RETHINKING STUDENT ENGAGEMENT

MIND
RESEARCH INSTITUTE

Contents

Introduction:
Wash, Rinse And Repeat

More than any learning paradigm, implementation strategy, or buzzword, student engagement is one of the Holy Grails of education. Our collective motto seems to be that if students are engaged, they'll learn better. Engagement is thought to be tied to sustained effort, intentional thinking, and active learning. Engagement becomes the ultimate goal of pretty much any learning strategy from voice and choice, active learning, hands on learning, project-based learning, personalized learning, etc. They are all strategies to improve learning through engagement.

In theory, all of these learning strategies are a new promised land that create never-before-seen educational realities. Yet the true reality is that they are dropped and replaced for something new and shiny every few years. They become buzzwords, turn into cliches, and are recycled into some new fancy thing that in turn does the same as its predecessors. Why is that? Have we ever asked ourselves if we are looking at student engagement in the right way?

In the following pages, we'll answer the question of why we're stuck, and offer a way to move forward in our thinking about student engagement. In doing so, we'll also examine why student engagement isn't exactly what we should be striving for, and what we should actually be focusing on in order for students to learn deeply and truly build conceptual understanding.

Chapter One:
Think Differently, Do Differently

What if the reason we are stuck in a cycle is because we aren't fundamentally rethinking mathematics education — and specifically student engagement? If we keep thinking the same way and only change our actions, we run in circles. We never get closer to the goal, so each new actionable attempt is equally far away from the heart of the matter...hence a literal run in circles. Or worse, an outward spiral away from our goal.

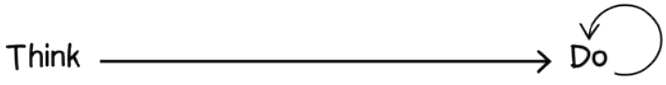
Just doing differently isn't enough. For actions alone, different doesn't automatically mean better. Many things are cyclical and yet feel new and innovative in the moment. How many songs are about a broken heart or love? These aren't new concepts, but we are convinced that each new artist takes a never before seen twist. In some ways, their jobs hinge on singing about well-established ideas in a way that convinces us it's brand new. Is this innovation or masterful recycling?

Recycling the well-established can be okay, of course. We all have songs we love to listen to over and over again. When it comes to education however, the question we need to ask ourselves is whether or not the well-established methods are truly working. If yes, we can recycle and improve them. If no, recycling may keep us in a pattern of beating around the bush.

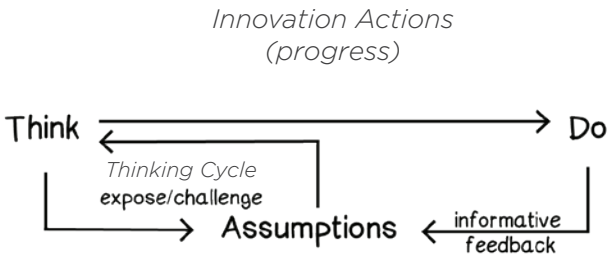
The data suggests that education isn't working at the depth and scale we need. We have a math crisis in the United States. The National Assessment of Educational Progress reports that as of 2017, only 40% of fourth grade students were proficient in math. For eighth grade, the number was 34%, and 12th grade students were even lower, at 25%.

We must break the cycle. Until we do, we are merely digging a deeper and deeper hole.

Recycled Actions
(hole)



To break the cycle, we must change our thinking. Our assumptions, our perspectives, our paradigms all determine our actions. Exposing and challenging assumptions is arguably the best way to create breakthroughs. If our "doing" isn't right, we must change our "thinking."



The real question is "How do we change our thinking"?

We could get lost in the weeds thinking and rethinking, and eventually fall victim to analysis paralysis, a thinking cycle that gets us in the same place our old doing cycle got us--nowhere new. Instead, we want to connect our thinking and doing.

Each action we take is a chance to learn by doing; it's an opportunity to learn what worked, what didn't, and most importantly, learn why. This requires that we test and gather informative feedback. It is crucial that we remove the guarantee of success. When taking this approach, our actions should bring assumptions to the forefront so that we reinform and challenge our thinking.

The Danger of History Repeating Itself

One of the biggest traps we fall into when challenging our thinking is that we don't go far enough. We often settle for refining an idea, which is not the same as fundamentally rethinking it. Refining says that the current solution is a good one, and improvements are worth our time. If we are only ever refining, we are saying that the status quo works if we could just do it a little better. This reinforces the status quo even more, which is dangerous in education.

When we don't challenge ourselves to truly think differently, we end up with products and proposed solutions that fail to deliver meaningful results. And because we all want the ideas and solutions we invest in to be successful, it's easy to fall into the "one good study" model when trying to convince ourselves that something works.

Look across the edtech landscape and you will see countless products that have a research study attached to them showing how effective the product is. These studies are often conducted with a few hundred students, in one school

or district. There are over 35 million K-8 students in the US (as of 2017). For a product or approach to show real impact, it must work reliably and on a much greater scale than one grade, one school or one district.

But reliable solutions at scale in education are very hard to find. Ones that work in mathematics are supremely hard to find. Heavy-hitting companies start new education "solutions" all the time and then close up shop in a few years. Why?

Perhaps it's because scaling an idea is hard so we give it our full effort. This can be a trap. We often jump right into scaling, but never get beyond an ineffective idea. Or, through scaling, we lose the idea's effectiveness. The worst thing we can do is scale before we have a solution to the problem and we know why it is effective. If we learn why it works, when we scale we keep the core innovations that made it worth scaling in the first place. If you are evaluating a curriculum or making a purchasing decision, remember that widespread doesn't mean effective. They may have scaled the wrong things or in the wrong way.

To counter this tendency, challenge your thinking and truly do something different. Since student engagement is top of mind with virtually all pedagogical strategies, let's start there.

The biggest assumption we make with student engagement is that we should be striving for it in the first place.

**If we are only ever refining,
we are saying that the status quo works
if we could just do it a little better.**

ADDITIONAL READING AND RESOURCES:

MIND Blog: Why You Need More Than "One Good Study" to Evaluate EdTech
National Assessment of Educational Progress: The Nation's Report Card
Book: Creativity, Inc. by Ed Catmull

Chapter Two:
Why Engagement Isn't The Goal

Engage, (v.) \inˈgāj\:	Engaged (adj.), \inˈgājd\:	Engagement, (n.) \inˈgājmənt\:
to hold the attention of; to provide occupation for	Involved in activity	the act of engaging; the state of being engaged

Source: Merriam-Webster

Why Is Student Engagement Not The Goal?

Many of us have grand theories of what student engagement is in our minds, but in practice we tend to lump it into one of two boxes.

BOX 1	BOX 2
Students are occupied and not having behavioral problems.	Students are excited (regardless of what about).

Based on the definition of "engaged" above, these two boxes actually make sense. To be engaged means to be busy or occupied. To engage someone is to attract them to something. But at best, that is a first step. For deep learning, we need to do more than engage a student to a concept.

And yet, we see ourselves settling for one of the two boxes time and again. Just think about substitute teacher plans. They often include work designed primarily to keep students occupied, especially at higher grade levels. Students are busy doing something, but that doesn't mean they are productive learners. Engagement can be superficial.

We don't want students conforming to classroom norms, but wasting time. We don't want to have tangential flash and flare and risk suggesting that "Math is fun when I'm not working that hard."

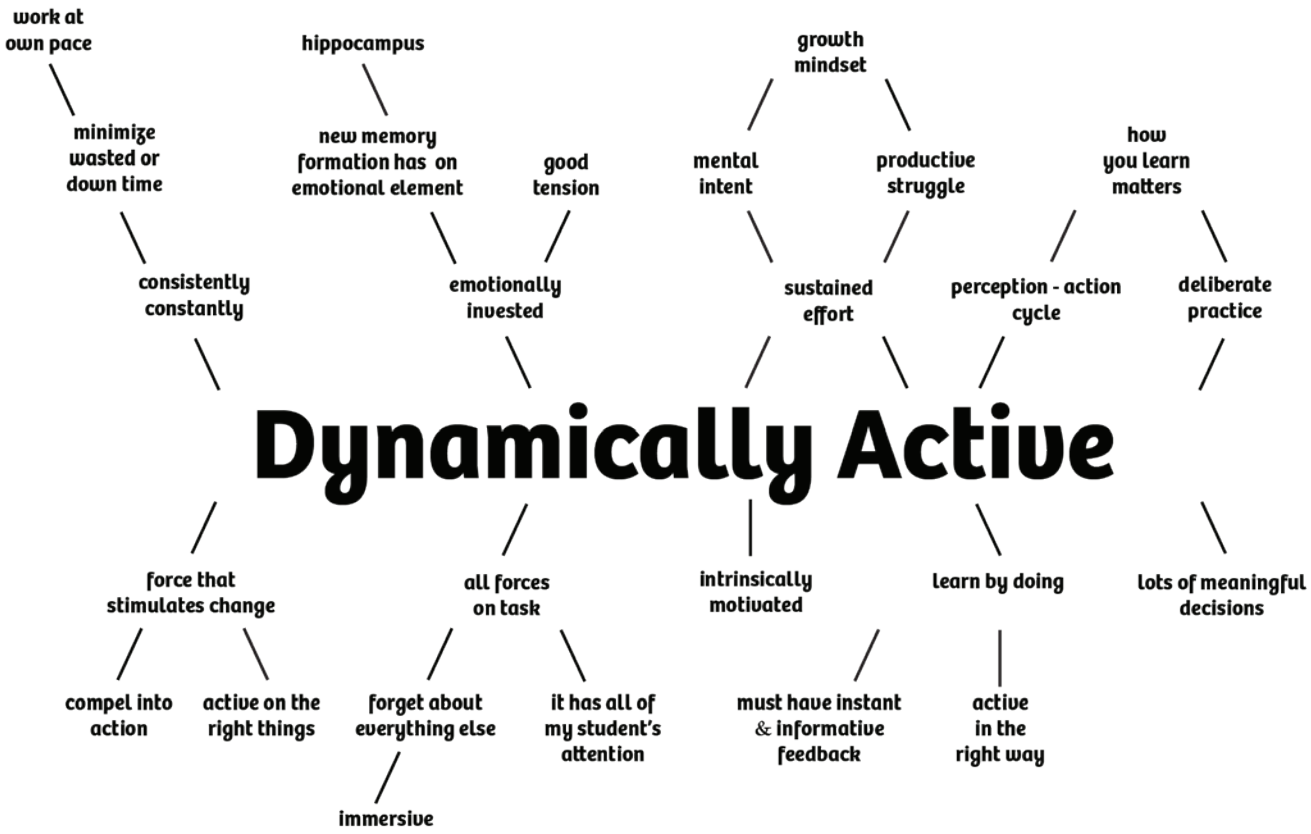
Yet so much content and virtually all experiences that are designed to captivate our students fall into either box. What we want to happen and what we make happen aren't lining up. It's time we think differently. We have plenty of innovative rhetoric, but not nearly enough strong innovative action.

Engagement can be superficial.

We Want Students To Be Dynamically Active With The Learning At Hand

We want them not just engaged to the concept — we want to motivate them through the learning, while challenging them at a deep level. Learning takes time. Learning is challenging. You can't cram deep understanding. There are no shortcuts. This means we need perseverance. Preoccupied is not the same as persevering. Being excited at the beginning doesn't imply that perseverance will follow. In fact, initial flare can sometimes work against persevering.

We don't want students engaged. We want students dynamically active.



ADDITIONAL READING AND RESOURCES :

MIND Blog: What Are Schemas?

MIND Blog: What the Perception-Action Cycle Tells us About How the Brain Learns

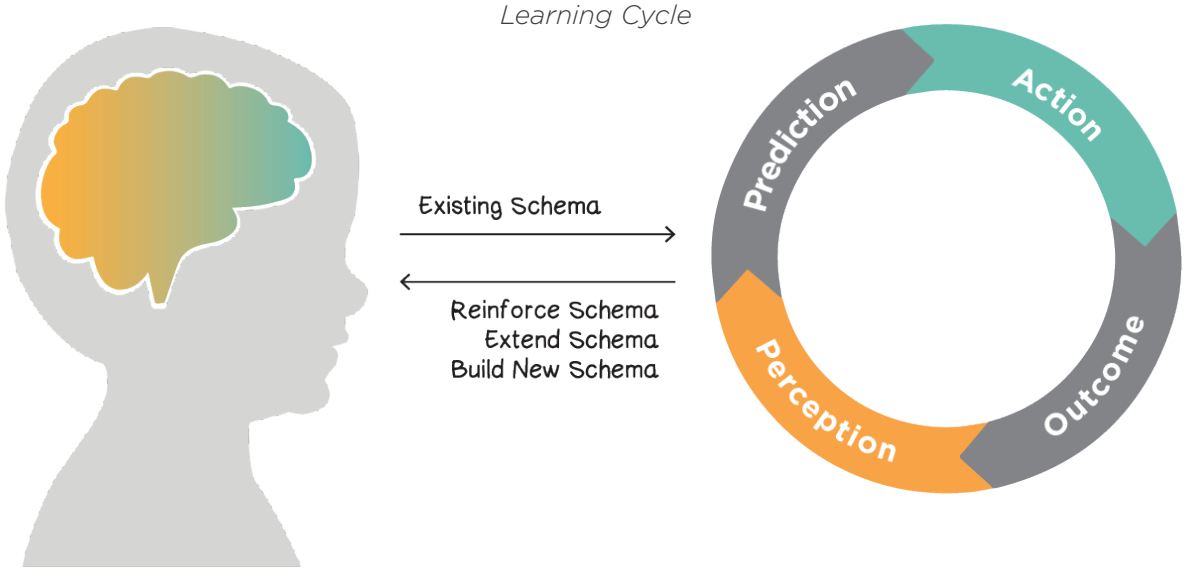
Inside Our MIND Podcast: GDC and Meaningful Student Engagement

Chapter Three: Moving From "Student Engagement" To "Dynamically Active"

Dynamically active moves beyond being preoccupied or having an initial attraction, and burrows into deep learning through meaningful tasks that don't just hook students in, but keep them there. It is important to constantly improve our ability to strip away barriers, get to the heart of the matter as quickly as possible and stay there as long as possible.

Dynamically active requires that we are consistently active in the right ways and on the right things. This means that we're creating lots of meaningful decisions that are targeted directly towards the matter at hand. For these decisions to matter we need to fail early, fail often, and keep at it. This requires instant, informative feedback.

Learning Cycle



This approach to learning is founded in our current understanding of the brain, and the perception-action cycle of learning. A majority of our brain is devoted to building a sophisticated level of mastery and fluency of any task — walking, tying our shoes, driving, reading, adding fractions, etc. Building these neural pathways to automaticity requires all of the above. Learning requires being dynamically active.

This lense shifts our understanding of classroom learning. A lecture, for example, can be highly engaging but struggles to dynamically activate the students. After all, the teacher is the most active person in a lecture. If a student isn't highly active, they are not dynamically active. A conversation, however, can be very dynamically active. Many of us have had

conversations in which we are emotionally invested, immersed in the conversation, challenge one another, etc. This is why academic discourse is so powerful (when done right). It can be an all-consuming experience in which we provide real-time and informative feedback to one another. A lecture can be engaging, but a conversation can be dynamically active. Academic discourse warrants its own separate discussion, so to stay on task it suffices to say that not all conversations are created equal.

Another danger of stopping at engagement is the trap of deceptive clarity. Deceptive clarity happens when you feel a clarity of understanding, but you've been duped. You were deceived by thinking you really understood it, and as soon as the moment is over, so is your understanding. A highly engaging lecture is often subject to deceptive clarity. Videos are notorious for deceptive clarity.

This is in part why video-based instructional tools, no matter how engaging, struggle to yield true learning results at scale. If a student doesn't understand the concept, all they can do is rewind and hear the exact same thing again. If they do understand in the moment, they may have trouble carrying that understanding forward due to deceptive clarity.

Being dynamically active doesn't allow us to stop at engagement. Dynamically active also needs to motivate us through learning by turning a frustration into a thirst for challenge. It's not that engaging is bad, it's just that we have to go beyond it.

Dynamically active is (1) sustained effort by being (2) active on the right things, and (3) in the right ways.
We can apply the lens of dynamically active to learning environment, by asking 3 questions.

ADDITIONAL READING AND RESOURCES :

MIND Blog: The Four Neural Subsystems of Deeper Learning
How Rich Is Your Classroom Discourse? by Jelani Jabari (Association for Middle Level Education)

Chapter Four: Using The Dynamically Active Lens

In the Classroom

We can use the "Dynamically Active Lens" to analyze any piece of content for any subject. Whether creating your own content or reviewing existing experiences, start by asking these three questions:

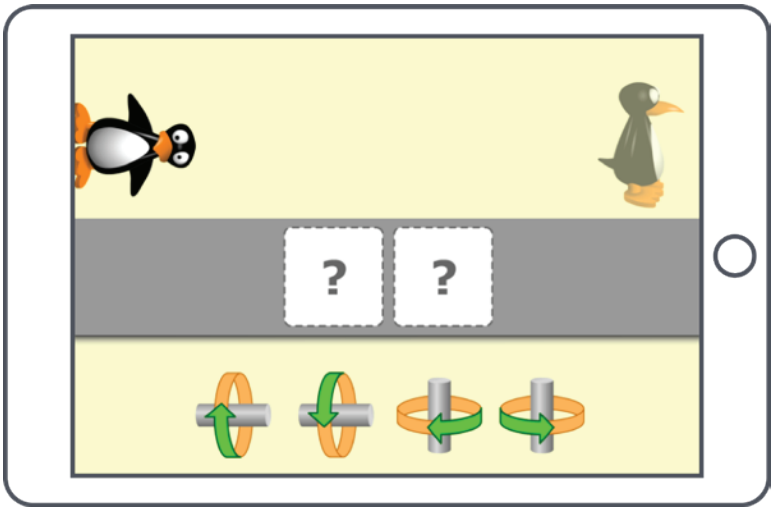
1. **What are my students doing?**:
    a. A lecture means that the teacher is doing all the work.
    b. A video means the narrator and producer are doing all the work.
    c. Reading a textbook isn't strong enough to be learning by doing.
        i. Barriers to learning take away the students' ability to learn by doing.
        ii. In textbooks, language is an especially strong barrier.
2. **How many meaningful decisions are my students making?**
    a. A "color-me-in" worksheet means students stop making meaningful decisions so they can color inside the lines.
    b. A textbook or lecture means students are not making many (or any) decisions at all.
3. **What kind of feedback are my students getting and when?**
    a. Reading a textbook or watching a video has no feedback
    b. Right/wrong doesn't help students know why. It's not informative.
        i. Feedback should help us fail differently next time.
    c. Submitting feedback on homework or an exam that is delayed by a few days is too far away. It's not immediate.
        i. Feedback should be in the moment of learning.
    d. Only interacting with students via grades means failure always has demerits. We must celebrate early failure.
        i. Feedback should empower, not punish.

By asking these three questions, we remove the guarantee of success. Not all content is effective. Not all content is worth our students' time, especially not our limited classroom time. By setting the bar for success higher, we begin drilling down to what is really effective.

Our biggest problem in math education isn't about classroom management, seating arrangements, or lecture tools. Our fundamental problem is a severe lack of content that dynamically activates our students. If, and only if, we have dynamically active content do these strategies start to matter. Until we get the content right, all other attempts drastically miss the mark. Engaging with ineffective content is quite possibly worse that not engaging at all.

Creating dynamically active content is very difficult, but necessary. At MIND, we focus on putting our research and approach to learning into creating breakthroughs in math education. We believe that if you solve the math problem, other subjects will follow.

Our software ST Math is designed to dynamically activate students in developing a deep level of understanding of mathematics. As an example, let's take one snippet of a game from ST Math, and run it through our "Dynamically Active Lens" questions. This particular game highlights creative problem solving:



What are the students doing?

There are no rules or instructions, so students aren't reading a book or watching a video telling them the algorithmic recipe to get the answer right. They have to take on a new challenge and make decisions on how to rotate JiJi, our main character in ST Math.

What do you see? At the top left, we see JiJi the penguin standing sideways, facing us. On the other side of the screen, we see JiJi facing forward, ready to move onto the next challenge. As we look below, we see there are two boxes with question marks.The bottom section shows us four possible 3D rotations of JiJi.

From the visual information laid out before us, we can deduce that we need to get JiJi from the position on the left, to the position on the right. We can change JiJi's position twice in order to accomplish our goal, and we have 90° rotations to apply.

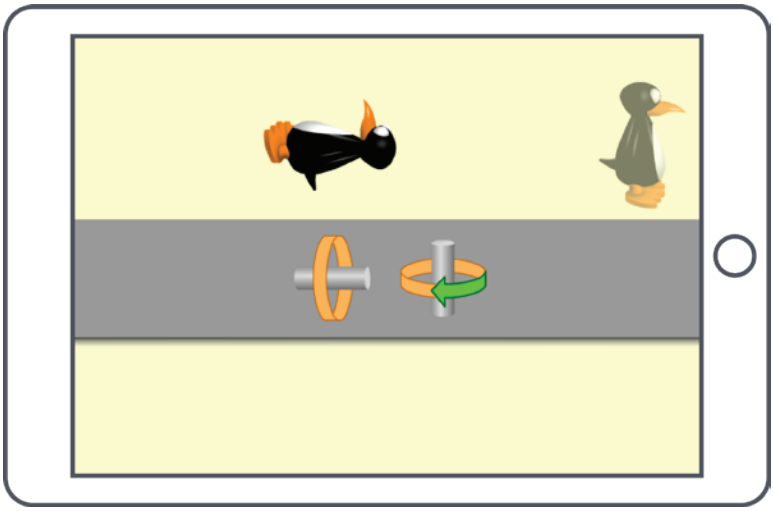
What are students doing? They are deciding the sequence of 3D rotations JiJi should undergo. The only way to complete the task is to do it for themselves. The students do all the work for themselves.

How many meaningful decisions are the students making?

Students have to choose what direction they will move JiJi in first, and think through where that will leave JiJi (this spatial-temporal reasoning is the "ST" in ST Math). Then they choose the next way to move JiJi which will put them in the right position to move forward. They are constantly making decisions about the result of various 3D rotations, visualizing the outcome in their mind and choosing which rotation to apply next.

These are incredibly deep reasoning skills and require complete focus. Students aren't picking colors for JiJi or wasting their time on other non-learning decisions. Their effort is completely devoted to the task at hand.

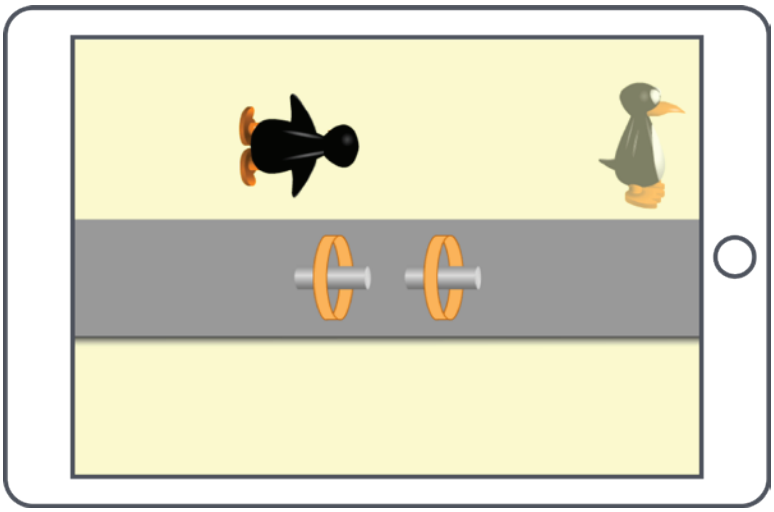
Not only are the decisions meaningful, when playing multiple puzzles of this form, you quickly see that students make orders of magnitude more decisions, and at a deeper level of thinking, compared to a worksheet or video or lecture.



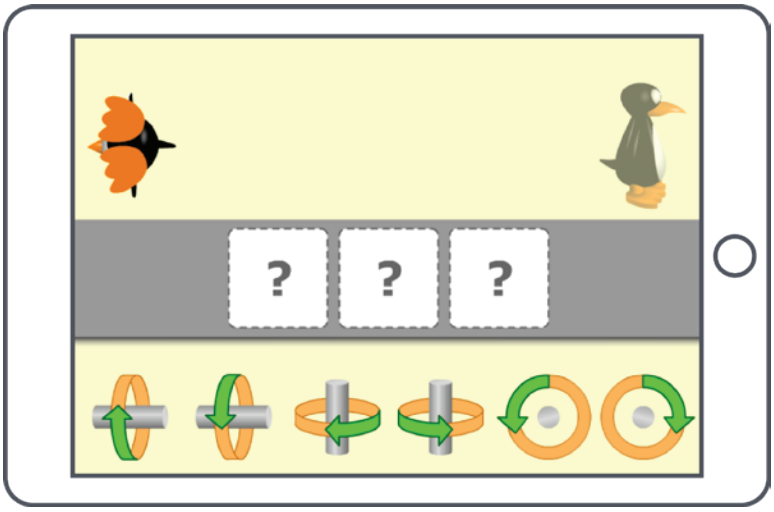
What kind of feedback are the students getting, and when?

Once students enter their movement choices, they get immediate visual feedback, as the movements play out before their eyes. The feedback isn't a static right or wrong with a hint. The consequences of their choices play out in real time. JiJi is repositioned twice, and students see exactly how JiJi changes position with each move.

If the end result is that JiJi is not upright and ready to move on, JiJi travels back to the original position. The feedback helps you see why you were right or wrong, and either prove that you are developing and understanding or help you fail differently next time. Right or wrong, students have a chance to literally see why.



The game we just used as an example is one in a series that builds a deep conceptual understanding as students move from very simple, to more complex puzzles. You can see in the example below, we have more movements to make, and more options to choose from.



This is just a snapshot of how ST Math creates a dynamically active experience for the students. But we can apply the same questions when designing experiences outside of mathematics, and outside of the classroom altogether.

PLAY THIS GAME AND MORE ON STMATH.COM

Beyond the Classroom

We can apply this same analysis outside the confines of a typical classroom lesson. For example, we could use this lens when looking at family engagement events. Many of us are thrilled just to get parents in the door of our schools. But are those parents really present?

Are students walking around a station model while their parents hang back, or worse, are parents focused on their cell phones? We can get stuck in the pattern of running a station model for family math nights because it's "engaging and gets parents to show up." But just like the classroom, we have to set the bar higher, so that success means something.

Apply the three "Dynamically Active Lens" questions and ask yourself-- **does your family night dynamically activate our parents?**

If adults are on their phones, the answer is an heart-wrenching "no." Unfortunately, this is an all too common sight at family engagement events—especially math or STEM nights.

Just as with students, merely engaging parents is not enough. We don't just need parents physically in the door; we need them as mentors and role models for their children and our students.

Why? Because parents' attitudes toward math affect their children. A growing amount of research suggests that the level of parental anxiety around math matters more than a parents' content knowledge of mathematics. In some findings, parents' content knowledge has zero correlation, but parents that are highly anxious around math correlate with decreased student performance. As parents, our relationship with math matters a great deal. Showing up to a STEM night is a superficial metric for measuring impact. Once we get adults through the door, we need to get them dynamically active, as well.

One of the ways we are doing this at MIND is through the family-facing content and experiences we create. Our Math Fair featured physical representations of some of our ST Math games for children and families to explore. A brand new series of games we've created focuses on the compelling ways math infuses with the human experience through games and stories in a way that anyone can play and there is no facilitation necessary. We've tested and iterated on these games, with around 2,000 families at over 30 different schools nationwide.

We've taken the games and experiences mentioned above into Family Math Nights with 200+ children and adults. And on the rare occasion a cell phone comes out during these events, it's usually to take a picture of what's happening. Adults and children are engaged together on a level playing field. Not only is the experience fun, it increases mathematical rigor in a way that engaging-only content simply can't.

Anyone can and should have many dynamically activating experiences in mathematics. Stay tuned for updates and the release of MathMINDs games this coming school year.

ADDITIONAL READING AND RESOURCES :

MIND Blog: Research-Based Solutions to Address Math Anxiety
YouCubed Blog: Parents' Beliefs about Math Change Their Children's Achievement
Intergenerational Effects of Parents' Math Anxiety on Children's Math Achievement and Anxiety

Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. Psychological Science, 26(9), 1480-1488. doi: 10.1177/0956797615592630

Conclusion

We need to hold ourselves to a higher standard of effectiveness. And we must relentlessly push for improvement even once we have something that is proving to have impact at scale. The only way to purposefully move in the right direction is to allow our thinking to fundamentally change as we look at our current doing.

So, the next time you evaluate a piece of content, put together a family night, observe a class, or write a lesson plan, look at it through the "Dynamically Active Lens" and ask yourself the questions we outlined in Chapter Four.

1. **What are my students doing?**:
2. **How many meaningful decisions are my students making?**
3. **What kind of feedback are my students getting and when?**

Reach out and share with us your dynamically active experiences on social media! Let's take an active role in pushing ourselves and others beyond the confines of what we see today to create a tomorrow that accomplishes the goals that got us all passionate about education in the first place.

Post your findings on "dynamically active" on social media by reaching out to us on Twitter @MIND_Research. Let us know what you find, what you are learning, or what you are doing differently! Most importantly, share the why .

More From MIND

At MIND, our mission is to ensure that all students are mathematically equipped to solve the world's most challenging problems. So, when implementing our approach to learning, we focus on creating mathematical content to serve that mission.

In the classroom, our K-8 visual instructional program ST Math focuses on dynamically activating our students as learners. ST Math builds a deep conceptual understanding of math through rigorous learning and creative problem solving.

Visit us at stmath.com or click the link below to request information on the program.

LEARN MORE ABOUT ST MATH

STMath.

MIND is also building out engaging and transformative content for everyone to enjoy outside the formalities of the classroom. Under MathMINDs, we have created Family Math Nights that don't just engage but dynamically activate. We also created the national K-12 Game-a-thon, which challenges students to design their own game that solves a mathematical problem. You can learn more about both initiatives at mindresearch.org.

You can also see and hear more from us on the MIND blog (blog.mindresearch.org), which features podcasts, thought leadership articles, interviews, resources and more.

About the Author:
Brandon Smith is the Lead Mathematician at MIND Research Institute where he designs mathematical requirements for the game-based ST Math® software, defines mathematical schema, develops exhibits for Social Impact programs, creates MathMINDs Games experiences, consults with MIND's professional development team, and is an advocate for mathematics in and out of the classroom. Prior to joining MIND, Smith was a college instructor where he won an outstanding teacher award, and was an educational liaison for the City of Costa Mesa to Windham, Australia. Brandon has a bachelor's in math and two master's degrees in pure and applied mathematics. You can follow Brandon on Twitter @bds_math.

Editor: Brian Letendre
Designer: Jo Zafra

MIND RESEARCH INSTITUTE