

6. Designing for equity in learning

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Understanding your learners

When I was in kindergarten I noticed that when the teacher would ask a question, children with their hands up wouldn't get asked to respond. The teacher had a tendency to pick children who didn't have their hands up to attempt the question. As a five-year-old, I figured out how to avoid embarrassment by raising my hand for every question, 'gaming the system' in a way. On the rare chance that I was picked to answer, I had a back-up plan. I would say 'I forgot' and escape through the laughter of the class. Reflecting on my schooling, Maths was always a subject where I gamed. With teacher-centred instructional approaches consistently used, the combination of possibly missing a key step, not understanding a procedure, not wanting to hold up the class, and not wanting to show that I didn't know something, meant I needed to game to get through each class. This was by pretending I was following along, nodding with agreement, and creative doodling penmanship.

However, it didn't necessarily have to be this way. Reflecting on my schooling I'm left wondering whether some of my teachers knew this about me and what they could have possibly done to help me see myself differently in order to get the best out of my schooling.

At the core of effective learning design is a deep understanding of students. It is crucial to recognise and address the unique experiences, needs, and identities of all students to foster their well-being and sense of belonging (OECD, 2023, p. 29). Embracing diversity is essential for creating an inclusive educational environment where every student feels recognised and valued. Learning designers and educators must acknowledge the significant impact of culture on learning and adapt their teaching methods to align with the sociocultural contexts and perspectives of ethnically diverse students (Gay, 2018, p. 52). By understanding these backgrounds, learning designers and educators can devise materials and methods that resonate with students, effectively bridging cultural and socio-economic divides. This approach aims to help students see themselves in what they learn, enhancing their sense of belonging.

In this chapter I'll introduce you to some inspirational educators based in the United States that I have had the pleasure of working with through a 21st Century Partnership for STEM Education project titled Mathematical Thinkers Like Me. The strategies and advice from these educators can be used by both learning designers and educators in the design of their learning. My first interview with Annie Fetter introduces you to

a simple yet powerful technique to start understanding your students – Notice and Wonder (Ray, 2013, pp. 42-55).

Interview with Annie Fetter

Annie Fetter is a Mathematics and Education specialist in the Philadelphia area. Annie has been a key figure in formalising the Notice and Wonder routine. This routine asks students what they notice about something and what they wonder about it. Student insights can be leveraged by the teacher to guide the discussion towards critical thinking and deeper understanding of the subject matter. This approach fosters a student-centred learning environment, where curiosity and inquiry drive the learning process. The routine is inclusive, allowing all students, regardless of their skill level, to participate and contribute. It also values all student observations and questions, which can boost confidence and encourage participation from students who might be hesitant to engage. The routine also provides teachers with insights into students' thinking processes, helping them to identify potential misconceptions and knowledge gaps, and ultimately, help them to understand students.

Designing Notice and Wonder

In 2011 at a National Council of Teachers of Mathematics (NCTM) Ignite Talk, Annie shared an anecdote to illustrate the Notice and Wonder routine. In the clip Annie describes an experience of sitting on an aeroplane next to a child and their father. Annie noticed the child continuously asking his father questions about what he saw out of the plane window, to which the father would reply directly. Annie intervened at one point while

the father was distracted by encouraging the child to think and express his thoughts on what he saw. This led to more original and personal insights from the child, and the child's father ultimately realising the impact of this approach. Annie recalls the father saying that the Notice and Wonder routine 'really made my son think'. When applied to teaching subjects such as maths, the technique demonstrates that even students who supposedly 'cannot do maths' can come up with insightful mathematical observations when encouraged to explore and think critically. Annie advocates for teachers to broadly adopt this technique, emphasising its ability to leverage what students notice and wonder, ultimately enhancing their learning and understanding.



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What issue does noticing and wondering address?

Annie: So school in general is not very great at nurturing and valuing students' ideas. And math is like the worst, right? It's like, you have to be able to replicate this set of things that somebody, white and male, figured out a while ago. And that's not entirely

true, but I think that's people's impression of it. And so what do we do to flip math around? How can you change math?

Imagine in English class, even if you don't like it, occasionally you're asked to write about something that comes from you, from within you. Like tell a story of what you did over summer. You're bringing 'you' to that classroom, and that matters, what you have to say matters. And in math class, that doesn't always happen. So the idea of starting off, particularly any scale of things, a unit, a lesson, a moment, by asking kids what they notice about something and what they wonder about it, that can really change how kids look forward to participating in that learning community.

What does Notice and Wonder look like in the classroom?

Annie: Let's assume that I'm going to ask kids to notice and wonder on paper for a few minutes because they're old enough to write things down, pick an age, say sixth grade. And then I might ask them to talk at their table and share what are three things you all noticed and three things you all

wondered that you would like to share with the group.

And then when they share those, I'm just gonna go around and ask every table, okay, table one, what's one thing you noticed? And I'm gonna write it on the board. Table two, what's one thing? So I'm assuming every table has things to share. Everyone has something to say, and I'm gonna go around once or twice, depending on the thing, and then say like, okay, does anyone have anything that we don't have up here that you think we should have.

But I'm also not reacting to any of their ideas, because I don't want to judge them. I don't want to be like, oh, Marissa, you're really awesome. And then go like, John, what have you got? And John's sitting there going like, I don't have anything awesome. I'm not going to say anything. So you just want to go like, oh, thank you. Inside you're going like, that is awesome, or that is not as much as I hoped for, but you don't, it's all like, take it in. And write down exactly what they said, because another thing we do in math is we the grownups, tend to reword things to make them mathier or more concise or more something, because we think that's important. And all that's telling the kid is that their ideas aren't good enough, and that I have to fix them so that we can move on. So don't do that. Write down exactly what they said, don't judge what they said.

If they say too much, you don't want to write it down, you say to them, could you say that shorter so

I can write it down? Put the onus on them to change their ideas. And then things that they wonder are really things that they wonder. But it's the same thing. Don't judge, write them down.

If kids say a wrong thing, you just write it down. It's not big, you know, everyone's worried that, oh, there's a wrong answer on the board. First off, there's research that shows it's not that important. And secondly, it'll probably police itself out by the end. Like someone will go like, well, I noticed this but I also noticed that that doesn't agree with the other thing that someone else noticed. Or someone will say, Oh, those two things don't agree. Or some kid will go like, can I change mine?

How does Notice and Wonder change teaching practice?

Annie: I'm working with a high school teacher this year. And then she watched that video of the kid on the plane. She says a thousand times, but I think she was exaggerating. And then she tried to notice and wonder with her kids. And what happened was her kids were amazing and it could have ended there, but what happened was it made her much more open to notice and wonder, as a teacher who used

to tell kids what to do and expect them to do it. And I suspect she was probably pretty decent at that, like a very traditional teacher model.

She became much more open to their ideas and ended up doing much more facilitating than telling, because she's like, the kids can do the work. And so she describes herself as now a completely different teacher. Just trying noticing and wondering was like the catalyst that moved her from here to there. You know, it's not the only thing, it's not the only change she made, but she made that change and then things snowballed from there. And she's like, I'm a completely different teacher. And she was, I don't know, a 10, 15 year teacher at that point. So that's a big shift for someone to make.

And I think just for kids to feel that they have ideas that someone's listening to, and for the teachers to elicit their ideas and start listening to them, and then getting better at hearing them, and valuing them, and then actually using them, that's a big change in a classroom. And I know a lot of people who say that it changed their careers. Like it saved their careers because of that shift in their room.

Thoughts on Notice and Wonder

Implementing the Notice and Wonder routine as a learning designer or educator involves several key steps that are straightforward to implement. First, identify the learning

objectives you aim to achieve through this approach. Next, select relevant content or topics and design observation prompts to stimulate students' curiosity and observation skills. Ensure your design of facilitated observation sessions also prompts students to articulate their questions and curiosities based on their observations, engage in discussions to explore connections and deepen understanding. The design of facilitated sessions should also provide guidance and feedback throughout the process, and include follow-up activities to extend learning. Building in reflective prompts for students to reflect on the effectiveness of the routine and encouragement for students to transfer their skills to other contexts may also be beneficial.

Some key benefits stood out from my chat with Annie on the Notice and Wonder routine. In particular, the routine serves as a pivotal tool in promoting engagement, critical thinking and deeper understanding in students. As Ray (2013, p. 55) notes, 'Learning depends on mulling, connecting, wondering, and repeatedly thinking about, and noticing and wondering enables this to take hold and blossom'. Consequently, I see potential for the broader application of the routine across domains outside of mathematics teaching. For designers and educators, this method also promotes inclusivity, as it allows for participation and contribution from all students. Each student's contributions can build towards a complete understanding of the problem (Ray, 2013, p. 55). Furthermore, this routine also helps to shift the role of educators from merely delivering information to actively promoting students' engagement with ideas (Ritchhart et al., 2011, p. 26), something learning designers also need to keep in the forefront of their practice. Thus, this technique is not just a teaching strategy for designers and educators to utilise, but a facilitator of a more engaging, thoughtful, and inclusive learning environment.

Being culturally responsive

Cultural responsiveness in education can be defined as the practice of 'using the cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant and effective to them' (Gay, 2018, p. 36). When reflecting on my schooling, there were what I would term tokenistic gestures to promote cultural responsiveness. Examples include celebrating annual events, such as International Day, where students could bring in and share food from a different culture. However, beyond these isolated events, school really did nothing to integrate cultural awareness into the everyday curriculum and address the deeper issues of inclusion, equity and respect for diverse cultures. The history, literature and perspectives taught in the classroom remained predominantly centred on the dominant culture, with little to no exploration of other worldviews, histories, or contributions of students from diverse cultural backgrounds. Growing up as a child of post-war migrants, I often felt out of place at school, feeling that I didn't truly belong there. This was true for me in maths, a subject commonly seen as culturally impartial and objective, which leads to questions about how teachers could broadly integrate culturally relevant teaching methods (Matthews, 2018).

In multicultural societies, classrooms can be seen as melting pots of diverse cultures, languages and experiences. This diversity isn't just a demographic fact; it's a valuable resource that can enrich learning for everyone. The cornerstone of capitalising on this diversity is cultural responsiveness, being able to design for learning experiences that 'teach to and through' the strengths of these students (Gay, 2018, p. 36). Instead of seeing cultural diversity as a hurdle, it's viewed as an asset that enriches education. This is crucial because students may face negative learning consequences if they feel

compelled to hide or downplay their identity, culture or language (Nieto & Bode, 2018, p. 135). This mindset shift has far-reaching effects on how teaching and learning take place. For learning designers and educators, this extends beyond merely recognising different cultures to actively integrating them into the curriculum, design of resources, activities, teaching methods and classroom practices.

The impact of this approach can be significant. Students who see their cultures and backgrounds represented in learning materials may experience a greater sense of belonging and validation. This can positively influence their engagement, participation and academic performance. However, achieving genuine cultural responsiveness involves more than surface-level changes. It requires ongoing self-reflection, professional development and collaboration with students and communities. As Hollie (2018, p. 18) emphasises, cultural responsiveness ‘begins with you and where you are in your heart and mind’. It involves questioning existing norms and being open to deep, transformative change within educational institutions. Additionally, it needs to acknowledge the inherent complexity of diverse learning environments, such as concepts like hybridity, recognising that students may identify with multiple identities beyond race and ethnicity (Nieto & Bode, 2018, p. 139), and Intersectionality, a way of understanding how different aspects of a person’s identity, such as race, gender and class, combine to create unique experiences of oppression and privilege (Zack, 2024). In essence, cultural responsiveness is not just a technique; it’s a philosophy. It embodies a steadfast belief in the value of each student’s cultural heritage, coupled with a commitment to ensuring that this value is acknowledged, celebrated and woven into the fabric of education.

My interview with Melynee Naegle introduces you to some innovative and practical approaches that help learning

designers and educators to provide a rich understanding of students, their culture and lives.

Interview with Melynee Naegele

Melynee Neagele is an accomplished middle-school maths teacher in Oklahoma. Melynee stands out for her dedication and inspirational teaching methods. Renowned for her commitment to education, Melynee utilises an extensive array of pedagogical tools to effectively engage and educate her students. Her approach to teaching is characterised by innovation and adaptability, allowing her to meet the diverse learning needs of her students. Melynee's passion for teaching and her ability to inspire young minds make her a remarkable educator, widely respected in her field for her contributions and the positive impact she has on her students. This part of the chapter unpacks just a few of Melynee's tools.



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Designing 4Hs of Belonging Centred Math Instruction

One tool that Melynee has in her pedagogical toolbox is the 4Hs of Belonging Centred Math Instruction: Home, Hobbies, Hopes and Heritage (4Hs), a heuristic and partner activity for

students (Matthews, 2018). The heuristic presents four key areas where students can find meaningful connections. This is delivered via an interest interview questionnaire. These questions encompass: 'Home', covering regular activities and the characteristics of their home environment, like cooking or family interactions; 'Hobbies', including personal activities done weekly, such as playing sports or using smartphone apps; 'Hopes', related to individual aspirations, interests, or goals, like career ambitions or financial management; and finally, 'Heritage', which connects students to their cultural traditions or communities, aimed to instill a sense of pride through elements like local heroes or historical figures in their community. The questionnaire is followed by a partner activity interest interview, which serves as a complementary tool to the 4H framework. These interviews utilise the collective 4H-related knowledge and experiences of the students in a class, guiding the development of lessons that are deeply connected to these 4H elements. Matthews (2018) also highlights establishing trust and showing a real interest in the students' lives as key factors that enhance the effectiveness and genuineness of 4Hs, and essential for integrating students' cultural perspectives into educational planning. With 4Hs, students are encouraged to express their views on their culture and interests from their own perspective, rather than relying on assumptions that might perpetuate stereotypes.

How do you introduce the 4Hs?

Melynee: During the meet-the-teacher night, I distributed the 4Hs questionnaire to parents,

though not every family returned it. I explained to parents that understanding their child's interests and experiences through the questionnaire would enable me to personalise and humanise the learning experience.

In class, I dedicate time to discussing the 4Hs with students, emphasising the relevance of math to their lives. We explore various methods for completing the questionnaire, including Google Slides, paper, or voice recordings.

After collecting their responses, I compile them into a list and align them with curriculum standards. This snapshot of my class's interests allows me to integrate relevant examples into my lesson planning, ensuring that math concepts resonate with students.

For instance, students interested in music can explore mathematical concepts like ratios and rates through musical notation. When planning lessons, I refer to this list to ensure that I incorporate students' interests into the curriculum.

During class discussions, I reference the information gathered from the 4Hs questionnaire to reinforce students' connections to the material. This intentional approach helps students see themselves in the math curriculum, fostering engagement and understanding.

Thoughts on the 4Hs of Belonging Centred Math Instruction

The 4Hs of Belonging Centred Math Instruction presents a valuable technique for both students and learning designers and educators, to enhance the educational experience through personal relevance and cultural integration. For students, this method offers a platform to express their individuality and connect their learning to personal aspects of their lives – Home, Hobbies, Hopes and Heritage. This connection not only makes learning more engaging but also aims to foster a deeper understanding and retention of mathematical concepts by relating them to familiar contexts. It empowers students by valuing their backgrounds and aspirations, which can be crucial for supporting self-esteem and motivation.

For learning designers and educators, the 4Hs technique provides invaluable insights into students' lives, facilitating the creation of more tailored and effective lesson plans. Dr Jamaal Matthews in his 2018 working paper, 'on mindset and practices for re-integrating "belonging" into mathematics instruction' (pp. 12-17), provides a clear and comprehensive justification and methodology for implementing the 4Hs. By understanding students' environments, interests, goals and cultural backgrounds, learning designers and educators can design and deliver lessons that are not only educational but also empathetic and inclusive. This approach aligns with culturally responsive pedagogy, grounded in four core pillars of practice – "teacher attitudes and expectations, cultural communication in the classroom, culturally diverse content in the curriculum and culturally congruent instructional strategies" (Gay, 2018, p. 53). Furthermore, the emphasis on building trust and genuine interest in students' lives strengthens the teacher-student relationship, creating a more positive and conducive learning environment. This technique, therefore, not only enhances

academic achievement but also contributes to a more inclusive, respectful and supportive classroom culture.

Ingenious Influencers

Melynee also promotes the concept of Ingenious Influencers in her classes. This involves introducing her students to famous, inspirational or influential individuals each day and a quote by that person. Promoting Ingenious Influencers in schools can offer significant educational and cultural benefits, contributing to a more inclusive and representative learning environment. This approach aligns with the broader objectives of multicultural education, as outlined by scholars like James A. Banks (2015), emphasising the importance of incorporating diverse cultural perspectives into the curriculum.

Can you walk us through your daily routine with your students?

Melynee: Absolutely. Every day, I start by introducing my students to inspirational figures such as Katherine Johnson and Ellen Ochoa, or individuals who resemble them and come from similar backgrounds. I find Dolly Parton to be particularly impactful. We discuss these role models and reflect on quotes that resonate with their dreams and aspirations.

What happens next?

Melynee: After our discussions, the students take the inspiration from these sessions and create vision boards. These boards serve as visual representations of their goals. They also write letters to themselves detailing how they plan to achieve these goals, which I then attach to the back of their boards. These letters are personal and confidential, serving as a commitment to their aspirations. At the midpoint of the year, we revisit their goals and progress. We discuss any obstacles they may have encountered and evaluate their achievements. I also check in on their well-being by revisiting what I call the 4Hs—asking if they have any additional questions or concerns.

What happens at the end of the year?

Melynee: Towards the end of the school year, we revisit their vision boards. They have the opportunity to update them based on their growth and experiences throughout the year. It's a cyclical process that fosters continuous reflection and growth.

It sounds like a comprehensive approach. How do you view the significance of each component?

Melynee: Each piece, from the introductions to the vision boards and goal-setting exercises, plays a crucial role in empowering my students and nurturing their aspiration.

How do you use Ingenious Influencers?

Melynee: In my classroom, I have a dedicated space called 'Ingenious Influencers Like Me', where I feature a daily quote alongside an influential figure. For example, today's quote is 'Don't tell me the sky's the limit when there's footprints on the moon', paired with Ellen Ochoa. I make sure to highlight her achievements, such as being one of the first Hispanic women in space and her induction into the Astronaut Hall of Fame.

After presenting the quote and the featured individual, I engage the students by asking them what they notice and wonder about our Ingenious Influencer and the accompanying mindset lesson. I encourage them to reflect on how these stories and

individuals can aid them in their goal-setting endeavours. This approach serves as a coaching tool, guiding them towards developing a growth mindset.

Similarly, during math class, I incorporate a daily quote and an Ingenious Influencer as part of our warm-up routine. I then facilitate discussions on how these individuals' accomplishments can inspire and assist the students in achieving their own goals.

By consistently incorporating these elements into our daily routine, I aim to instill a mindset of growth and possibility in my students. The expansive nature of my approach, which includes both daily quotes and overarching life principles, ensures that students are exposed to a variety of inspirational messages and themes. Following each presentation, I prompt students to reflect on whether the featured individual serves as a window or a mirror into their own lives, encouraging them to connect with those who resonate with their aspirations and values.

How do students relate to Ingenious Influencers?

Melynee: What I've observed is that when students hear the stories of these influential figures, it often

prompts them to share their own experiences. They'll say things like, 'Oh yeah, she did this and that, which reminds me of something similar I've gone through'. I make a conscious effort to select figures who have relatable backgrounds or experiences to my students, which encourages them to engage with one another and recognise commonalities.

I tailor the selection of these Ingenious Influencers based on the 4Hs, their Home, Hobbies, Hopes and Heritage. As the school year progresses, each student is likely to find connections with the individuals highlighted each day. This ongoing process fosters a sense of connection and community within the classroom as students recognise aspects of themselves in the stories of these remarkable individuals.

Thoughts on Ingenious Influencers

For learning designers and educators, designing experiences that expose students to a diverse range of cultures and perspectives in the educational setting is crucial for fostering cultural competence among all students. A key obstacle to culturally responsive teaching is 'mainstream ethnocentrism and hegemony' (Gay, 2018, p. 282), a tool that Ingenious Influences directly challenges. Beyond merely being an educational strategy, the promotion of Ingenious Influencers and diverse cultural representatives in educational settings

plays a pivotal role in advancing social equity and encouraging cultural pluralism. It helps in dismantling stereotypes, broadening students' understanding and appreciation for different cultures, and preparing them to participate in a multicultural society with respect and empathy. This approach also aligns with educational goals of inclusivity, ensuring that students from various backgrounds see their cultures and histories reflected and valued in their learning environment. By integrating a wide array of cultural perspectives into curricula, educational environments not only enrich the learning experience but also contribute to a more equitable and culturally diverse society.

Designing collaborative maths

Reflecting on my experiences in mathematics classes, the concept of collaboration is notably absent. Typically, these classes were structured around individual tasks, with a strong emphasis on personal understanding and performance. For me, maths instruction often followed a traditional teacher-centred instructional approach, where students listened to explanations, took notes, and then worked through problems independently. This format left little room for collaborative learning, where students could actively engage with each other to solve problems, share diverse perspectives, or develop collective strategies. The focus was primarily on individual comprehension and skill mastery, assessed through solo homework assignments and tests. While this approach can aid in developing personal responsibility and individual problem-solving skills, it misses the opportunity to harness the benefits of peer-to-peer learning and the rich, diverse insights that collaborative discussions of different ways of seeing problems can bring to mathematical understanding (Boaler, 2016, p. 59). The lack of collaboration in these settings didn't just limit the

social aspect of learning; it also potentially narrowed the scope of understanding, as it restricted the flow of ideas to a single source, typically the teacher or the textbook, rather than allowing for a more dynamic, interactive and multifaceted exploration of mathematical concepts. This can potentially prevent the establishment of a learning space where every student, irrespective of their background, has the opportunity to engage and contribute on an equal footing. While the lack of collaborative learning strategies may enhance educational disparities, Cohen & Lotan (2014, p. 23) note that if students are properly prepared, heterogeneous groups can allow students to use each other as resources, enabling exposure to challenging material and developing basic skills with peer support despite temporary skill gaps.

Virtual Math Teams (VMT)

Virtual Math Teams (VMT) is an online platform that represents a progressive approach in mathematics education, leveraging the power of digital technology to facilitate online collaborative problem solving and interactive learning experiences. Developed as part of a broader research initiative on technology-enhanced learning environments, VMT offers a platform where students engage in mathematical problem-solving and discourse in a virtual setting (Stahl, 2009). The platform enables the use of activities made with Desmos and Geogebra as its underlying workspace. A distinctive feature of the platform is an inherent focus on turn taking. This is promoted through a feature that allows only one participant to be in control of the workspace at a time, to perform actions such as manipulating interactives, or advancing and rewinding screens. Anonymisation is a configurable feature for designers and teachers within the platform. When activated, it allows students to work together anonymously, fostering an

environment where they might be more inclined to take risks and experiment with their problem-solving approaches. VMT allows students from diverse locations to collaborate via text chat or voice to text, bringing together varied perspectives and problem-solving strategies, thus enriching the learning process (Roschelle & Teasley, 1995). Turn taking in the platform is promoted by students taking or requesting control in the shared space. Designers, teachers and students also have the ability to replay VMT sessions to learn from student interaction and chat conversations in each session. The Mathematical thinkers like me (MLM) with Desmos Activities on Virtual Math Teams video introduces students experiences with the VMT platform.



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Interview with Richard Tchen

Richard Tchen is an Educational Program Developer based in Philadelphia. Richard has extensive experience co-designing with teachers in VMT and analysing student interactions within the platform. Both Richard and Annie Fetter make a point of trying to meet with students where possible to get their views on the platform and their input for improvements. They have also been active in collecting rich asynchronous exchanges and feedback from students via online Jamboards.

The importance of participation

Richard: One major takeaway from my perspective [is] the sense that participation is important. When it doesn't happen, it's painful and it makes the experience a struggle. The depth of that feeling was particularly impactful on me, really impressed me. And ironically, having interviewed easily between the two of us, Annie and I, having interviewed at least half of, I guess, half of the eighth grade there, everyone was convinced that, oh, we are participating fully.

Annie: It was also interesting that more of them, they were like, I think it's great, except when you're in the room with people who don't do anything. And it reminded me of these surveys, where they survey people of like, who's cheating on their spouse and who thinks their spouse is cheating and those numbers don't match up at all. It really seemed like they wanted to do math, they wanted to learn math, they wanted to have math conversations, they liked the environment, and they didn't want people to be lame. Worse off, they didn't want people to be jerks. So that was like when they spam the chat and all that. But I think there were two levels of you're a jerk, that's really not appropriate. And then you don't do anything. And it kind of almost made them sad, like, but wait, we're missing out on ideas and we want everyone to throw their ideas in so that we can think about stuff.

As a designer, what do you look for when replaying student VMT sessions?

Richard: There's such a rich range of activities and experiences. I guess it's affirming that there is no such thing as a typical chat or a typical replay experience, a typical kind of VMT experience. I will say when I go through them, I do rely a fair amount on chat and on the system messages about control, I like being able to see it in the context of what's happening in the interactive space.

So, you know, you can get a quick sort of overview about participation (in the VMT replayer). But I like to try to hear as much through the chat as I can about collaboration, about problem solving, and then texture that with observations from the VMT system messages about who's in control, how long they've been in control, how long it took for control to change when someone explicitly requested control or just made a suggestion, the unfulfilled proposition or something like that, you know, someone suggests an idea to the person who's in control and it never gets discussed and it never gets implemented.

So I try to look through and see who participated, when they were participating, how much they participated. And even before that, I actually make a point of looking at the roster list that the teacher has assigned for the specific room and reconcile that against who actually entered the room.

Because, as we know, the pandemic and the reality of many public school students' lives in the United States, especially at these Title 1 schools, it doesn't guarantee attendance, you know, and their teachers have to account for that. So I focus a lot on just basic attendance and speech and actions. And I will add that, or complicate the analysis by pointing out that some of my favourite moments have been entirely wordless. They may have not really materialised in chat, but they have consisted of students almost silently, it's like the educational collaborative equivalent of Adam Smith's hand in capitalism, where there was an idea that got passed from one person to another, but each person took a different interpretation on it or had a different insight into. And yet very few words were spoken in the chat, but control passed from one person to the next. And at the end of it, the chat became one of, okay, so which one are we going to go with? And the whole sequence was beautiful.

What advice would you share with learning designers?

Richard: I mean it's really humility. The more you design, the more you engineer, the more you're

serving the software as opposed to the opportunities for learning. There is, I mean, with executive functioning, there's a tremendous amount of educational benefit to inhibiting some of the affordances that you know you could bake into [the platform]. Sometimes less is so much more, especially when the more we want is more learning. Like there is a certain amount of lifting and pivoting and change that we want to elicit from students that too much technology will do for them. So it's about humility of what you can bring as a designer and humility about what you should assume about your students. And of course, humility about what brilliance they will have.

Thoughts on Virtual Math Teams (VMT)

VMT exemplifies a progressive educational platform where students engage in real-time collaboration to solve mathematical problems. This approach not only fosters learning through diverse group interactions, enhancing empathy and appreciation for different perspectives, but also aligns with the needs of a globally interconnected world (Johnson & Johnson, 2009). For me, a critical aspect of collaborative tools like VMT is the design of pedagogical sequencing and related considerations, both inside and outside the platform, to help promote inclusive and equitable learning. For example, working with students to develop

collaborative norms may help ensure that every student has an equal voice. As a learning designer or educator, one great feature of Virtual Math Teams is its support of existing Desmos and Geogebra activities. These may require some tweaking to ensure they work within the collaborative context of the VMT environment. For example, instructional prompts may need updating to promote discussion via the chat functionality.

Ensuring equitable access and engagement for all students is a consideration in the design of activities and resources before, during and after interaction with the platform. As a teacher, understanding when to intervene during online sessions is also vital, ensuring that guidance is provided while maintaining the collaborative integrity of the learning process. A fascinating aspect of VMT is the ability to replay sessions, learn from student interaction in the sessions, and iteratively improve their lessons. Such approaches in platforms like VMT not only enhance mathematical understanding but also ensure that all students, regardless of their background, have access to a rich, collaborative and equitable learning experience.

Final thoughts

This chapter introduces a few innovative pedagogical strategies: Notice and Wonder, 4Hs of Belonging Centred Math Instruction, Ingenious Influencers, and the collaborative online platform Virtual Math Teams (VMT). Collectively, these strategies and tools represent practical ways for learning designers and educators to help create inclusive and engaging educational environments. Notice and Wonder stands out as a versatile tool that encourages students to actively engage with their learning material, fostering critical thinking and curiosity. It shifts the focus from mere absorption of facts to a more interactive and reflective learning process. The 4Hs of

Belonging Centred Math Instruction, on the other hand, brings a personalised touch to learning by connecting class content to students' homes, hobbies, hopes and heritage, thus making learning more relevant, personal and engaging. Ingenious Influencers, by introducing students to diverse role models and thought-provoking quotes, not only broadens their horizons but also instills inspiration and relatability, contributing to a more culturally rich and motivating learning atmosphere. Lastly, VMT, as a platform for collaborative problem-solving, leverages digital technology to enhance mathematical understanding through interactive and cooperative learning experiences. Together, these approaches embody a holistic and progressive educational philosophy that not only enriches the student experience but also nurtures a more equitable, thoughtful and inclusive learning community.

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