

Jennifer Carolan : (00:00)

I worry sometimes that all of this excitement and this innovation, this building in the space, sometimes disregards the things about us that make us uniquely human.

Dan Meyer: (00:13)

Welcome to Math Teacher Lounge. I'm your host Dan Meyer. I'm flying solo today. No Bethany here to keep my worst impulses in check. Well, I'll see if we regret that decision. We've wrapped up our series on math anxiety, and we're now gonna spend a couple episodes talking about something fairly topical, which is artificial intelligence. If you are a teacher, odds are good that your technologically inclined uncles, aunts, siblings, whoever, has asked you something like, "What does this mean for teaching, these new AI products that we're seeing pop up?" A lot of discussion here. So to start off our summer miniseries on AI in education, we'll talk to a person who wrote one of my favorite pieces on the topic of AI and math, ed tech investor Jennifer Carolan of Reach Capital. Her piece was entitled, "What AI Will Disrupt But Never Replace." I always find her so serious on the matter of building things for classes with technology and also teaching and how it interacts with students. So please enjoy this conversation with Jennifer Carolan.

Dan Meyer: (01:17)

Well, we are so happy to have Jennifer Carolan in the Lounge. Jennifer, welcome to Math Teacher Lounge.

Jennifer Carolan : (01:26)

Thank you for having me.

Dan Meyer: (01:27)

We have sparkling water in the fridge. Ignore any brown bags that have names on them that aren't yours. But yeah, you're welcome to have anything from there that you want. But thank you for being here. Can you just tell people a bit about your background? We've intersected a lot of different ways in both of our time in the Silicon Valley in the Bay Area, and you've just had a very interesting career path. Can you just give a few of the highlights, from your perspective?

Jennifer Carolan : (01:50)

Sure. So I grew up in Chicago, went to school in the suburbs, and then also in the city. And I had this very formative experience of going to a Chicago public school my sophomore year. And this was the year Bill Bennett declared CPS the sort of worst schools in the nation. I remember seeing that on the front, the headline, of the Chicago Sun Times. And then I also went to school in the suburbs and had a completely different experience. So that really shaped me in ways that I didn't fully understand at the time, but probably motivated me to go into education. I became a classroom teacher, a public school teacher. I taught history at the middle school and high school level. And I did that for seven years. I moved out to the San Francisco area. I got my master's in curriculum, in teacher education. I published my research in Ed Leadership. And for my master's thesis, I studied differentiation — or personalized instruction, as some call it now. I then went to go work for a nonprofit called NewSchools Venture Fund, and they were combining this venture capital model and education. They tried to overlay the venture capital model into education, and back education entrepreneurs. And so I sort of learned the craft of venture capital there for nine years. And I met Wayee Chu, who became my co-founder, and Shauntel Garvey was our first hire. And we spun out and formed Reach Capital Venture Fund, and we've been at it since 2011. We have four funds and we are totally focused on education technology investing.

Dan Meyer: (03:43)

So I love that you have the background as an educator. You've been a student yourself. You've seen school systems at their best-resourced and least-resourced, perhaps. And now you're working as a venture capitalist. Can you just explain for our audience, you know, high-level, what does a venture capitalist do, day-to-day, in the education space, for instance?

Jennifer Carolan : (04:02)

Sure. So yeah, when I was growing up in Chicago, I never knew what a venture capitalist was. It was not until I came to Silicon Valley and I got to meet all of these technology entrepreneurs and understand the financial system that was kind of fueling all of this innovation in the Valley. And so I thought, could this vehicle of growth be used in the education space to bring technology and different tools to that space? And I was particularly interested in it because I was grabbing technology tools sort of off the shelf, or making them. We didn't have — this is gonna date me, but we didn't have digital graders, electronic graders, back then. We did it all in that green folder that you were given on the first day of school. And so I was really interested, because I was shopping online and banking online, and I thought, gosh, this job is really hard. I'm teaching 175 students. And I can't even get a good kind of grader, automatic grader, for

this job. And that really began my exploration of, how can we bring great technology into schools? So to answer your question, the job of the VC is really capital allocation. So we are given money through a lot of nonprofits, foundations, endowments, high net-worth individuals, and we invest in entrepreneurs, founders of companies. In our case, it's ed tech entrepreneurs that are building companies in the space. So companies like ClassDojo and Desmos and Instructure Canvas and these. So venture capitalists back these companies early on, oftentimes when they have no customers at all. And then we work alongside them. We partner with them, support them over the years. And that's in a nutshell sort of what we do. So my job is, a couple days a week I'm sourcing and looking at new companies. We have about a hundred companies that come inbound per week. And a couple days I'm working with my existing companies that I'm on the board of. And then, I'm also managing the fund.

Dan Meyer: (06:27)

That's super helpful. Yeah. From the perspective of a teacher, I came to a school and we had a bunch of tools that we were using that were picked by people who were not me. And I didn't have a strong sense of where those tools were selected from, what other options were available, how did those options come about. And that, in my mind, is where I think you come in, and Reach comes in. And when I worked at Desmos, you were a group of people that had access to a bunch of money and we needed money to grow and came to you and convinced you that we were a good bet. And that's part of our growth story. So I think it's just interesting to think about the choices that we have available, these huge companies that just feel like they are part of the air, like they're natural forces that have always been, are actually the result — in lots of cases — of people like you, who make choices based in values and experience and knowledge about what seems like a good thing to give money to. That's, to me, a very interesting and consequential job.

Jennifer Carolan : (07:25)

I will say though, that I was stalking Desmos for many years. It was ... I was delighted when we had the chance to invest.

Dan Meyer: (07:35)

Well, so I guess I'm curious. So there is a question that you have mentioned you get all the time now, in your role as someone who thinks about technology, and what could work in schools and what could be,

you know, profitable in learning. By lots of definitions of profitable. What is the kind of question you're getting? What's in the air right now in your world?

Jennifer Carolan : (07:54)

Yeah. So, definitely, AI. Generative AI. And will AI tutors replace teachers. So this is ... I don't know, when I'm seeing a hundred companies a week, I would say now almost half of them are, are AI, generative AI companies.

Dan Meyer: (08:10)

Super interesting. We will come back to those 50 in a little bit. I have questions about that. But for the sake of our audience, AI has been around for a very long time. You know, like, self-driving cars have been a pursuit for a very long time. You know how from movies, you know, from way back in the day have been examples of AI. But why are we all talking about AI right now? What's been going on that's so big?

Jennifer Carolan : (08:35)

Yeah, I'm glad that you mentioned that. It has been around for a while. And we've been backing AI-driven companies or machine-learning companies for many years. We backed Gradescope and Right Lab and Mainstay, and those were companies that leveraged AI for their solution. But this new generation of AI is a step function different. It's very different than the innovations that have come before. So I think of generative AI as this like umbrella term, really, for this sort of groundbreaking form of new creative AI that can produce original content on demand. So it's not just analyzing or classifying or categorizing data, but it can use the patterns in these large language models and existing data to create entirely new content. And that's what's so different and groundbreaking about it.

Dan Meyer: (09:31)

And as that intersects with education, why are people looking to this sector of education in particular, saying, "Ah!" Like, people aren't thinking that AI will disrupt every sector in the same way, but it feels like there's a lot of attention on education as a possible place where AI can go in—

Jennifer Carolan : (09:47)

Yes.

Dan Meyer: (09:47)

—and go wild with it. So what is so impressive about these models that has people thinking, "Ooh, education."

Jennifer Carolan : (09:55)

Yes. That's a great question, because the venture capitalists and those sort of in this space are really identifying education as one of the first sectors that it will dramatically change. And I believe it's because at the core of education, it's about communication and learning and content. And there is a belief that AI can sort of dramatically change the way that content is delivered or transmitted between humans. And it's also something that every person on the planet experiences. Education in some form. So it's seen as a huge market. It's seen as something that is content-driven. And anything that's large-market, that has content, I think that people think that this type of technology can disrupt.

Dan Meyer: (10:47)

Right? So the person who, you know, fixes my toilet or runs my electricity or whatever, that's not a content-delivery kind of field. We aren't thinking about applications there quite as much. Education is a lot of things, obviously, but one thing it does do is try to reproduce ideas from one generation to the next, often through what feels like content delivery.

Jennifer Carolan : (11:09)

Yes.

Dan Meyer: (11:09)

There's some, like ... "I'm gonna say some things and hope you learn them!" So can you just paint a little more of a picture, would you, about what things like ChatGPT, what these Gen AI models ... like, what does it look like? What does content delivery look like, when it runs through one of these new tools that has people thinking, "Ooh, content delivery and education! We should try that here!"

Jennifer Carolan : (11:31)

So, there's lots of different ways that this content gets transmitted to students or between students. And there is the classroom, there is group work, there's just all different pedagogical approaches to teaching and learning. The tech sector has been very ... I would say almost obsessed, in some ways, with this

concept of personalizing learning: You know, this belief that this one-size-fits-all education is not good for kids or can be improved through personalization. And you saw that kind of pendulum swing in 2000s where, you know, some of these classrooms looked like call centers, where you had kids in cubicles—

Dan Meyer: (12:17)

Yes.

Jennifer Carolan : (12:17)

—that were learning online, by themselves. And I think that this latest technology, people are excited about in some ways because you can improve that personalized process of learning, where, you know, in a classroom, a teacher sometimes is gonna have individual learning time. They're going to do one-on-one teaching. There's tutoring that happens. And there's this belief that ChatGPT and other forms of generative AI can mimic the skills of the teacher in a lot of ways and transmit that knowledge, maybe even better and more precisely than a teacher could. So I dunno if listeners have heard, have used Khanmigo or some of the other AI tutors that are out there now, but they're getting quite good and impressive in a lot of ways. But I think that's one of the ways that the tech sector is very excited about this, is that, hey, this can really personalize learning in a way that is automated. It doesn't require much work from the teacher, and can kind of target each student's zone of proximal development very precisely.

Dan Meyer: (13:28)

I think that Khanmigo ... I liked a lot how it felt so oriented around my assets as a learner when I was playing with it, in ways that previous tools have not.

Jennifer Carolan : (13:35)

Yes!

Dan Meyer: (13:36)

Where previous tools would be like, "Hey, you got this wrong. Do you want to watch me do it for you?" And then you can do a different one. That sort of thing. Khanmigo, I would get it wrong — intentionally, I should just add for the listeners' sake here — and it would tell me like, "Oh, what you might have been thinking was this." Which to me felt much more like a knowledgeable human instructor. It was pretty

interesting to me. I guess I'm wondering then ... you've been on record with a really persuasive essay, I thought, that we'll put in the show notes, that AI may disrupt teaching, but not replace teachers. And so, could you reflect a bit for us on where you see the power of AI and the power of teachers? Like, where the power of AI stops? What is the difference there between the best AI-generated teacher we could imagine here and what a human teacher does?

Jennifer Carolan : (14:28)

Yeah. I should start by saying that AI, the pace at which AI is evolving and improving, is wild. And like nothing I've seen before. It's really improving rapidly. This weekend I was at the Berkeley AI hackathon and it was 1500 hackers from around the US, and I think that almost 25% of them were working on education products, education tools. And it was just remarkable, some of the things I saw. So I think it's very exciting. First, just that we'll start there, that the pace of change and the evolution is happening at such a rapid clip that it's hard to say where things are gonna be in five years. But that said, you know, I'm a believer that learning is inherently social and that there are these sort of biological realities of us as human beings that technology really isn't gonna change. And that things about us that really enhance the quality of our communication and our ability to teach. And so there's obvious things like body language and tone and eye gaze, and then there's other less obvious things like the kind of cadence and rhythm of a conversation and language that can be lost in computer-driven interaction. And so I worry sometimes that all of this excitement and this innovation in this building, in this space, sometimes disregards the things about us that make us uniquely human. And we know that learning and the teaching component here — there's a social piece to it. And you know, the piece I wrote really wasn't a warning, but it was, it was more of a message, that, hey, let's not forget that we are human, and there's parts of us as human beings that we need to integrate into this process as we think about these AI tools. And so I also really think about who's creating these tools. And are they hiring the people that are specialists, with an understanding of developmental stages of life, and how vulnerable teenagers are? And as we go through different stages, making sure that technology is responsive to that development.

Dan Meyer: (16:57)

You outlined a bunch of research in your piece, illustrating the importance of social engagement and social processes on learning, which I found really persuasive. And I don't want to generalize much about the kinds of people that are building these tools ... but I do wonder sometimes if they are representative of students more broadly. You know, some of the engineers that I know, who are extremely talented, I

think that they have less of an interest — some of them! not all! but some of them! —in some of the social processes of learning. In many cases, they were far smarter than their classmates. Felt limited by classmates. Smarter than their teachers, et cetera. And I do wonder what that does to the ecosystem of tools that is emerging. And whether it'll have an actual impact on the majority of students here.

Jennifer Carolan : (17:43)

Absolutely. Why it's so important for these builders to create diverse teams and to bring in people that are not like them, and people with different backgrounds and specializations. Yeah. It's something that's very important to me.

Dan Meyer: (17:58)

And get into a classroom! I mean, it's not the easiest thing, but it's not the hardest thing. And I just find ... part of my work right now at Amplify is, I have swivels out there in the world with six classes piping in video all the time. 'Cause we have a huge company with people who are doing important work in education and have not themselves been classroom teachers.

Jennifer Carolan : (18:15)

Yes.

Dan Meyer: (18:15)

Which is not a prerequisite for doing important and good work! But I'm just finding that dropping in a two-minute clip of great teaching from Amanda Roush in Chicago Public Schools, or Jen Izmendi in San Diego just helps to expand people's horizons for like, "Oh, this chatbot that I am building to approximate teacher interaction from the front of the room does not account for the ways that the teacher, like, stands there for a longer second than natural, and raises an eyebrow, and the kid auto-corrects their response!" It's tough. I don't know, I'm curious how you ... you mentioned two days a week you are kind of doing business development for your portfolio companies. Are there ways that you help them understand like, "Ahhh, that's not really how this works"?

Jennifer Carolan : (18:58)

Yeah. This is a pet peeve of mine. Because I don't understand why, in sectors outside of education, why there is a focus on the customers, and that customer experience. Intuit, for example, their team, they're



encouraged to go in the homes of their software users and to watch them use it. And they have this process called Customer Journeys. And I sometimes feel that in the ed tech sector education, they don't appreciate that experience of teachers, and what's going on in the classroom. And it's strange. Very few companies in the sector are prioritizing that, and getting into the classroom and really elevate the work of the teacher, and see it as highly technical and challenging. And in our role at Reach, we really encourage that push that at the board level. And really try to get them to set goals around that, and to inculcate their company with those types of values, where they are as focused on the customer — which is often the teacher — as other companies are in other sectors.

Dan Meyer: (20:13)

That's great to hear. Yeah, certainly not knowing your customer, in education, has not been an impediment to a successful company. Like, there's companies that have done lousy — what we consider lousy — work, that manage to be successful. But I'm looking at this just huge space, that you're seeing emerging around education. I feel a sense of almost resignation, where I don't feel like I need to throw myself on the tracks to stop some of these efforts; they're just not gonna be successful.

Jennifer Carolan : (20:41)

Exactly.

Dan Meyer: (20:41)

Like, they don't account for the ecology of a classroom. And I'm just like, "Well, I mean, you know, take Jennifer Jennifer's advice or don't. But it's not gonna work otherwise."

Jennifer Carolan : (20:50)

Yeah.

Dan Meyer: (20:51)

So I would love to know: what are you excited about, in terms of AI? You've mentioned what you think AI won't replace about teachers — a lot of the social interaction, for instance. What are some applications that you see as exciting, from, perhaps, companies that you've invested in?

Jennifer Carolan : (21:06)

So I do think that we have been on this journey for many decades of specialization of the teacher's role. We used to call it the milk-money problem, where, you know, when teachers were teaching 50 years ago, they sort of did an entire range of — they still do, but they were collecting the milk money. They were doing everything that you can imagine in the classroom. You know, soup to nuts. And now we have increasingly — it's very slowly happening, but specializing the job of the teacher while at the same time piling a lot of stuff on the teacher's plate, too. So I think that some of these tools that's already happening clearly are starting to automate certain parts of the teacher's job. So we are seeing a lot of essay-grading tools, a lot of writing — writing, grading. And I think that in a few years ... and they're quite good. I think that teachers will work in partnership with these tools to automate some of the grading. We're seeing a lot in — for your listeners, the math. Starting to see a lot of ... math has been behind English, in terms of the grading. Because it's just more challenging, 'cause of the computational language. But I saw a lot of those, actually, this weekend. And starting to see more and more products in that space that are really doing a good job of using computer vision to parse the math equations, and not just tell them the right answer, but sort of do what Khanmigo is doing, where they're pulling apart "Oh, this is where you went wrong in this problem. This is perhaps why. And this is how you can consider these different solutions." So I think that a lot of the tools that I'm seeing now are addressing different parts of the teaching-planning process. So lesson planning takes eight to nine hours per week for teachers; I think that we're gonna have a lot of tools that are going to be supporting the planning process and making that easier for teachers. So that's the part that I'm very focused on right now.

Dan Meyer: (23:13)

Yeah, that's great. I like the idea of the human in the loop, as they call it, where these tools will offer some suggestions and the teacher does that last mile of like passing it along through. Or the AI isn't directly interfacing with the student — just always feels a little bit better to me.

Jennifer Carolan : (23:28)

Yes.

Dan Meyer: (23:29)

Like, I'll make you a lesson plan and you can decide if this looks right and make some modifications for your context. That sounds great. And yeah, as a positive outcome here, I really dig the focus on, like, what is the unique value that a teacher offers?

Jennifer Carolan : (23:44)

Yes.

Dan Meyer: (23:45)

I guess I worry that the folks that are building at hackathons actually don't know. Like, they see the value that technology can offer, and they feel very confident there, but don't actually — because perhaps they haven't had as much of a need for it, or haven't experienced it directly — don't know what the value that a teacher offers to so many students in this world. The question I'd love to follow up with here, Jennifer, is: Out of these companies that come to you and say, "Hey, we've got the thing and we just need a little bit of money, and we got the thing," what kinds of pitches have not been exciting to you? Given your perspective on the value a teacher brings, and what a classroom is like? What kinds of ideas are you like, "Uhhh, I don't know about that."

Jennifer Carolan : (24:27)

To your earlier point about the unique value of a teacher, I do think that one of the unique values of a teacher that really hasn't shown up that much in a lot of the products I've looked at is the pedagogical content knowledge. And that's a term that most investors, most people, don't understand teachers do. But that's a very unique set of knowledge. It's a very unique skill set. And incredible teachers are highly skilled in how to teach a certain set of students at a certain level of understanding a new concept. And if investors would just understand that what even PCK is and how it's this unique skill set that's developed over time and how we are trained in it, I really do think that that would improve a lot of the tools and materials out there. So that's something that I'm hoping that AI can free up teachers to focus more on, and to really think about that in their lesson planning. But stuff that's not interesting ... I'm seeing so many AI tutors that I ... not to say I'm not interested in AI tutors. OK? I'm eyes wide open, looking for great ones. But this kind of like this chat body thing with these AI teachers? There will be a use case for them and they will become ubiquitous. No question. I'm just not super-excited about that as the use case. Because I see the ways in which we are going to push forward education and knowledge. And, you know, human progress is going to come through social learning. And I keep coming back to that, because I think it's so powerful. And teachers understand that the unit of the classroom is being such a powerful unit there to be teaching within. For lots of different reasons. Collaboration, this kind of shared

understanding for the sort of microcosm of what we want the ideal society to look like. I know I'm getting lofty here, but —

Dan Meyer: (26:41)

Preach it.

Jennifer Carolan : (26:43)

These are things that teachers uniquely understand can be so powerful. And so I'm looking for tools for teachers, and products that can enhance that social experience, social learning experience. And, you know, we've certainly made progress over the last decades. And I think we continue to measure human wellbeing, how it has increased over time. And I think a lot about circles of empathy, and how we care for one another as fellow humans, and how technology can improve that experience. And you know, I wrote about this in my piece that I published, but thinking about one of the first technologies being the Gutenberg press, and how that allowed people to have an empathy for people outside of their villages, and I think that some of the new technologies can really increase empathy and can enhance this social learning piece.

Dan Meyer: (27:44)

Yeah, I love that. And I appreciate the word on the virtual tutors slash chatbots. They're interesting. It feels like they might become just a commodity, almost.

Jennifer Carolan : (27:53)

Exactly.

Dan Meyer: (27:53)

I don't know. In my thinking I've tried to imagine for myself like, what if they're perfect? Right now they kind of do some weird hallucinations. But let's just like, as you said, the developments are just so fast. Let's just assume that they're perfect. Like the best tutor you could want, available via a chat interface. And I ask myself, when would a student want to interact with that chat interface in the classes that I'm watching where students feel engaged and socially connected and are learning? And I just ... I have a hard time imagining a student wanting to say, "Hold on, I'm gonna check outta this conversation we're having and check it over here with my chatbot and ask a question and then come back to you." It's just,

it doesn't to me resonate a lot with the classes — it could be part personal preference, the classes that I love to be in or observe, for instance. One last question, then. So we have listeners who have never encountered OpenAI, ChatGPT, any of these tools, who might be for the first time hearing about these things. Like, I dunno, I have a brother-in-law in Silicon Valley who is a special educator and he is like, "No one's talking about this. No one's talking about this." So if you were to invite someone to experience what feels to you, us, magical about these tools, they go to one of these tools that's free — ChatGPT, I don't know what, and they type a thing in and they're like, "Oh wow. That is kind of magical." Do you have an invitation to our listeners for like what they might try, to just like get their hair blown back a little bit?

Jennifer Carolan : (29:24)

Well, yeah. It's a really good point. But to your brother-in-law, your brother-in-law's students are probably using AI. And looking at the data, AI is now I think the number two most widely used tool globally, for students, already. It's the fastest growing, zero to number two, I've ever seen before. So students are already using this tool. It's not just Silicon Valley kids. It's kids all over the world. And with any technology, the first time you use it can be this magical experience. I remember the first time I — now this is gonna date me again, too — but I remember I was worried about putting my credit card online the first time I made an online purchase. Like, that was a huge deal. Or the first time I used an Uber. So I would encourage to use ... what I have used it recently for is for like sightseeing or visiting a place. Like, if I'm going to Yosemite, like what are the top ... if I'm this type of visitor, if I like hiking, you know, you describe yourself and then you ask for what should you do in 24 hours or something like that. So a lot of people are using it for travel. And then when teaching, I am surprised at, like, you can ask, like, "Give me this lesson. Teach it to me using a Socratic method." And I'm surprised at how good the results are. I'm sure your listeners will find a lot of problems with that, with people that really understand it well. But just experimenting with these tools, it's delightful in some ways. Have you used it?

Dan Meyer: (31:05)

Yes. I came in as a skeptic. I was like, "I'm gonna type some stuff in and I'm gonna hate what happens." And I didn't hate it. And you know, for instance, like, "What's an engaging way to start a lesson on topic X, Y or Z?" I was pretty ... I would prefer as a teacher, as a curriculum developer, I have some conflict of interest here, but I would prefer to have an engaging and coherent experience for students across a year and not have to do that every day. I'll say that with some conflict. But if I am a teacher who has no

curriculum and is forced to make it up on the fly, what came out was definitely better than what my gut would've been as a year-one teacher. Far and away more interesting to students.

Jennifer Carolan : (31:47)

Oh, interesting.

Dan Meyer: (31:47)

So that was, pretty cool. Well, thank you so much for joining us. I know you're busy. And it's been extremely interesting to chat with you. And I'm always very grateful to know that someone like you, who knows what the term "pedagogical content knowledge" means, is someone who's influencing the direction of the ed tech our teachers and students experience. So thanks for joining us.

Jennifer Carolan : (32:07)

Oh, thank you, Dan. Always a pleasure to talk with you.

Dan Meyer: (32:12)

Well, thank you all so much for listening to my conversation with Jennifer Carolan, co-founder and partner at Reach Capital. We'll have a link in the show notes to her piece, "What AI Will Disrupt but Never Replace." I'd love to know what about this vision of the future sounds exciting, sounds scary. I definitely hope you folks felt from both Jennifer and me that your perspectives, your expertise, is something that is sorely lacking in so many conversations about technology and the future. To the peril of all these folks who are suggesting new products. So, your work and perspective is so valued by all of us. We'd love it if you made sure you were subscribed to Math Teacher Lounge, wherever you get podcasts. That way, you can get the next episode in our summer series, "Looking at the Intersection of AI and Math." If you've got comments or questions about AI, let us know in our Facebook discussion group, Math Teacher Lounge Community, or on Twitter @MTLShow. What resonated? What questions do you have? And we'd also love it if you rated us and left us a review, wherever you find podcasts. That will help more people find this podcast. And my own mother reads my reviews and is so excited to see good ones. So make Ma happy. Thanks again for listening, folks. Take care.