the intellectual exercise.

It's not, how do we add game mechanics to math? It's, what is already fun and playful and interesting in math? And then how do we have that fun and playfulness kind of surface and emerge so that we get learners to engage with that first? In *Vanished,* how do we teach scientific thinking, scientific practices by having those practices emerge kind of naturally in this conspiratorial, mystery kind of story that happens?

Oh, good. This is a great example of what Khalil was just talking about of the very playful environment. We'll give you some experience points. We'll tell you about your time. We'll call you amazing. We'll give you these funny little stickers.

I mean, this is-- I don't know if any of you do-- did your elementary teachers put stickers on successful assignments and stuff like that? Can you think of gold stars and stuff like that? Yeah, this is just like a digital version of that. It is the same kind of thing. Let's give you some kind of visual reward reminder to get you to keep playing and doing these things.

This is one that I talk about in the book,*Lumosity,* which maybe we'll talk about a little bit later when we talk about transfer and things like that. All right, so I would like to invite you to play two of these games. And you can find these links in the syllabus. Why don't we take 15 minutes or so and let you pull out some computers?

I'm going to give you-- I'm going to give you. Maybe before you pull them out, let me just explain these four things, and then you can do whatever you want with them. The first one is *Math Blaster.* I don't think I successfully found the 1983 version. I think I found a 1996 one. But you should play a few rounds of *Math Blaster* and see what all the hype is about.

The second game is *The Logical Journey of the Zoombinis,* which was a key part of Erin's childhood. And so now she'll get to go back to that. It has a really long kind of intro story and stuff like that. If that's what you're into, you can do that. But if you want to play the game, you'll have to skip a bunch of introductory stuff to get into some interesting combinatorics kinds of things.

One thing, which is not a game, but if any of you are big *Minecraft* fans, I gave you a link to what is essentially the *Minecraft* website for teachers. You won't be able to-- unless you've got *Minecraft* on your computer, you won't be able to jump in there and play with things.

But a thing that you can do is go to their Lesson Plan Finder. And that's probably the most useful-- probably the thing you'd find most interesting is go to Explore Lessons, and pick a topic you're interested in, and see whether or not you think the-- good, going back to the coordinate system, like how would how would you use *Minecraft* to teach the coordinate system? And they've got all kinds of guiding activities and student activities. And you won't be able to see the world that's associated with them, but each one of these lessons has a kind of *Minecraft* space that's been built. You can at least get some screenshots from it.

And then if anybody hasn't played Duolingo, it's not-- you could probably pretty quickly start creating an account and doing some things like that. If you want to do it with the person next to you, you should feel free to do that. The easiest place to find all of these links-- you could just Google them, but they are on the syllabus, bit.ly/lmtsyllabus.

And then on the day for learning games, I've put four of these links there. So it's 1:35. Why don't we take until about 1:50 and just let you-- and feel free to do it with a partner or something like that. And if they've got sound, you can turn on the sound quietly and stuff like that. So you can hear it without bothering people next to you. But they're pretty fun things to mess around with. Sound good? Ready to go?

So having-- who played around with *Zoombinis?* It looked like we had a lot of *Zoombinis* players. What are your reactions having spent some time with *Zoombinis?*

AUDIENCE: It's cute.

AUDIENCE: It takes so long. I want it to go. Hurry up.

AUDIENCE: Yeah. Then you get to see them walk up and bounce up.

JUSTIN REICH: Yeah, yeah. So the more actually, most of you are playing with sound off, which might be a mistake, because I think part of the stakes of *Zoombinis* are set-- like, there's a narrator in the back who tells you about how the Zoombinis were oppressed, and you're saving them, and things like that. And having you develop a kind of affinity for them is in a storytelling world as part of the game. Having them be cute, I think, is important that you develop some care for them and want to engage with them and things like that.

In fact, the more you peel away those elements, the kind of narrative elements, the social elements, the artistic elements, and just get down to the math, the more that could risk some of the fun of the engagement.

AUDIENCE: I'd rather play Sudoku.

JUSTIN REICH: Rather play Sudoku. OK, good, which is just like a straight immersion into--

AUDIENCE: [INAUDIBLE]

JUSTIN REICH: And those kinds of personal preferences raise some real challenges for teachers, right? You can imagine having-- if you were to take time in a math class to have people play *The Logical Journey of the Zoombinis,* there would be some kids who are like, this is the best day of class ever, and there would be other kids who are like, can we just go back to doing whatever we were doing before? And it's like an expensive investment of time and other kinds of things to have a third of your class be like, ah this game is not that fun. Emily did it sell you eventually?

AUDIENCE: No, it seemed boring.

JUSTIN REICH: Yeah.

AUDIENCE: I switched games.

AUDIENCE: I would say I kind of like it, honestly.

JUSTIN REICH: Good.

AUDIENCE: I think it's just-- I don't know. It could be like that tendency, like you said, of create-- like having an affinity for them, or it's like these cute little creatures, going across the screen, and how much you enjoy that, or how much you might care for that. And I'm very much down for a fun little game with little cute--

JUSTIN REICH: Characters, and identities, and things like that.

AUDIENCE: I feel like it might just be because now I'm so used to things having to happen very quickly, because even lectures, I tend to watch them in two times speed instead of the normal way, like the normal time. So then it's like watching-- playing these games, they're so slow that I'm just like, you've lost my attention. I don't want to play it anymore.

JUSTIN REICH: Good. Yeah, there's a little kind of gap in there.

AUDIENCE: I have a question. Did you guys skip the transitions, or were you sitting through them?

AUDIENCE: Skipped them.

AUDIENCE: I clicked out of them.

AUDIENCE: Skipped them, yeah.

AUDIENCE: OK. Because the transitions are-- I see what you mean, but the transitions are like, OK, you're slowly highlighting the next place I'm going, and have for a minute. And it's like, OK, I've seen enough.

AUDIENCE: It was fun to figure out what the traits were that they were selecting for. But then you kind of-- I felt like I instantly found the traits, and then I was just like, oh, OK. I'll just-- I didn't really have to completely do a crazy search for the traits or whatever. I was just like, oh, OK, well, maybe this hair is good. And then all that hair turned out to be fine. I'm like, oh, OK, great.

JUSTIN REICH: I mean, it might have been harder if you were 10.

AUDIENCE: Actually, you can build those two together. I'm like-- I don't remember when I was going through this game as a young person if I recognized or was even looking for the traits. I think maybe I might have been more pulled to the affinity to the characters, and like, oh, no, they got bounced back. That's not good.

And just doing-- I would do it with my sisters, and we'd just drop them all over the place and see if they'd go in. But I cannot remember if I noticed that there were conditions. And I just-- we cared-- we were OK with the slowness, because we cared more about just getting them through. It didn't matter. And I can't remember. And that's killing me a little bit.

JUSTIN REICH: How many of you clicked the question mark hint button that has an explanation and how many didn't discover the-- it's kind of an interesting design feature, to be able to say that you can play the game without any instructions about how to play the game. You're just put in the world, start clicking things around, start moving things around. If you had to put *The Logical Journey of the Zoombinis* as instructor-guided learning at scale, algorithm-guided learning at scale, or peer-guided learning at scale, what would you call it?

AUDIENCE: I feel like instructor-guided learning. It's not like if I was able to solve all of the-- or get all of the Zoombinis through one or two errors, that it would automatically jump me to level 5. There was very much a sequence that you were supposed to follow. And when I would place one, and then it would try and go up, it almost felt like an autograder of it's like this is either pass or fail.

JUSTIN REICH: Yeah, the autograder is a lot more fun, because a thing crosses a bridge, or gets kicked back, or somebody eats a pizza, but doesn't eat a pizza. But it's not really any different from a green check or a red check or other kinds of things like that.

Now, the way that I argued that *Zoombinis* fit is that it's instructor-guided learning at scale with an autograder. However, almost every MOOC is inspired by more instructive kinds of approaches, and this is very much more inspired by kind of a situated learning apprenticeship kind of approach, where it's almost trying to hide the autograder, trying to hide the instructor.

I mean, it's very much trying to hide the instructions. It says just like, go into this world, immerse yourself into this world, play around, see what happens. There's sort of winning and losing, but it's actually fine to fail a level. It's fine to have all your Zoombinis kicked back. You can try again and rescue some other Zoombinis, other sorts of things.

There's no point in the game where it stops and is like, OK, kids, actually, we're teaching you combinatorics, or probability, or whatever else you think is the mathematics of the game. It just lets that be a kind of natural learning that happens throughout. There are other-- so this is an exercise that I think is the kind of thing that might be helpful if you were a department head, a teacher trying to figure out whether or not you should adopt this technology in your classroom, which is, for any new technology, three good questions to ask are, who drives and controls the pace and path of learning? What are the technologies here? What are the pedagogies? And then, what can I predict will happen in my educational system, given a consequence of this design?

So *Math Blaster* is pretty instructor-guided. It's got an autograder. I mean, they're just worksheet problems. There's no difference between that and a worksheet problem, except maybe I will slightly motivate some of my students to do more worksheet problems because there's aliens, and it's kind of fun, and things like that. But maybe not. Maybe there's some people who are like, I really don't want to have-- just give me the math problems to answer.

I had often thought of Duo-- how many of you played around with Duolingo for the first time as you were clicking around here? Any sort of new Duolingo people? It certainly is algorithm-guided, as it's trying to-- there's a lot of good writing. The developers of Duolingo keep blogs and other kinds of things where they talk about, for instance, they have-- anybody ever heard of the concept of the zone of proximal development? It's sort of a classic educational concept.

Basically, you want to try to as you're teaching people, have there be a difficulty level where you feel competent, but also stretched. If things are too easy, it's boring. If things are too hard, it's boring. There's a zone of proximal ideal development for that. They measure that zone of proximal development by saying, we're trying to aim for people to have a certain kind of error rate. I don't know exactly what it is, but it might be like, we want you to get about 20% of the things you're hitting wrong. If you're getting more than 20% wrong, then we're probably making it too hard. Otherwise, too easy.

But what are the-- I don't know. We talked a little bit, but what are some of the situated learning elements that you saw? If you were to say that it was not so instructionist, but it was more inspired by kind of constructionism, situated learning, what kinds of things like that are in Duolingo?

AUDIENCE: I found out Duolingo has a music thing now, which is really cool, because I've always wanted to learn music. I'd like to play around with that, but I don't understand it. I can't read notes or anything. I just think, and then play piano. But it's more interesting to see they have this stupid simulation of playing "Hot Cross Buns," and I swear I could play that if I tried, but doing it with their little app, it was like you had to pace it, and you had to recognize the notes. And it went back to that 10 times. And it's simulating playing the piano. It's really simple for a computer game, but that was pretty engaging.

JUSTIN REICH: So it immersed you in the feeling of playing a piano, even though you're kind of on your phone. That seems like a good quality of a situated apprenticeship kind of thing. Now, you had played "Hot Cross Buns" before.

AUDIENCE: I feel like you could just play it sitting at a piano without-- if I looked for the notes sound-wise, like, I can't read piano notes, but I can figure out songs if you tell me what they are, like if I hear them.

JUSTIN REICH: Playing by ear. Yeah, cool. And so you feel like this could be a pathway to doing-- I mean, I'm sort of increasingly convinced now that Duolingo-- Duolingo came out of Carnegie Mellon University, and they have some of the best learning scientists, learning engineers in the world. And one of the things I like about them is that they're methodological pluralists. They're like, what are all the good ideas, and how do we shove them all in there?

So in some sense, Duolingo is very much constructionist. It's taking big, complex things and breaking it down into small pieces. It'll show you examples, then give you practice and all those kinds of things. But it also has this way of, well, let's give you an identity in this environment. Let's have you build a parasocial relationship with an owl. Let's feel like you're sitting down with a piano. Let's reward you. Let's help you go on a journey from being a newcomer to an old timer by having badges and streaks and these other sorts of things with it, kind of a nice blend of those things.

We've talked a bunch in this class about how one of the signature challenges of self-paced online learning is that people are typically bad at it. People typically quit. Duolingo has probably been as successful, maybe more successful, than any other education technology company in building a product that's just super sticky for people. They really have put a lot of effort into trying to break down the challenges of self-paced learning, through these gamification, through streaks, through making it playful, through having it feel like it'd be fun.

I don't know. Have any of you tried to quit Duolingo? They send you haranguing emails when you're not doing it enough, and things like that. They've got all kinds of ways of trying to continuously pull them in there. They're super scientific about all this stuff, too. So I'm sure all those emails that you've ever gotten have been A-B tested a zillion times, all different kinds of timing, and language they use, and other things like that to rope you back in. Good.

How many of you looked around on the *Minecraft* website? What did you find there, Khalil?

AUDIENCE: I played a game where they're trying to teach kids good game, like, stuff. And it's still very-- there's not much to do. It's just like, go there. Do that. Should you feed the dog? You probably should feed the dog.

[LAUGHTER]

So it felt a little bit forced in terms of the path that you could take. But after doing these chores, it tells you, hey, you have to write this good game guide book. And, oh, what's the-- you should write a certain instruction. Do you want an example? Oh, what you did today was chores. You should do your chores before playing games. And then you get to write whatever you want, in which case, they don't really check what you write in there.

But after that, you get to play a little game where you shoot balloons, I guess. And then you're back into a new day. So it felt a lot of let's simulate life in *Minecraft.* You have even-- you have parents in the game, which is they named them Trusted Adult.

[LAUGHTER]

But yeah, it felt a little bit too much constrained in terms of what activity you could be doing. And it felt very much clearly instructivist. I mean, I'm very much an adult. So it's not like--

JUSTIN REICH: You're not the target audience. But--

AUDIENCE: [INAUDIBLE] for this. But I hypothesized a kid would recognize that they are telling me to do my chores before playing games.

JUSTIN REICH: But they're just doing it in *Minecraft.* Yeah.

AUDIENCE: Yeah.

JUSTIN REICH: Yeah, I think that's-- I mean, to me-- how many of you are *Minecraft* players just in your regular lives or were at some point in you-- to me, the joy of *Minecraft,* the thing that they discovered was the joy of the boundlessness of just people inventing their own missions, and structure, and things like that. There's a little bit of the Overworld of the game, but I mean, for me, it was always like, all right, I'm in a new world. I will need a wizard's tower. I had a construct in my mind of what I should live in. And it was a wizard's tower.

And that just cuts off-- it's very difficult to conduct educational activities which are like, everyone, go do whatever you want. I mean, usually, when you have some instructional activity, you're like, let's all do x, you know? And so, to some extent, the kind of, let's all do go do x is directly against the fabric of one of the main things that makes *Minecraft* so special is this open world where you can do anything you want.

So there's a sort of-- those kinds of tensions show up all the time in-- I think it could-- I think *Minecraft* is incredibly sticky to young people. It is incredibly compelling. And so you go, oh, maybe we could take this really sticky, compelling world and have people do learning in it. But as soon as you add this dimension of, OK, you all have to do x inside my *Minecraft* world, it's often much, much less compelling for people. You're taking away one of the key features that made it sticky in the first place.

But even if you wanted to do that, I think one of the central questions that games pose is, if you spend a lot of time in *Minecraft,* are there things that you're learning that are useful for other things, or are you just learning how to play *Minecraft?* And that is a very old educational question. It is an educational question that actually somebody we've talked about a bunch, Edward Thorndike, was one of the very earliest researchers in. And it relates to a problem that's called transfer.

To what extent, when you learn something, can you take that learning and apply it into some other different kind of context? That is one of the most important questions we could ask in education. The more you believe that things learned in one context will help you do other kinds of things, in some ways, it simplifies the education system, like, let's just get you to be really good thinkers in one domain, and then you'll be good at all kinds of stuff.

The more that you believe that things don't transfer very well, that people are really only good at doing the things that they're taught how to do, the more difficult and complex education becomes. In Thorndike's time, the thorny challenge that he was faced with was that people were still big fans of classical curriculum, teaching people Latin and Greek. And the argument that was out there was that if people got really good at learning Latin and Greek, they would learn, generically, how to think well. They would learn how to think well, how to communicate well. You all are giggling at this. Why are you giggling at this? What seems silly about that argument?

AUDIENCE: I mean, learning Latin and Greek is-- first of all, it seems kind of elitist and hilarious for that reason. But also, it's like any language, or I guess, any [INAUDIBLE] task, it's a lot of pattern matching, I imagine. I'm not a great language learner, but I can't imagine how you could apply the same underlying--

JUSTIN REICH: If I just learned a lot of Polish, I would be really good at lots of other kinds of things. It doesn't stick quite as well. Good. What are things in our current educational system that we tell people, "if you learn this thing, you'll be good at lots of other kinds of things"?

AUDIENCE: Math, especially higher level stuff.

JUSTIN REICH: OK, good. And can people think of other kinds of things that have claims that are similar to that?

AUDIENCE: Just reading in general. People claim like, oh, if you can read, then you can read anything, and you can learn it.

JUSTIN REICH: So there's domain-independent reading skills. That's a thing that comes out there that we can ask some more about.

AUDIENCE: I could argue that many academics stuff not relating to academic stuff gets that claim. If you do this good academic achieve whatever, like, learning, you will do good at non-academic certain tasks, whether that be normal day-to-day getting a job, or something like that.

JUSTIN REICH: Yeah, yep, yeah, that schools help you with other things. Chess gets this a lot. Learn to play chess, you get strategic thinking.

AUDIENCE: If you take classes, you will be good at the job that they're teaching you.

JUSTIN REICH: Yeah. My wife works on the faculty here in material science. And she had somebody who did material science in an engineering company once come, and came to a faculty meeting, and basically was telling the faculty how little she thought of the training that they got in labs. She was like, well, I guess it's OK if you do a UROP. It's better than doing lifeguarding for a summer, or something like that, but it's really not very helpful, which was funny at the time. But the point being that, yeah, the things that people do in companies to actually build products are quite different than the things that happen in academic research labs to imagine these kinds of things.

Here are a couple of striking examples. And I'll point out this later. I think computer programming gets this. Have you any of you ever heard the phrase computational thinking? So computational thinking is roughly the claim that if you teach people how to program computers, they will have a bunch of skills that are useful in other kinds of domains, like, you will learn how to break problems down into smaller problems. You'll learn how to think through things with algorithms, and stuff like that. It is actually that line of argument is very similar to the argument a century-plus ago or a couple of centuries ago that if you learn Latin and Greek, you will have these domain-independent thinking skills that are good for reasoning and other kinds of domains.

Here's a remarkable study that a colleague of mine did recently that illustrates this. He was trying to figure out, how good are people at differentiating-- at sorting truth from fiction online? So he shows them two websites. One of them is the American Academy of Pediatrics. The other is the American College of Pediatricians. Those sound pretty similar. The websites actually look pretty similar.

The American Academy of Pediatrics is a 40,000-member organization that represents pediatricians across the United States. The American College of Pediatricians is like a 400, or 500, 600-person splinter group that split off from the American Academy of Pediatricians in opposition to same sex adoption. So like one is a very mainstream group. One is a splinter group.

Professional fact checkers who work at newspapers and magazines and stuff like that could identify this-- the difference between these websites and organizations 100% of the time. How well do you think historians did at this, professional trained historians did at this, who spend their entire lives studying how to evaluate information, and how well do you think Stanford freshmen do at this task?

AUDIENCE: Like, saying this group is not the same as this other group?

JUSTIN REICH: Yeah, I mean, it was slightly more detailed than that. It was like, which of these would have better substantiated claims, but even recognizing the difference between them, like even identifying that the American College of Pediatricians is not the same thing as the American Academy of Pediatricians.

They do shockingly, shockingly poorly. So 50% of trained, award-winning, tenured historians either wasn't sure-- I think the question they ask is, which of these is a more reliable source of information? And the fact checkers were like, yeah, the Academy, with all the people and the mainstream group. And historians, about half of them did that. And actually, about 20% of Stanford freshmen people, who got into a university with a 3% acceptance rate or something like that.

Are fact checkers smarter than historians, tenured historians, or Stanford students? Like, it doesn't stand to reason that they would have better generic, like domain-independent thinking skills, or critical thinking skills, or problem solving, something like that. A better way to think about it is, they must be doing something different. And it turned out that when you observe them, they were.

When historians and Stanford freshmen go to a website to evaluate the website, they scroll up and down. And they look on the website for markers of credibility. Does this-- is it formatted correctly? Does it seem to be from a reputable organization? Is it a .org or a .com? Does it have citations? Stuff like that. The American College of Pediatricians has all of those markers of credibility. All the bad guys have lists of how to make a credible looking website.

The fact checkers do something totally different. As soon as they go to a website, they leave it. So they would go to the American College of Pediatricians, and they immediately just Google American College of Pediatricians, in which you very quickly learn it's a 600-person splinter group, and those sorts of things.

And so people with-- the thing which is so striking here, actually, the reason why this research group picked this tenured group of historians is they were hoping that they would be examples of experts. They would be like, these people have trained their entire lives to study information and to sort truth from fiction in historical documents. And it turns out spending your entire life learning how to truth from fiction in the archives doesn't help you very much, learning how to sort truth from fiction on the internet.

So this is one of the key ideas of transfer, that if you learn how to do something in one domain, even changing the context of that domain not that much, going from sorting truth from fiction in the archives, is sufficiently different from sorting truth from fiction online, that there's not a generic set of critical thinking skills that helps you bridge that. If you want to get good at sorting truth from fiction online, you have to learn a specific set of skills that are related to learning to truth from fiction online.

Here's another one of those examples. This is a classic experiment that gets replicated in various kinds of ways. In one experiment, third graders, some identified by a reading test as good readers, some as poor, were asked to read a passage about soccer. The poor readers, who knew a lot about soccer, were three times as likely to make accurate inferences about the passage as the good readers, who didn't know much about the game.

Current education practices show that reading comprehension is misunderstood. It's treated like a general skill that can be applied with equal success to all texts. Rather, comprehension is intimately intertwined with knowledge. So we think there's ways of measuring, are you a good reader or a bad reader? But it actually sets aside the fact that if a bunch of stuff about soccer, you're a good soccer reader. And if you don't know a lot of stuff about soccer, you're a bad soccer reader.

This is terrible for reading instruction, right? It would be much better for the world if we could just make you a good reader. But actually, the way to be good at reading in a domain is to teach you a bunch of facts and knowledge and information in that specific domain, that, in fact, the skill of reading doesn't transfer that well from reading about soccer to reading about softball. It's not that it doesn't transfer at all. And also, being able to read well about soccer is more like being able to read well about softball, and less likely-- less related to being able to read well about restaurants or something like that.

This is my way of making fun of the claim that computer science taught me to break down problems into pieces. This is a classic kind of computational thinking argument, that if you teach someone computer science, they'll be able to break down problems into pieces. So here's an AP literature question. Before using computer science, I answered this with one long sentence, but now I use paragraphs to break up my arguments into pieces. No, of course, from the very beginning of you learning how to write, you were taught to break down problems into pieces. That's what writing is. You break big ideas into paragraphs. You break paragraphs into sentences. You make sentences into phrases. You've been taught forever how to break ideas down into pieces.

But turning written words into breaking them down into pieces doesn't really help you at all in taking computer programming problems and breaking them down into pieces. Before studying computer science, I wrote one equation to solve all these problems, but now I break problems down into pieces.

AUDIENCE: Yeah, I could speak like that from firsthand experience. I've done computer science problem-solving very much since like middle school. And in terms of domain knowledge, I don't-- when I encounter with a different domain, I don't know where to even cut the pieces for the problem. Sure, I want to do that. But where? I don't know where to cut it into smaller pieces. This is something I have to acquire, just like anyone else.

JUSTIN REICH: Yeah, that is the domain-specific knowledge that you need to acquire in that particular domain to know what-- I mean, it is probably slightly useful to have the intuition. Hey, bigger problems can be broken down into smaller problems. That's probably a little bit helpful in a lot of cases. But I like the way that you phrased that. If you don't know anything about the domain, you don't know what the relevant division points for breaking something into pieces are.

One of the first people to study this was Edward Thorndike. I was just rereading today one of the studies that he did, which was to have people be really good at estimating the size of rectangles. So he would cut rectangles on pieces of paper and have people look at rectangles, estimate their area, give them some feedback, and you can actually get-- there's 100 different rectangles of different sizes. And he found pretty quickly you can get people better at estimating rectangles.

Then he would give them piles of circles and triangles and rhombuses and things like that. And they're no better at estimating the size of circles and triangles, having studied how to estimate rectangles again. There are all kinds of studies that are done like this, a lot-- a wave recently being studies that disprove that there's any relationship between chess knowledge and academic outcomes, or chess proficiency and academic outcomes, between music knowledge and academic outcomes. These things are much more separate than we might have hoped.

AUDIENCE: About the reading comprehension thing.

JUSTIN REICH: Yeah.

AUDIENCE: Do the standardized tests like a SAT or ACT take that into account or they don't?

JUSTIN REICH: It's a huge problem. So I mean, in a sense, they-- here's how they try to take it into account is they try to indicate to educators what are the domains of knowledge that will be sampled by the SAT and have people read things that are related to those domains of knowledge. One of the knocks about particularly early standardized tests-- I think standardized testing companies have done better about these kinds of things-- is there would be all kinds of questions that are about-- or where the examples take place in a country club or something like that. And 75 years ago or whatever, maybe it would have been pretty likely that just about everybody who is applying to college knows what a country club is. But there are tons of Americans who have no idea what a country club is.

And so if you treat reading as a domain-independent entity, where everybody should be able to recognize the words country club, and then process the rest of the sentence, then that seems fair. But the more you realize, no, knowing something about a country club gives you an advantage on questions that are about country clubs. And I think we could all agree that knowing about country clubs is not something that's particularly important to going to college, or advancing higher education, or other things like that. And they're like, oh, that is kind of unfair.

So I think there's more recognition of those things over time. Of course, you have the opposite problem, which is that the more you tell people exactly what the domains are that might be tested, the more you have people just studying and practicing those domains. And that's not exactly the point of these testing systems either. Ideally, they would give us some kind of indication of people's proficiency in a wide range of things that might help them be good at college. But it's a real problem.

AUDIENCE: I've heard that SAT kind of changed their argument a little bit, or the way they phrase it into it's not that the test matters at all. The argument now is more leaning towards their performance on the test indicates the student's ability to prepare for the test, even though the test is meaningless, the ability to prepare for the test is what is being tested, and that correlated well with other kinds of things, which is not completely outrageous to say.

I give you a completely stupid subject no one heard of and tell you to prepare for it. The people who better prepare for it are probably better studiers who will perform better at college, where you will also do that study. But it's not perfect. And it will lead to disproportionate outcomes when these people who do not fit into the neat, nice line where standards fit go.

JUSTIN REICH: I think that's right. I think an early rhetoric of testing would have been something along the lines of intelligence is a universal human quality. We can design tests. That's not culturally specific. We can design tests that measure intelligence. And using these accurate tests that measure intelligence, we can find the most intelligent people, and then we can send them into college.

As soon as you recognize that some degree of intelligence tests are culturally biased, because of all these transfer problems that we've just been talking about, that if you have a bunch of questions about ranching, then you benefit young people who are in rural states where there's a lot of ranching going on. But what does that have-- that's the equivalent of the country club kind of thing.

And then the other argument for them is that they are pretty good-- there are correlations between people's success on these tests and their later success in college. It's not a perfect correlation, but it is one indicator that if someone is struggling to do well on these tests, there's reasonable reasons to believe that they might struggle to do well in college settings and so forth.

Anyway, you can imagine unraveling this kind of question has huge implications for how valuable it is for kids to spend zillions of hours on *Minecraft.* So when kids play zillions of hours on*Minecraft,* they learn a ton. They learn how to collaborate with other people. They learn how to find information on the internet.

Minecraft, a little bit like *The Logical Journey of the Zoombinis* has no instructions on the screen. You have to go to wikis. You have to watch playthrough videos. You have to do other kinds of exercises to figure out how to engage in *Minecraft.* And some of those things seem like domain-independent sorts of skills-- how to find information from other places, how to set goals, how to pursue those goals, other kinds of things like that.

But an enormous question about the value of playing games like that is something like, well, if you know how to do all that in *Minecraft,* does it help you do that somewhere else? There's a lot of educational psychology research that suggests that transfer is really hard, that when you learn things in one domain, people are not that good at passing it to another domain.

To me, there are two contrary arguments to that. There's a joking way of putting it. But I think one of the best arguments against humans' ability-- one of the best arguments in favor of humans' ability to transfer learning is civilization. It's pretty hard to imagine how you would develop civilization if people weren't pretty good at learning some things, and then applying them to new kinds of tasks.

So a theme of counterargument is that, basically, educational researchers are not good at detecting and observing transfer. We're not good at conducting studies that measure people's abilities to take things from one domain and put them to another domain. If you listen to that podcast episode with Constance Steinkuehler, who's a huge advocate of the benefits of games for learning, you'll hear her make an argument along those lines, which is like, come on, Justin. If you get really good at doing cool stuff in *Minecraft,* that will help you with other things that you're doing in life.

Not that different from what Dana said at the beginning of the class about the things you learn playing*The Resistance.* I can learn how-- I learned how to keep a poker face there, and now I can keep a poker face in other kinds of places. So unanswered questions to be sure. Good.

2:25. You all should have a wonderful spring break. You should come-- there's a little bit of reading that you have to do, but mostly you should come with a draft, the strongest draft that you can put together for paper two on Monday, a week from Monday. And we'll have a chance to do some peer editing in that class. And we're going to shift from genres of learning at scale to the as yet intractable dilemmas in the second half of *Failure to Disrupt*.