

A teal circle containing the text "UDL MATH" in pink, bold, sans-serif capital letters with a slight glow effect.

UDL MATH

UDL is a “way to
move” (Dolmage
2017)

Engaging educators in the
spirit of UDL Math

Dr. Rachel Lambert

University of California Santa Barbara

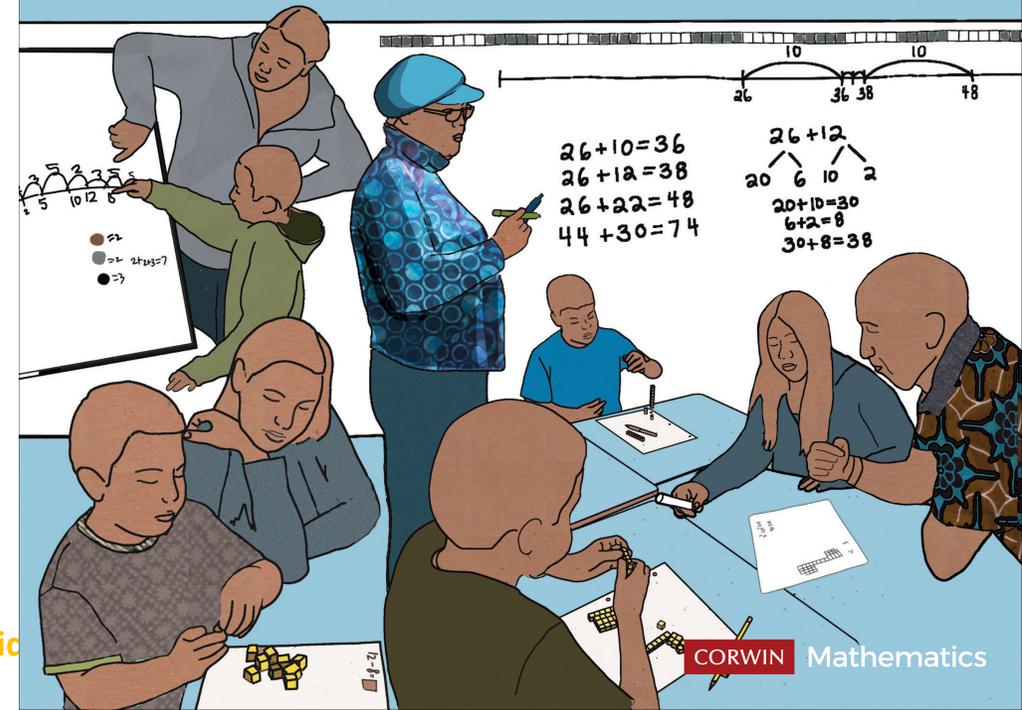
Rachel Lambert

- Taught for over 10 years as a general ed. classroom teacher, special ed. co-teacher, resource room teacher, preschool intervention specialist in New York City, San Francisco and Los Angeles.
- Associate Professor in Mathematics Education and Special Education at UC Santa Barbara
- Author of a book coming out April 9!!!!!!
[discount code at Corwin.com RAVEN25]

RACHEL LAMBERT

Rethinking **DISABILITY** and **MATHEMATICS**

A UDL Math Classroom Guide for Grades K-8



Slide

Critical analysis of research on the math learning of students with disabilities

Rachel's research

Studies of how students with disabilities construct identities as math learners (focus on Latinas with LD/ADHD/EB)

Reimagining intervention

UDL Math and Design Thinking as educators redesign curriculum, interactions, routines, spaces and systems

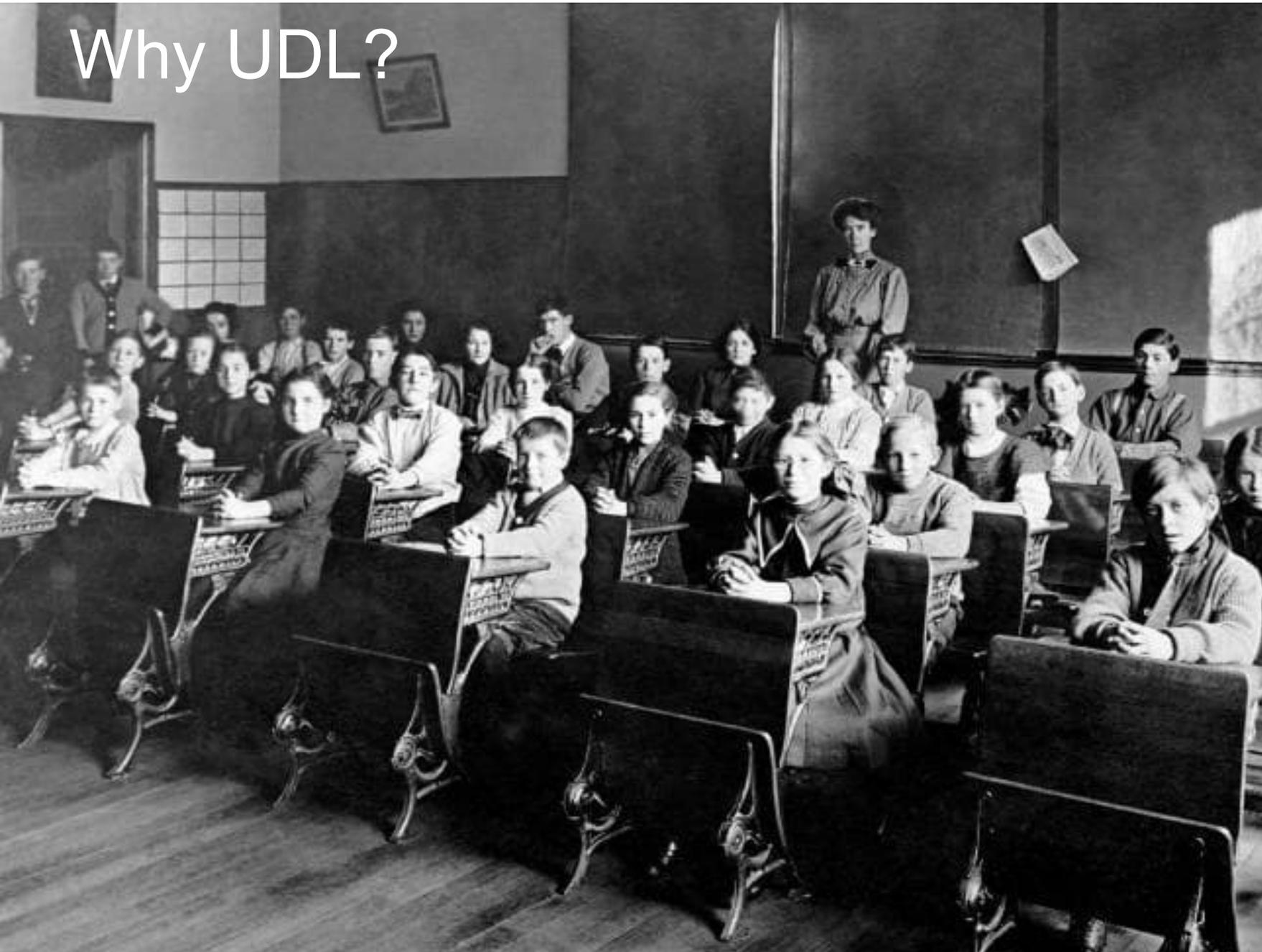
All available at mathematizing4all.com

Neurodiversity and math: Dyslexic mathematicians

My talk

- Why UDL?
- What is UDL?
- Radical potential of UDL
- Big UDL/UDL Math ideas to teach
 - SHIFT MINDSETS ABOUT DISABILITY
 - DESIGN/TINKERING MINDSET
 - DESIGN PROCESS BEGINS with EMPATHY

Why UDL?



NYC schools
in 1890s

Then came
compulsory
schooling laws . . .



The Ungraded
Classes (special
education)
begin in 1899

Elizabeth
Farrell's
ungraded class
in NYC in 1899

“appeal to the constructive, the acquisitive, the imitative instincts in the child” and be “full of things to do, full of interesting activities to pursue, full of constructive activity” (Farrell, 1907, p. 11; Farrell, 1925, p. 11)



- Math education reform comes to general education classes
- “full of things to do, full of interesting activities to pursue, full of constructive activity”

- General Education
- General Education Teachers
- General Education Teacher Training
- General Education Administrative Structures
- Mathematics Education Research



- Measurement of IQ
- Definition of disabilities
- Separate system for children (and adults)
- Behavioral approach to teaching

- Special Education
- Special Education Teachers
- Special Education Teacher Training
- Special Education Administrative Structures
- Special Education Mathematics Research



What is Inclusive Education?

Inclusive Education is not a place or a placement or a service model or coteaching.

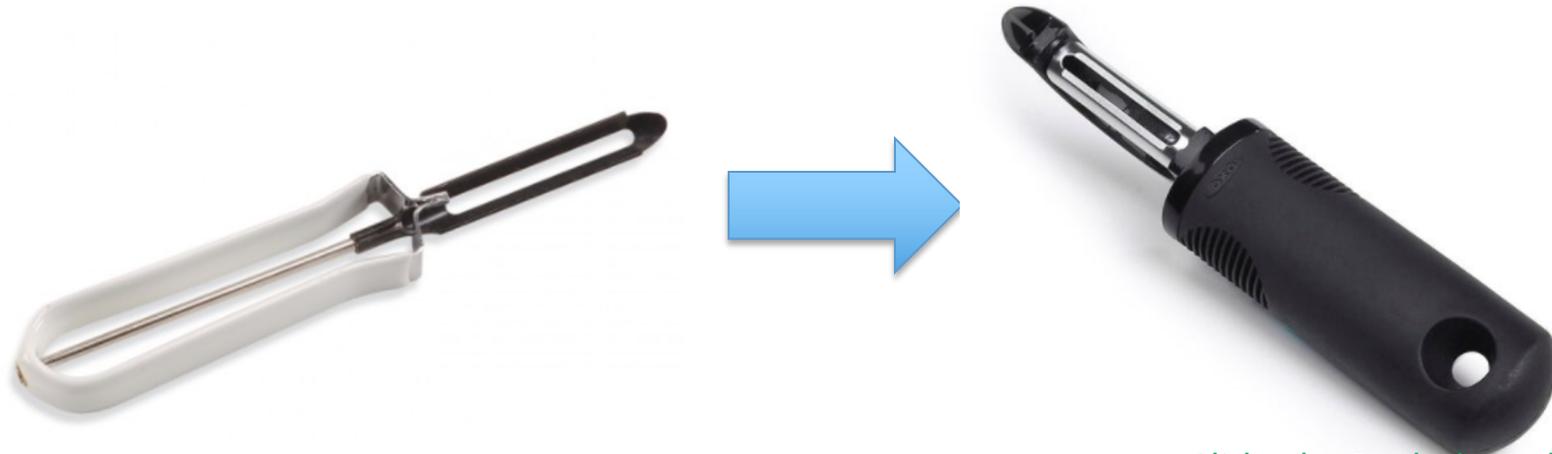
It is “a continuing struggle against the processes and practices of schooling that erect barriers which compromise the participation of some students” (Slee & Allen, 2001). If we truly included all kids in our schools, it would transform our schools (Naraian 2017).

[If we truly included all kids in math classrooms, it would transform mathematics \(Tan & Kasterberg, 2017\).](#)

What is UDL?

Universal Design (Hamraie 2017)

- Products, buildings and spaces should work for all people
- Designs become better through including all users
- Begin by understanding the experience from a disabled user perspective- *empathy interviews*

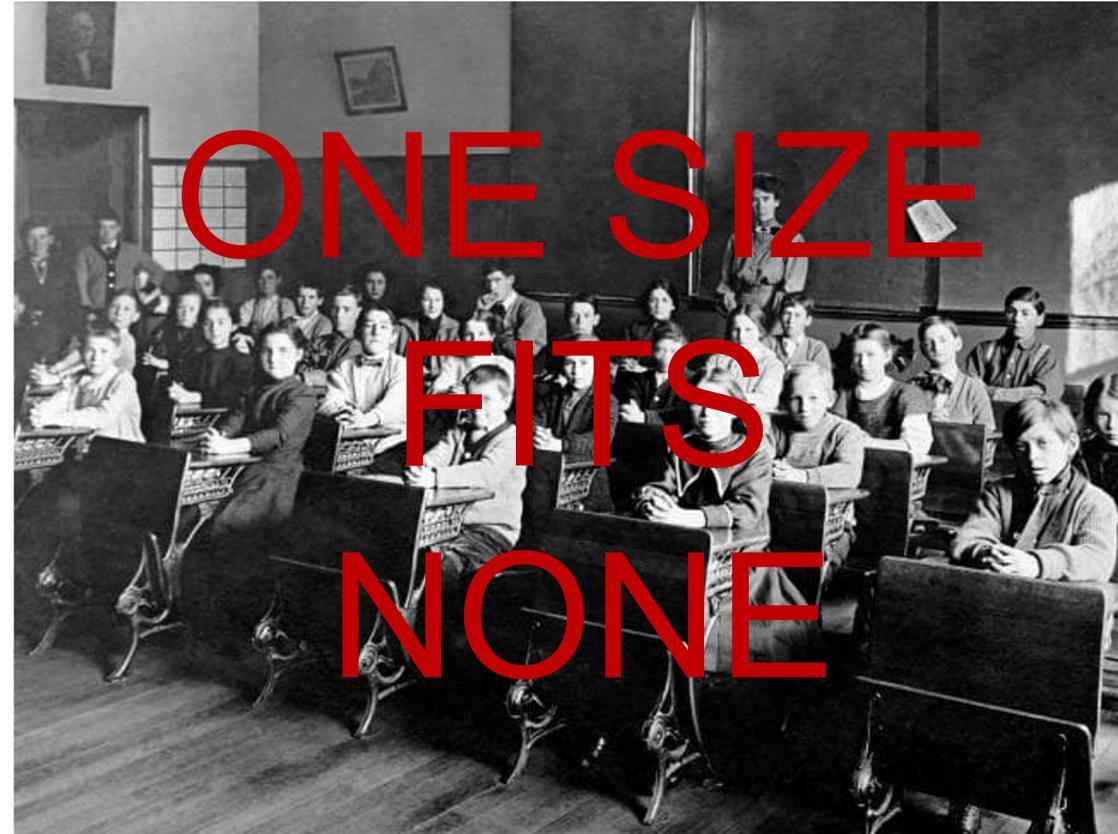


Universal Design for Learning (CAST)



Universal Design for Learning (Meyer et al., 2014)

- The problem is in the one-size-fits-all curriculum, not in the students
- Classrooms become better by including all students
- Designing curriculum around learners, not fitting learners into pre-set curriculum
- Design from the margins



Universal Design for Learning

“**barriers to learning** are not, in fact, inherent in the capacities of learners, but instead arise in learners' interactions with inflexible educational goals, materials, methods, and assessments.”

Teaching Every Student in the Digital Age, p. vi

UDL is based on research in

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graph TD; A[UDL is based on research in] --> B[LEARNING SCIENCES]; A --> C[NEUROSCIENCE];
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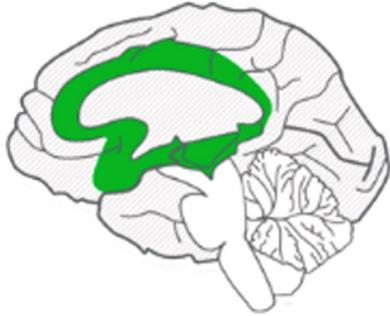
LEARNING SCIENCES

- Goal: expert learner
- Learn through engagement in authentic experiences
- Importance of motivation, self-regulation and executive functioning

NEUROSCIENCE

- Learner variability
- 3 interconnected networks of the brain

AFFECTIVE NETWORKS:
THE **WHY** OF LEARNING

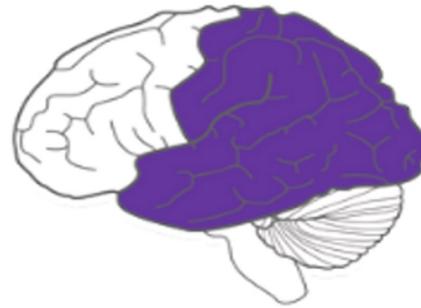


Engagement

For purposeful, motivated learners, stimulate interest and motivation for learning.

Multiple means
of engagement

RECOGNITION NETWORKS:
THE **WHAT** OF LEARNING

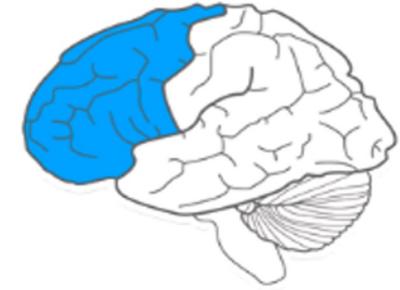


Representation

For resourceful, knowledgeable learners, present information and content in different ways.

Multiple means
of representation

STRATEGIC NETWORKS:
THE **HOW** OF LEARNING



Action & Expression

For strategic, goal-directed learners, differentiate the ways that students can express what they know.

Multiple means
of expression

The radical potential of UDL

- Disability located in the contexts of schooling, not only in the individual (from the medical model to social/political/relational models of disability)
- Learner variability- we are all complex
- Aligned with neurodiversity: strengths and challenges
- Sees learning as development of the whole learner, not just memorization of facts/procedures (expert learner)
- Teachers as designers- we can DESIGN our way out
- Students as having real power to decide "what works"

Worries and critiques of UDL

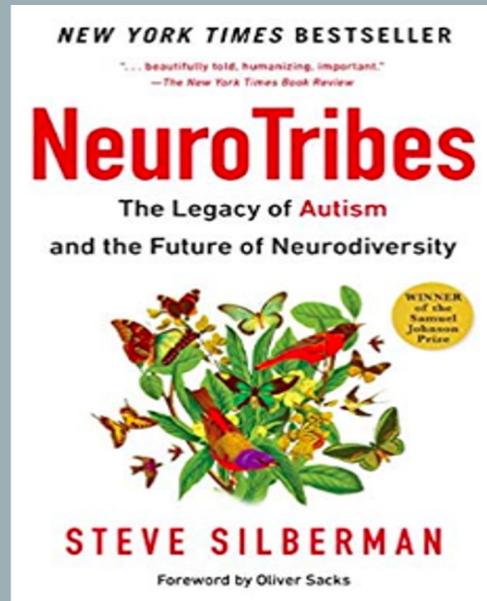
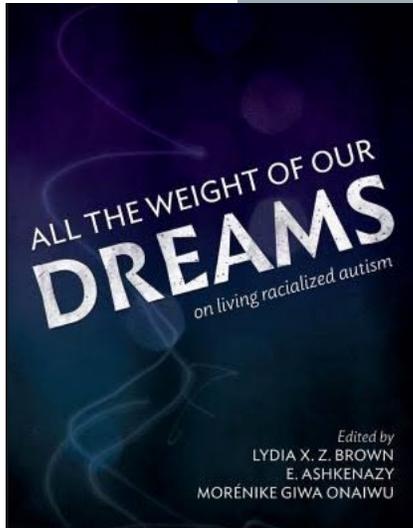
- Focus on “all students” can erase specifics of disability (Dolmage 2017)

Who is UDL for?: EVERYBODY

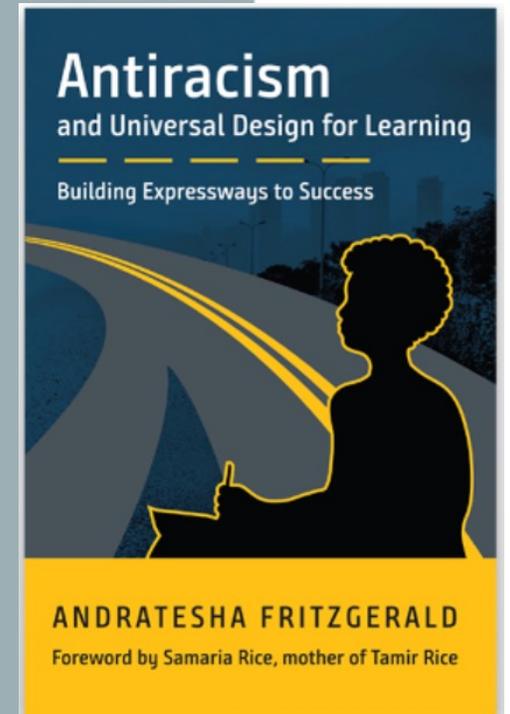
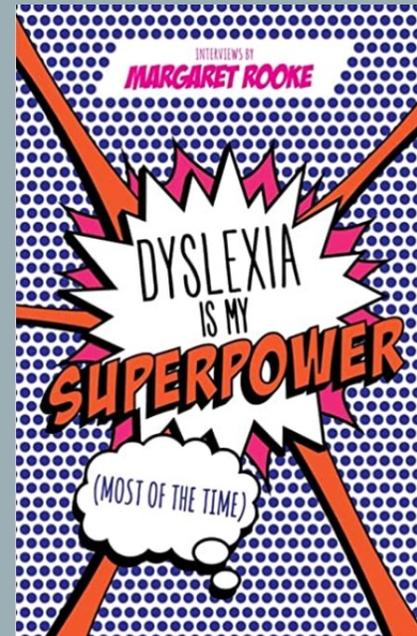
Who is UDL for?: EVERYBODY, but I am centering disability, and those who are multiply marginalized

Neurodiversity

- Insiders are the experts
- Design through strengths, consider challenges

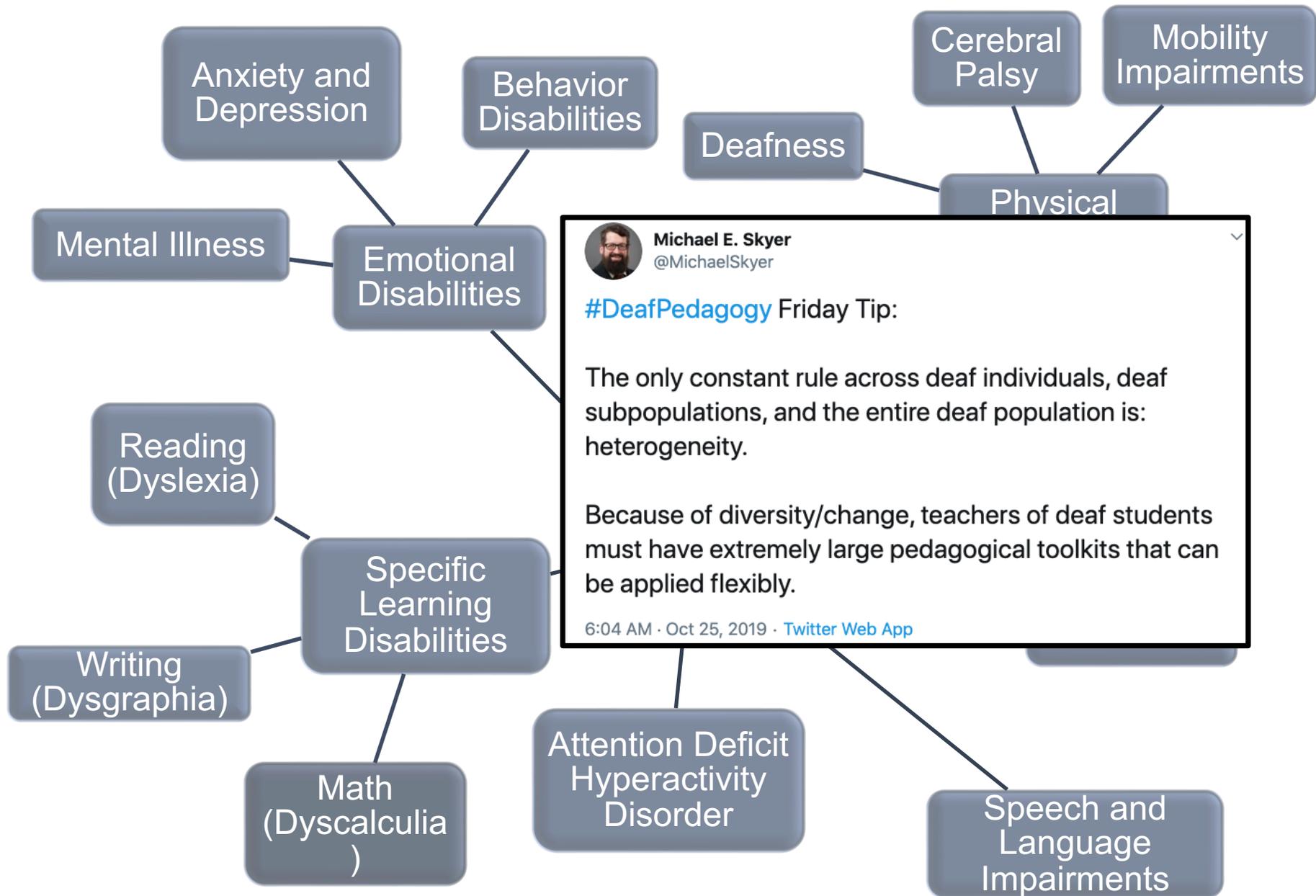


Disability



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Insider Perspectives (dyslexic kids on math)

Other kids had known I was struggling in primary school. It was quite obvious when it came to doing maths. We would stand in a line with the teacher facing the front of the queue. The teacher would ask, "What's 9 x 12?" If you got it wrong you would go to the back of the queue and I was always there. I still can't remember my times tables. I can't quite place the information together. (Elliot, 17)

I was always labelled 'not good at maths' when this shouldn't have been the case. Schools put you in boxes and leave you there. (Charlie, 17)

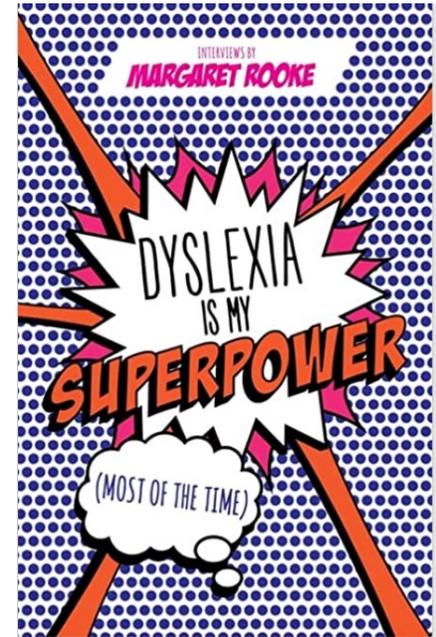
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I'm very good at 3D, the hands-on stuff, and I'm quite good at science and the geometry side of Maths. (Max, 17)

I actually like maths. I like getting through it slowly and problem-solving. What I like is that there is more than one way to answer a question. If I can't do something I can get there another way (Fiona, 15)

In Maths they were really quick at sums the took me ages. (Elijah, 12)

I solve maths problems in a different way. I visualise them. (Molly, 13)



What **barriers** exist for these learners?

What **supports** learning?

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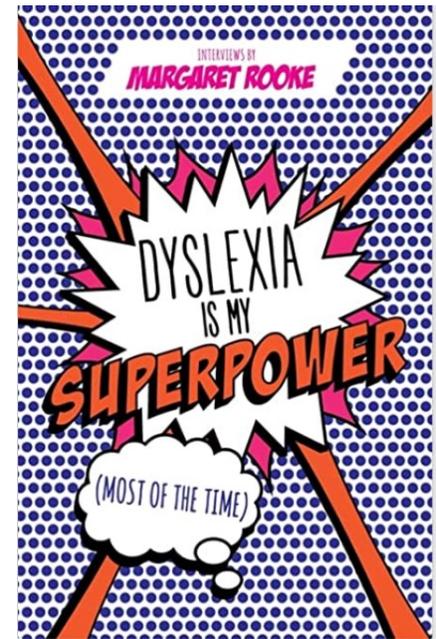
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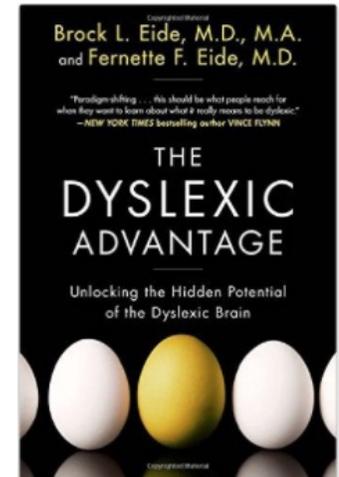
Neurodiversity: Dyslexia/LD

Challenges may include:

- Phonological processing
- Language
- Memory for facts and procedures
- Working memory
- Executive functioning

Strengths may include:

- Visual spatial processing
- Creativity
- Pattern finding, seeing connections
- Seeing the “big picture”
- Narrative thinking



Worries and critiques of UDL

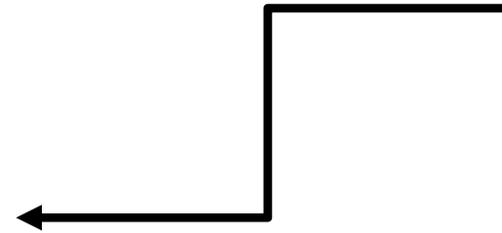
- Focus on “all students” can erase specifics of disability (Hamraie, 2016)
- Lack of a design process: “checklistification”(Dolmage 2017)

Rhode Island Modified UDL Educator Checklist – Version 1 (9/14/09)
 (Adapted from CAST UDL Guidelines: <http://udlguidelines.wordpress.com/introduction/>)

To analyze a lesson or unit for UDL features, use the checklist to identify if each component is present (Y), not present (N), or not sure (?).

UDL Checklist <i>(Examples in italics)</i>	Y N ?	Comments
I. Provide multiple means of representation (Knowledge Networks)		
1. Provide options for perception	Your response	
1.1 Vary ways to display information <i>Visual information: size, contrast, color, layout, spacing, etc. Auditory information: amplitude, speed, timing, cueing, etc.</i>		
1.2 Alternatives for auditory information <i>Text provided for spoken language, voice recognition-to-text, visual symbols for emphasis, sound alerts, etc.</i>		
1.3 Alternatives for visual information <i>Text or spoken equivalents for graphics/video/animation, tactile supports for visuals, Use of physical objects or spatial models, etc.</i>		
2. Provide options for language and symbols	Your response	
2.1 Alternative access to key vocabulary & language <i>Pre-teach vocabulary & symbols, highlight components of complex words, embed vocabulary supports in text – hyperlinks, footnotes, definitions, etc.</i>		
2.2 Clarify language structure & rules <i>Make rules & relationships explicit, clarify links between concepts, use less complex vocabulary or language structures, etc.</i>		
2.3 Alternatives for text symbols & mathematical symbols <i>Text-to-speech programs for digital text, use digital math notations (Math ML) with voicing, use text alternatives (tapes, DVD, digital text) with human voicing, etc.</i>		
2.4 Provides connections across different languages <i>Key information in dominant and second languages, vocabulary definitions & pronunciations in both languages, shared/related roots identified, syntax/grammar links & differences identified</i>		
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3. Provide options for comprehension	Your response	
3.1 Access background knowledge <i>Activate prior knowledge with imagery, concepts, etc., use organizers (KWL, concept maps, etc.), pre-teach concepts, “bridge” ideas with analogies & metaphors, etc.</i>		
3.2 Highlight essential information & “big ideas” <i>Emphasize key elements, use organizer, prompts & cues to identify & connect key elements, use multiple examples and non-examples, mask or reduce extraneous elements, etc.</i>		
3.3 Guide information selection & processing <i>Use interactive models, explicit prompts and scaffolds, develop multiple points-of-entry & pathways for content, chunk information, release information progressively, etc.</i>		
3.4 Support memory & knowledge transfer <i>Checklists, sticky notes, electronic reminders, mnemonic devices, space out reviews, organizers for note-taking, connect new information & prior knowledge, embed analogies & metaphors, etc.</i>		

UDL is often presented as a checklist



But many of us think of it as a mindset, as a process, as a “way of thinking”



UDL is not simply a *listing* of various flexible options and strategies; rather, it is a *process* of designing intentionally to reduce cultural, cognitive, behavioral, and physical barriers”

(Smith et al., 2019, p. 177).

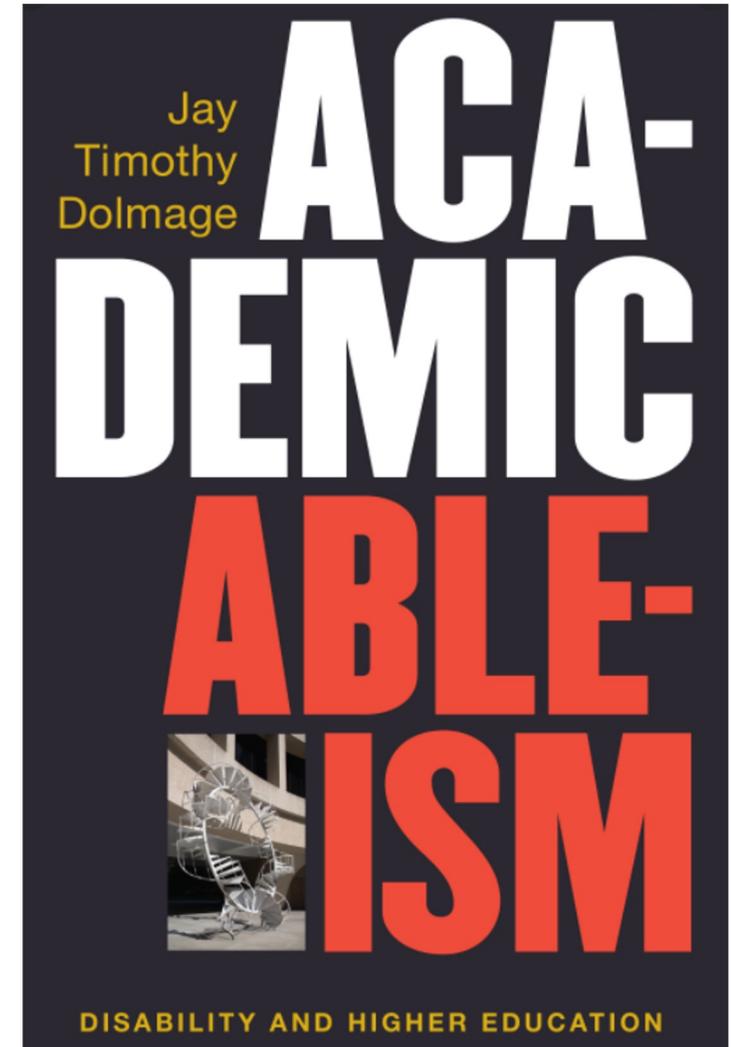
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Three metaphors from Universal Design in architecture

(Dolmage 2017)

- Steep Stairs
- Awkward Add-ons
- Universal Design



STEEP STAIRS



AWKWARD ADD-ONS





Fig. 5. "Katie Lalley's Access Ramp." Courtesy of SWNS.com.



UNIVERSAL DESIGN: design at the outset for the widest range of humans



UNIVERSAL DESIGN

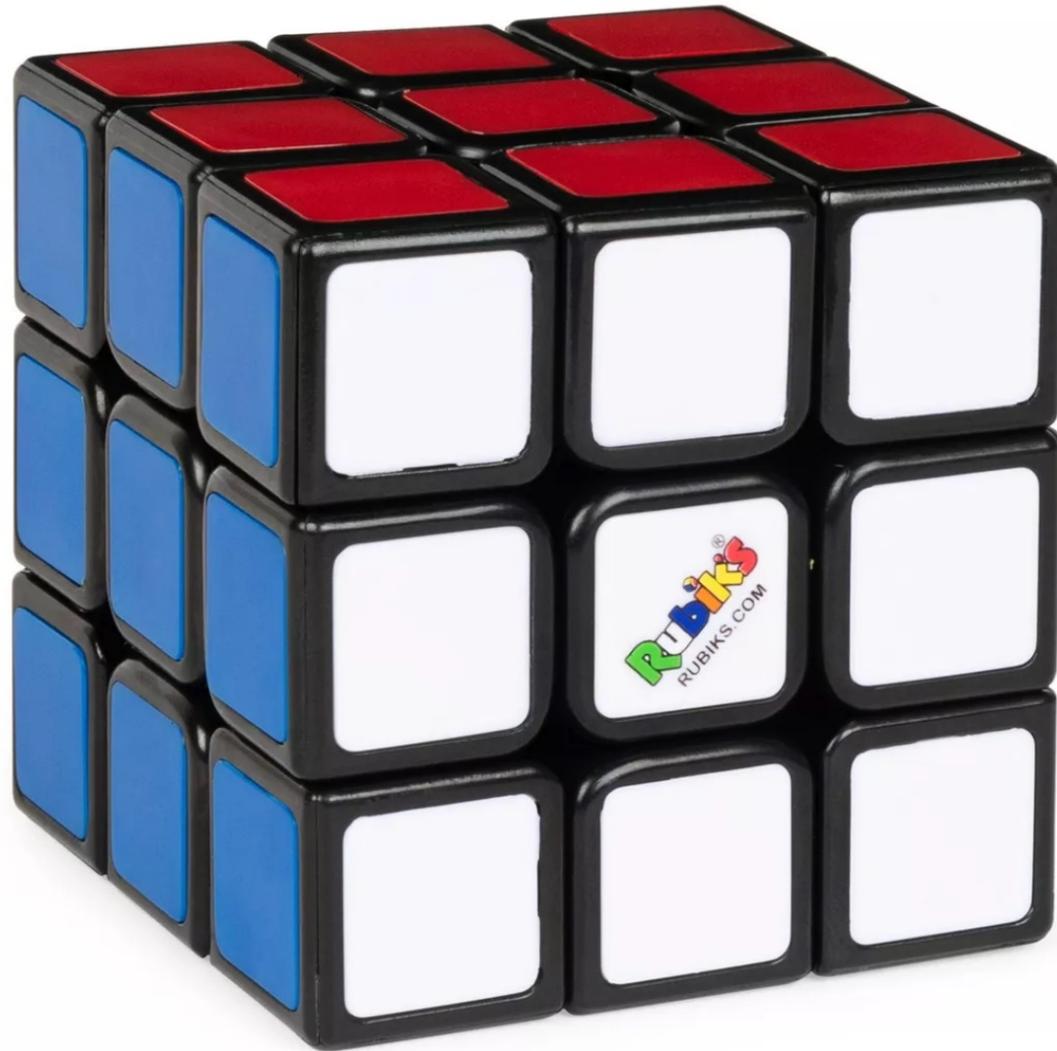


AWKWARD ADD-ONS



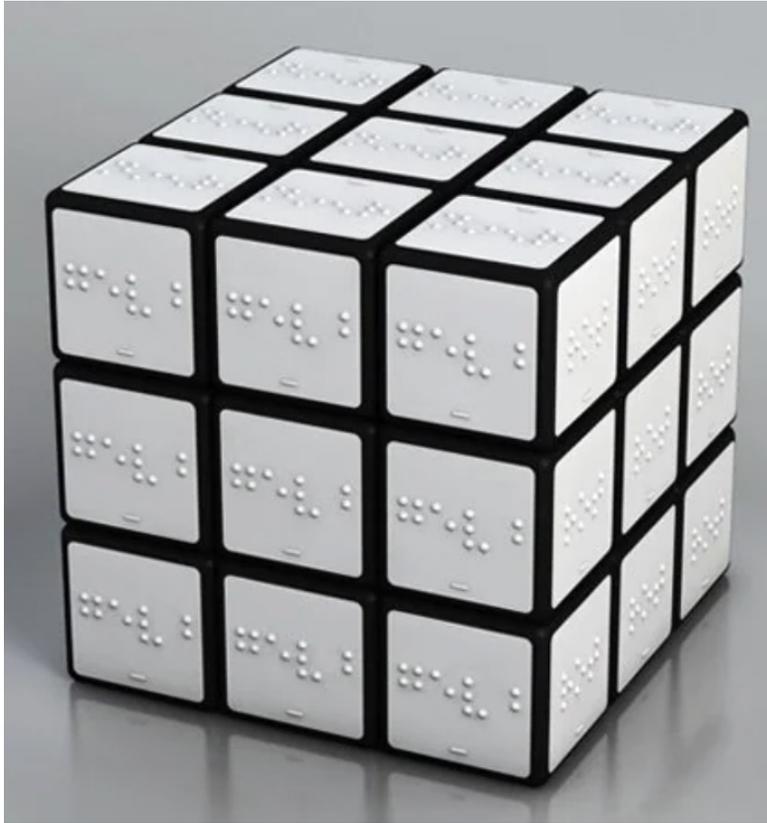
STEEP STAIRS

Rubik's cube



Which is more accessible?

A



B



Worries and critiques of UDL

- Focus on “all students” can erase specifics of disability (Dolmage 2017)
- Lack of a design process: “checklistification” (Dolmage 2017)
- Too general, not specific to mathematics



What is an expert learner in mathematics?

Work on developing self-regulation when math class feels tough

Makes connections to what they already know and across topics.

Knows what they do not know

Motivated by learning math (mastery-oriented vs. performance-oriented)

Jumps into problems and solves them. Persists when stuck.

Sets goals for their own learning

Collaborates

Develops and shares math strategies

Wants feedback and pays attention to it

Strategic Sense Makers

Are students constructing identities as strategic sense makers in math?

Asks questions when they need help

Engages in the math strategies of others

Uses multiple tools and models to make sense of problems

Knows how to study

Can describe their strengths and challenges in mathematics

Keeps working until they reach understanding. Math questions nag at them.

Knows what supports help them.

Asks questions to push the group's thinking further

UDL Math Design Elements



*Do your students feel safe enough
to take mathematical risks?
Are they building relationships in
and through math?*

Supportive
Classroom
Environment

ENGAGEMENT

*Is the math in your class
meaningful to students?
Do students regularly
engage in sense making?*

Meaningful
Mathematics



Multimodal

*Is math content accessible?
Multimodal? Can students
choose how they solve
problems?*

REPRESENTATION



Focus on
Core Ideas

*Does the design of your
class guide students to
understand and
remember core
mathematical ideas?*

*What do your students learn about themselves as math learners?
How do you support that development?*

Understanding
Self as a Math
Learner

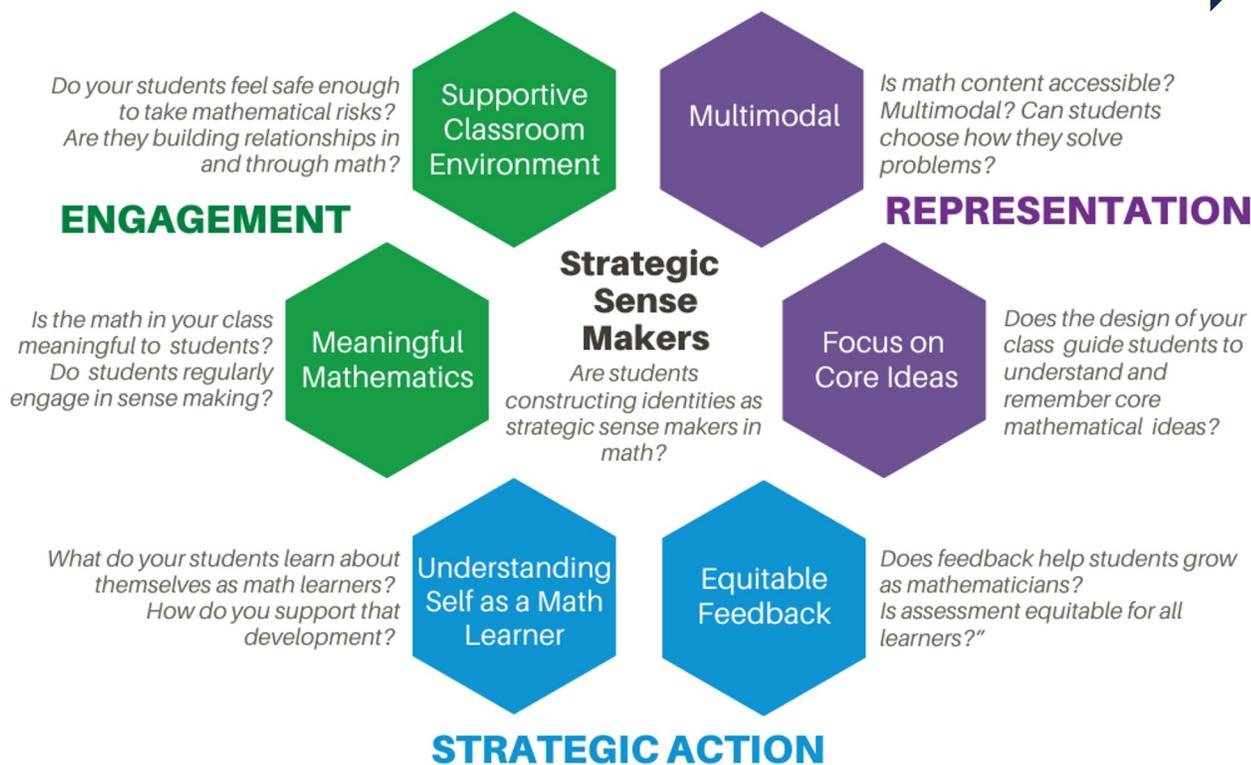
Equitable
Feedback

*Does feedback help students grow as mathematicians?
Is assessment equitable for all learners?"*

STRATEGIC ACTION

My fear . . .

UDL Math Design Elements



Lambert 2021

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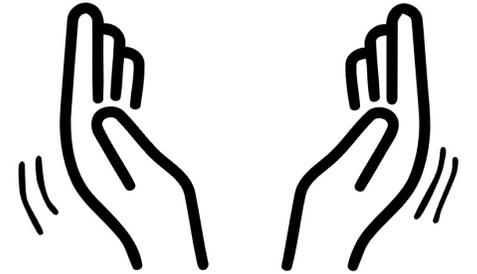
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UDL MATH

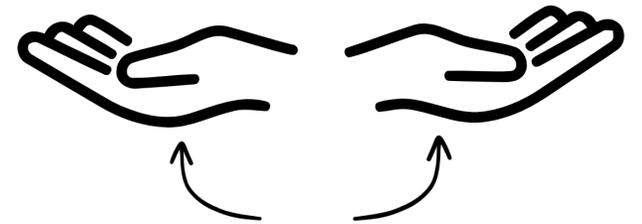
1. Math class is too narrow



2. Open up math class



3. Strategic Supports



Design from the margins: After reading these narratives, Name one thing you would STOP doing as a math teacher and one thing you would START doing?

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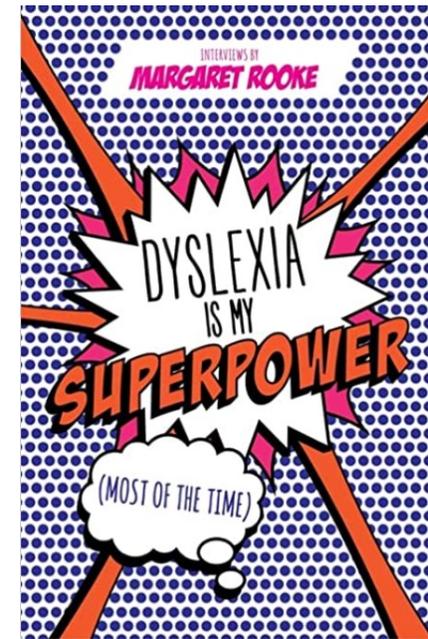
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- Two studies about teachers engaging in this kind of UDL + Design Thinking work

Study 1: Rethinking Math in Uncertain Times: Using Design Thinking and UDL to Support All Kids (Summer 2020)

Collaboration with Dr. Kara Imm, CA Math and Science Community of Practice, UCSB grad students Avery McNiff, Dr. Rachel Schuck and Sunghee Choi.

Virtual summer course for 35 CA math educators in 2020 that integrated UDL with the design thinking process.

Data: course video, materials, surveys, and focus groups 8 months later.

Course Outcomes

We take up design thinking as a problem-solving practice.

We listen to users and design for them.

We rethink our ideas about disability.

We appreciate, celebrate, and make use of learner variability.

We understand Universal Design for Learning as a Design Process.

We develop new understandings about how UDL applies to math teaching and learning.

Rethinking Math in Uncertain Times Course Design

Shift mindset



What barriers exist for these learners?
What supports learning?

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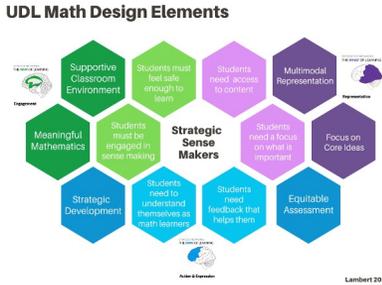
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UDL (math)



Engage in design thinking

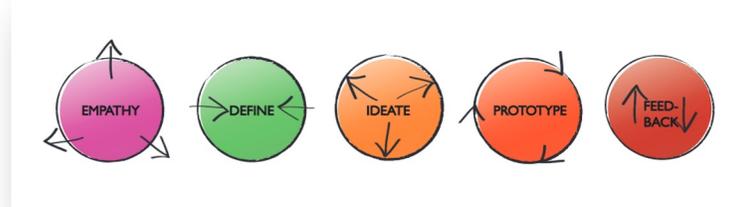
Empathy Interviews

Design Teams define and tackle access problems

Social media campaign about valuing home mathematics

Starting a newsletter to motivate math teachers

Beginning the 2020 school year with teachers, paraprofessionals and students collaborating in a virtual problem solving fair.



Course Outcomes	No Growth	Some Growth	Definite Growth
We take up design thinking as a problem-solving practice.	0	8	25
We listen to users and design for them.	0	7	26
We rethink our ideas about disability.	0	6	27
We appreciate, celebrate, and make use of learner variability.	0	8	25
We understand Universal Design for Learning as a Design Process.	0	19	14
We develop new understandings about how UDL applies to math teaching and learning.	1	19	13

UDL + Design Thinking Course Design

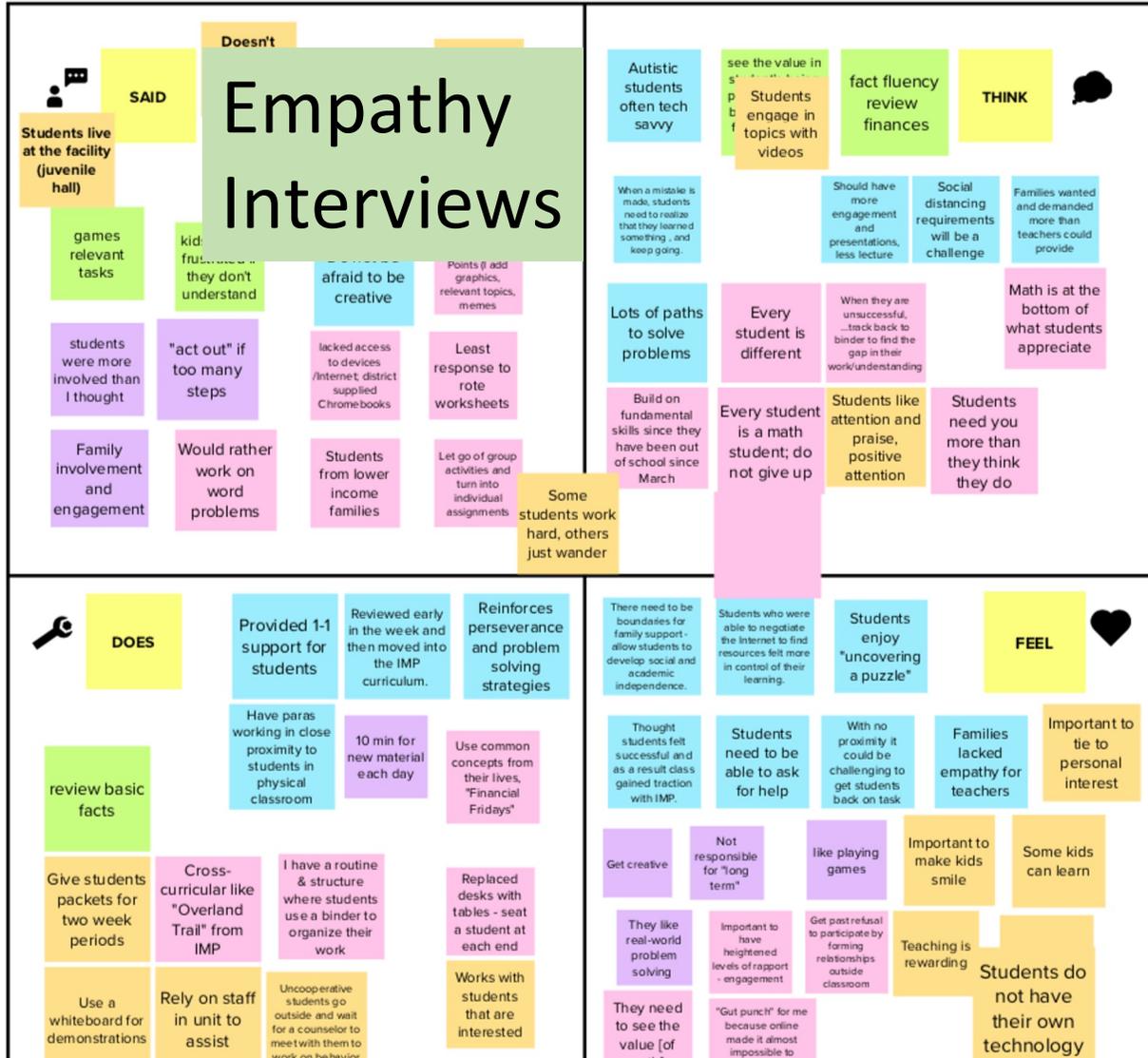
Shift mindset



“My major learning was coming to understand the struggle of people with disabilities to actually be recognized as individuals deserving of the same human rights as everyone else.

Watching the movie Crip Camp was a powerful, informative experience for me. I recognized that for far too long I had seen the education of "SPED" students as something for others to do, and did not look at my work as a teacher through the kind of critical lens needed to ensure that ALL students really did have the opportunity to engage with mathematics in a meaningful way. “

UDL + Design Thinking Course Design



“It has helped in giving me the lens of starting with empathy. Of course all educators empathize with their students, but I loved the idea of really sitting with students and problem solving based on their individual perspective instead of just my own . . . It is going to give my work more heart.”

“I now see over and over again people designing learning experiences from their perspective without being able to see how the user might experience it. I can't unlearn starting with the user and what they need.”

Focus Groups: Classroom teachers

- All four classroom teachers used empathy interviews with their students throughout the year.
- Teachers described how UDL helped them “catch their deficit thinking”
- All described UDL in a new way for us:

Design thinking and UDL are an active process...not like an approach or sitting out here and doing something a certain way, but it's in those moments, in a teaching moment, even in your live-on-your-feet lesson, as you shift and adjust, that...is UDL. (special educator)

Empathy connected to redesigning systems

- There's such a lack of empathy with – and rigidity. Like if there's no other time for you to like rethink your grading like – this isn't going to do it for you? What's gonna do it? (special educator)
- If we're going to make any social impact, social justice change, we have to listen to the stories of the people that are in our community. And so you know, instead of relying on my general tendency to look at large sets of data, we need to listen to the voices. And so I feel like just in my personal position, I've been challenged to think of storytelling--creating empathy by talking to individuals, especially in my position now at the county. (math leader)

How hard it is to teach UDL . . .

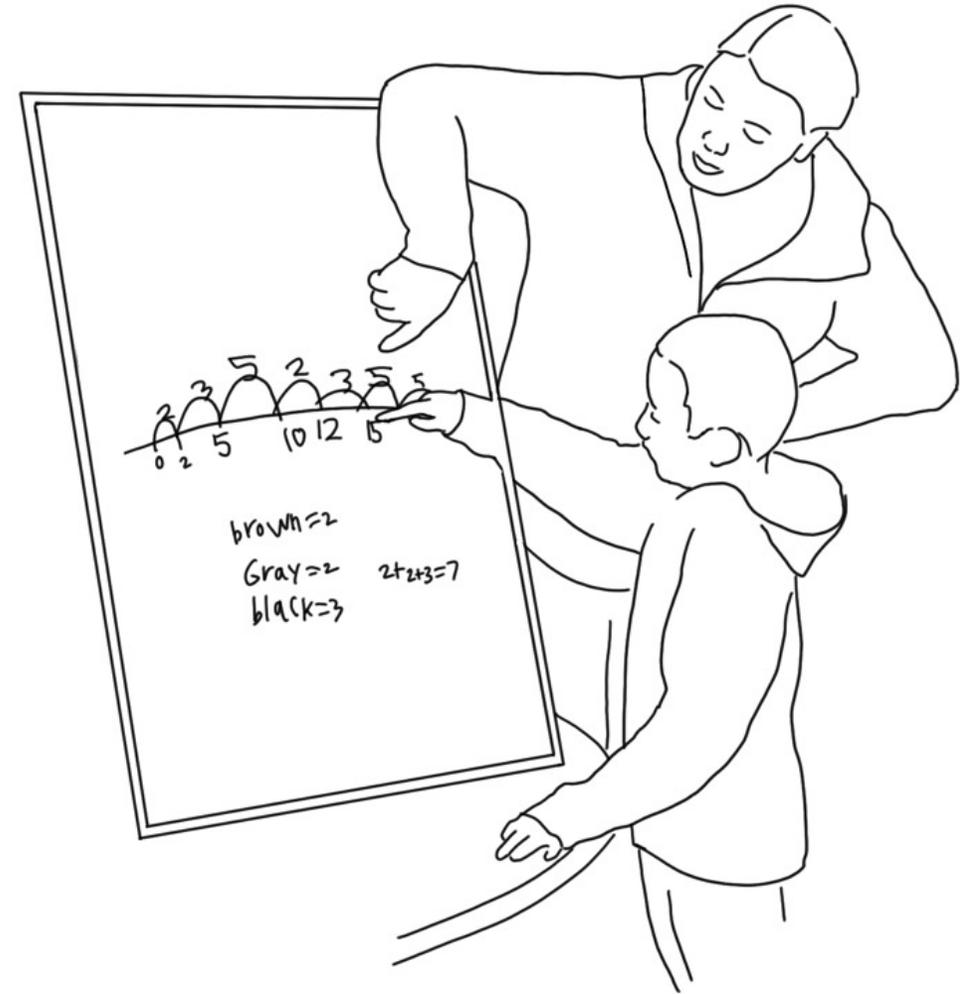
It's hard to take the UDL framework . . . Now you choose number one in the purple color, the green column, and then number five and then, and then the results will be right. It's not a formulaic process unfortunately or fortunately. I would say, myself included, sometimes we need those kind of like clear directions, but when you have those clear directions, like a recipe...You lose your agency in it, you don't have your autonomy in it, because you're just kind of following a sequence of events. So how do you get someone to take...the framework...or the UDL principles and apply them in a very organic and meaningful way that's pertinent to the situation? That's not an easy transfer. (elementary school teacher)

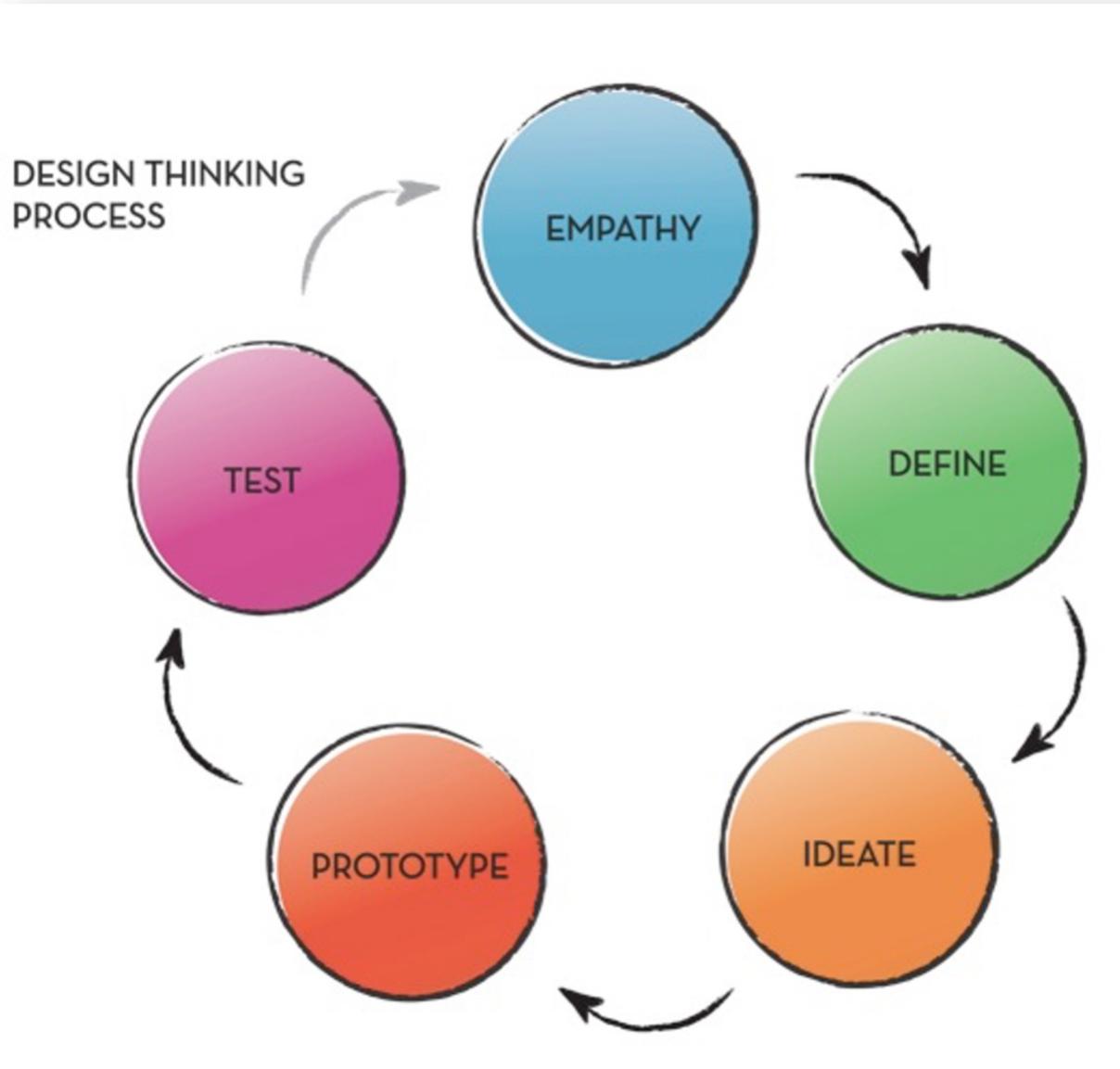


Study 2: The UDL Math Process

Ms. Diaz

- Study within a teacher professional development program
- I led the group in the UDL Math Design Process on three spread-out PD days
- Two participants:
 - Ms. Diaz (2nd grade) and Ms. Murphy (1st grade)
 - Both long-time early childhood teachers and leaders in math professional development
 - Both increasingly have students with IEPs in their general education classrooms. Ms. Diaz had 10 students with IEPs in her classroom of 22 students, along with 3 additional paras.
 - Both experimenting with Thinking Classrooms.





UDL as a mindset, as a process, as a “way of thinking”

Process developed by Dr. Kara Imm (Imm et al. 2024) with materials from Design Thinking for Educators (IDEO)



Q1: What matters? What is not working?

1. What matters to you in the mathematics education of students at the margins? Students with disabilities? What do you want your math classroom to be like for these students? **We want all our students to be able to interact with the math in dynamic ways. Looking at different approaches to solving problems and communicating their ideas. We want our classroom to help support these students to interact with others in cooperative groups and communicating their ideas with others. We do not want math time to be solitary. We want it to be mutually beneficial for all students.**
2. What is not working in this area? What do you wish you could change?
The need to work in cooperative groups requires these students to use social skills that cause challenges to be able to do the math. We want to change the structure of cooperative grouping that would allow these students to positively participate.

Q2: Choosing a user and a design space

3. Who do you want to design for? (students, teachers, families)

Our students on the spectrum and those who interact with them.

4. What do you want to design? (curriculum, routine, interaction, space, system)

Instructional design and moves for cooperative learning groups.

Q3: Planning an empathy interview

For this empathy interview, you will interview one person who is in your user group (students, family members or other teachers). Plan a 10 - 15 minute interview with that person to better understand their perspective on math class and math learning.

Begin your interview by putting the person at ease and explaining your purpose (for example, trying to understand math class from a student point-of-view). Also explain that any information will be kept confidential and you will use a fake name to talk about what you learned with your design team (that's us!). You can audio record or just take notes.

Aim to ask questions to elicit stories and feelings.

- Imagine it is a day where we work in groups for math class. How do you feel? Why?
- Who do you like to work with in groups? Why? What makes them a good partner?
- Are there times another student is hard to work with? Why? What do you do then?
- What do you enjoy most about math class?
- Can you describe what a great day in math class looks like?

Who will you interview?

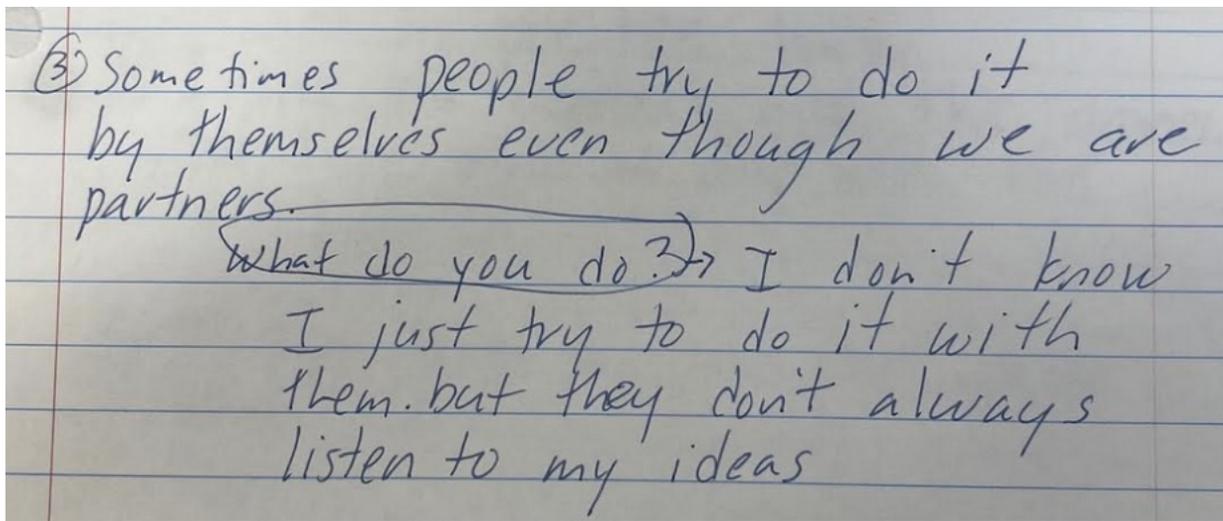
- One student on the spectrum
- One student who interacts with a student on the spectrum

Anthony (Ms. Murphy's class):

"I like doing problems. It gives my brain a workout." When asked about working with partners: "I like working with partners. They help me with strategies." Group time was his favorite time in math.

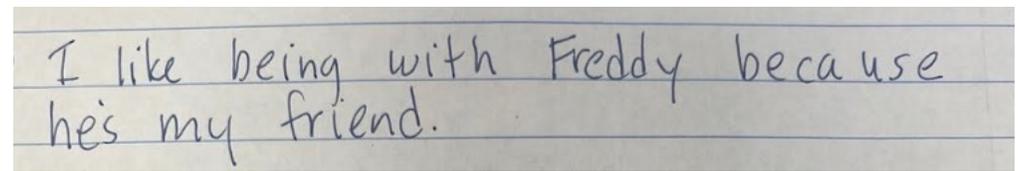
All students' favorite time was ""whiteboards"" which was Thinking Classroom group problems.

The pain point for students was when 1) you were not with a "friend" and 2) when other kids don't communicate during group time

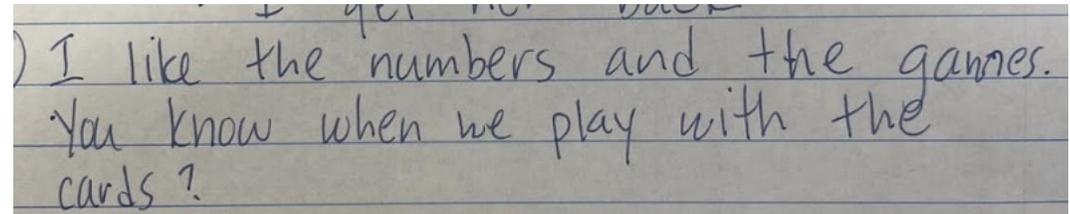


③ Sometimes people try to do it by themselves even though we are partners.
What do you do? → I don't know
I just try to do it with them. but they don't always listen to my ideas

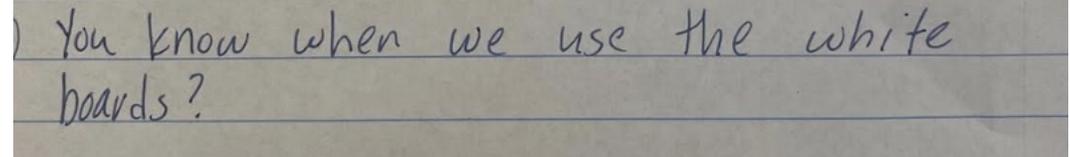
Tomas (Ms. Diaz's class)



I like being with Freddy because he's my friend.

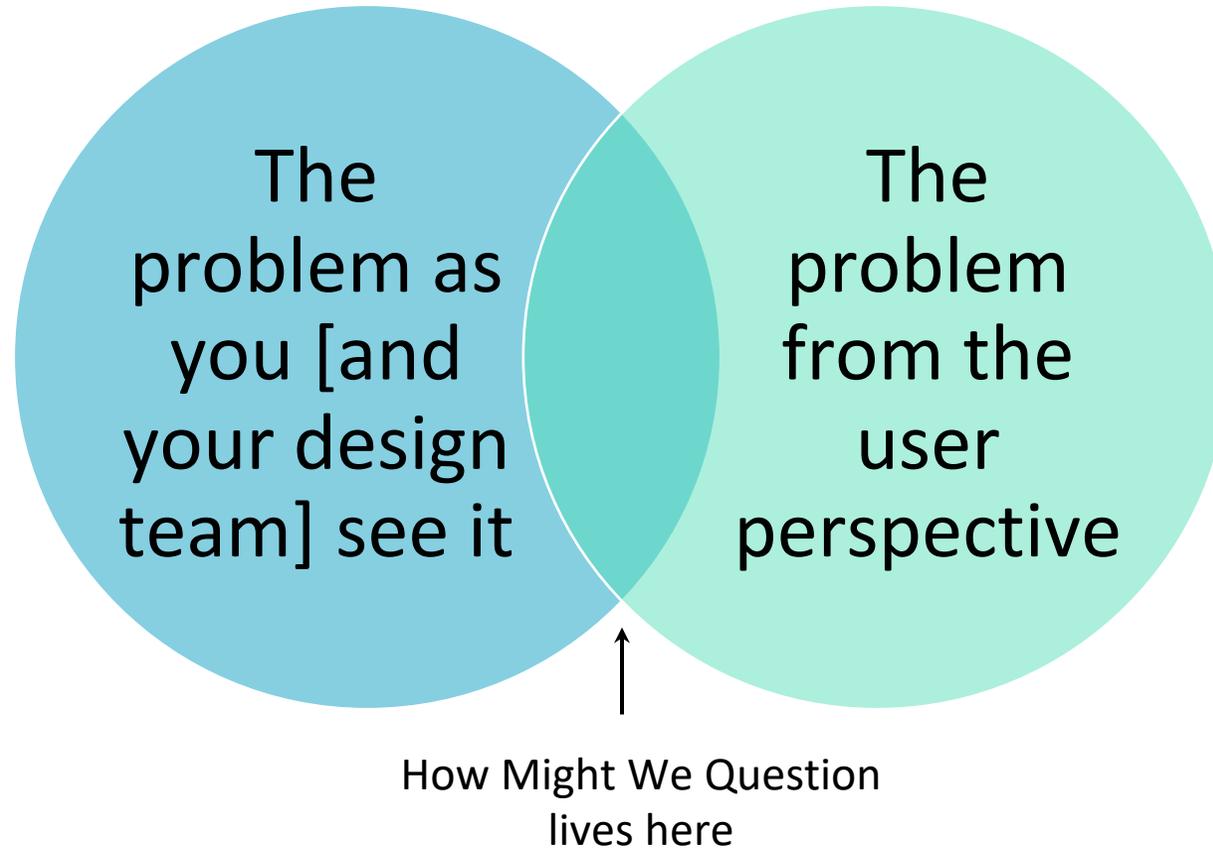


I like the numbers and the games. You know when we play with the cards?



You know when we use the white boards?

Bringing Empathy into the UDL Design Process



Bringing Empathy into the UDL Design Process

Brainstorm your answers to the following questions, keeping the empathy interview in your minds.

1. What did we learn about our problem of practice? What is narrow about math class/math learning in my context? How is that experienced by users?
4. How could we open up math class?
5. What strategic supports might be useful?

Write a How Might We Question:

How Might We design a partnering structure to empower all our students to create a mutually beneficial team?

Wild Brainstorming

Create a list of possible ways you could design/redesign for your How Might We Question. BE WILD. Think of ways that seem impossible. Don't limit yourself to what you already do as a teacher . . .

- See “perseverance” as a positive thing in math but are looked as negative in other areas
- Tools to give those kids to contribute
- Highlight students strengths in tasks
- Show videos of positive partnerships and analyze what they see
- Give roles for partners
- Strategic groups of 3 for certain students (who have to leave early, or who might get frustrated)

Prototyping

Pick one idea and develop it. Use paper, a jamboard, or this space to write out your thinking.

When We Problem
Solve:

- never give up
- every mistake gets you closer to the answer
- every problem is a fun treasure hunt
- everyone has good ideas worth listening to!

Both teachers decided to make sure that problems were visual and multimodal.

Both teachers added discussion of how to work in groups, as well as reflection on group work each time.

Ms. Diaz added two additional pieces of support for Tomas:

- Visual math tools (blank hundreds chart)
- Groups of 3 (so that he could take more time to start talking)

Test

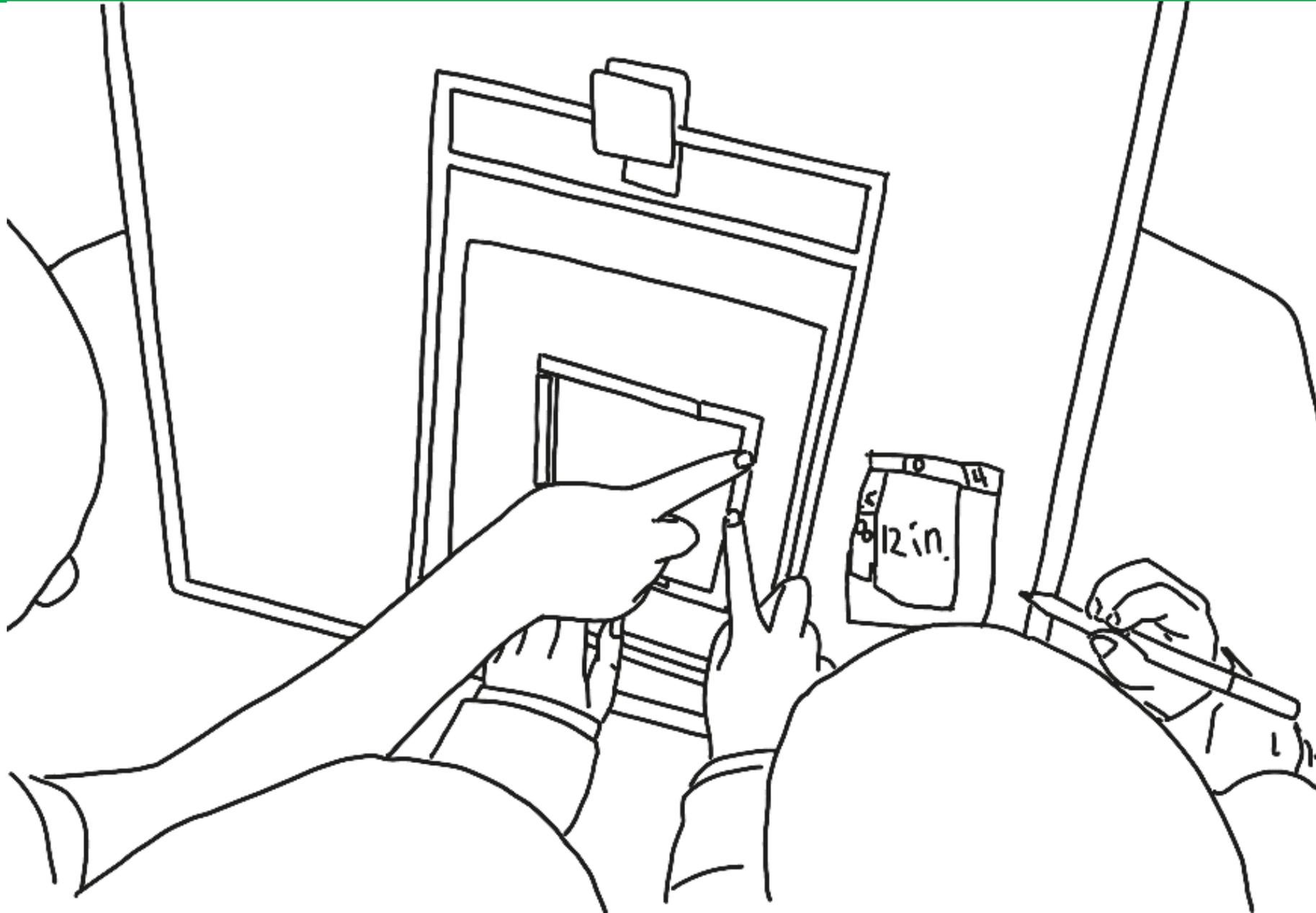
How can you cover the frame with tiles?

The diagram shows a large rectangle representing a frame with a height of 14 inches and a width of 12 inches. Below the frame are several rectangular tiles of different sizes, each labeled with its length in inches: 3 in, 4 in, 5 in, 6 in, 7 in, 8 in, 9 in, and 10 in. The tiles are arranged in two rows: the top row contains tiles of 9 in, 8 in, and 7 in; the bottom row contains tiles of 3 in, 4 in, 5 in, and 10 in.

How many different arrangements can you make?

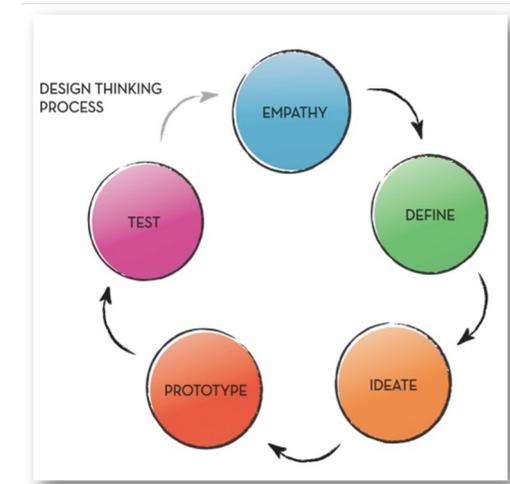
Ms. Diaz's
Second Grade
Class

Test

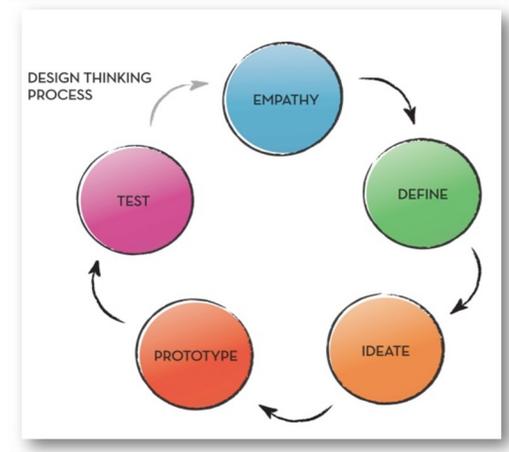
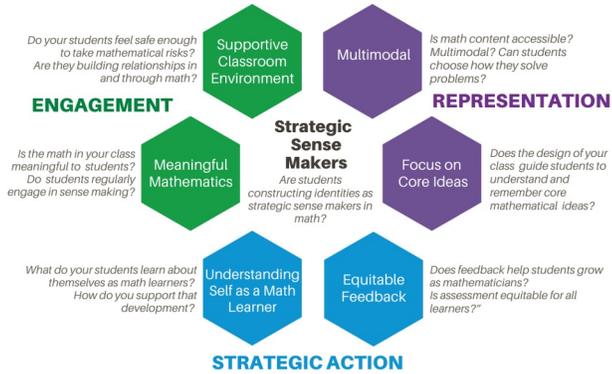


My talk

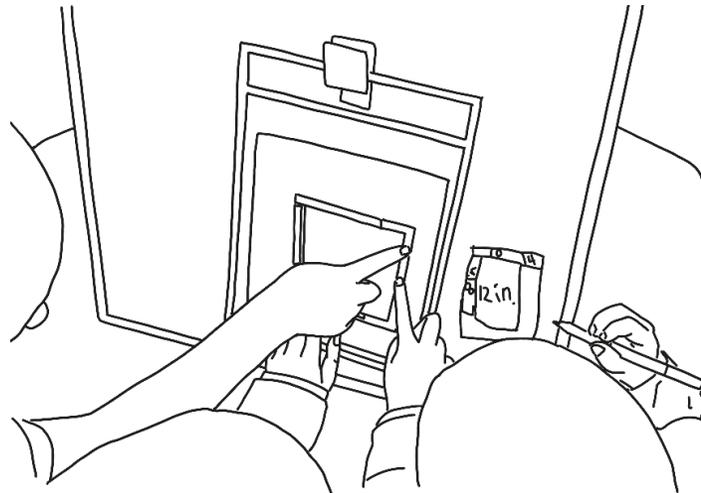
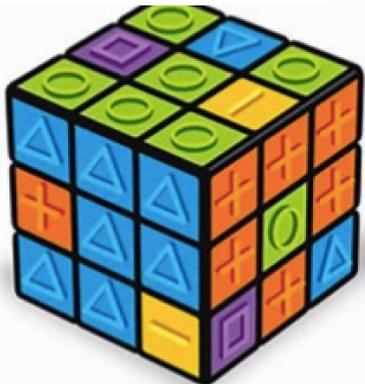
- Why UDL?
- What is UDL?
- Radical potential of UDL and
- Big UDL/UDL Math ideas to teach
 - SHIFT MINDSETS ABOUT DISABILITY
 - DESIGN/TINKERING MINDSET
 - DESIGN PROCESS BEGINS with EMPATHY



UDL Math Design Elements



“the problem with the terms ‘include’ and ‘inclusion’ in the first place, is that they assume that the goal is to be included into a system that’s always already oppressive, as opposed to transforming it”
(Alim et al., p. 18).



Resources (*many at mathematizing4all.com*)

Resources (*my articles all available at mathematizing4all.com*)

My New book on UDL Math <https://ca.corwin.com/en-gb/nam/rethinking-mathematics-and-disability/book287710> (RAVEN25)

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- Silberman, S. (2016). *Neurotribes: The Legacy of Autism and the Future of Neurodiversity* (Reprint edition). Avery.
- Waitoller, F. R., & King Thorius, K. A. (2016). Cross-Pollinating Culturally Sustaining Pedagogy and Universal Design for Learning: Toward an Inclusive Pedagogy That Accounts for Dis/Ability. *Harvard Educational Review*, 86(3), 366–389. <https://doi.org/10.17763/1943-5045-86.3.366>

Extra Slides

Rapid Design Cycle

	Game Redesign Challenge
10 min.	Play as a group, looking for barriers/ways the game is narrow/pinch points for students in either grades $\frac{3}{4}$ or middle school. Make a new game with the same materials, or refine an existing game.
10 min.	Wild brainstorming- what can/should be redesigned about this game
15 - 30 min.	Build a prototype
30 min. (12:45)	Test with students (students cycle between stations)

Allow engagement with big ideas of fractions (math)

Visual support

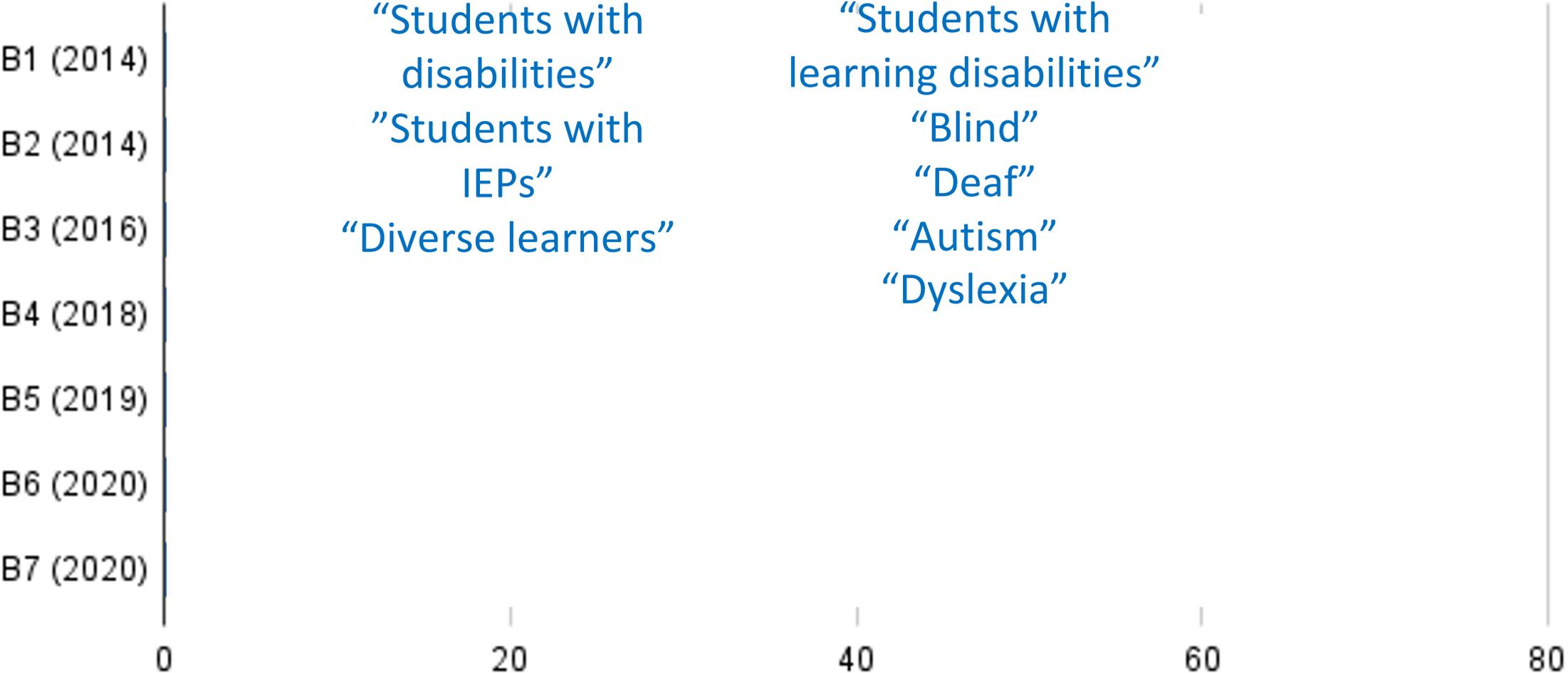
Ease of play

Kids at different prior knowledge levels can play together

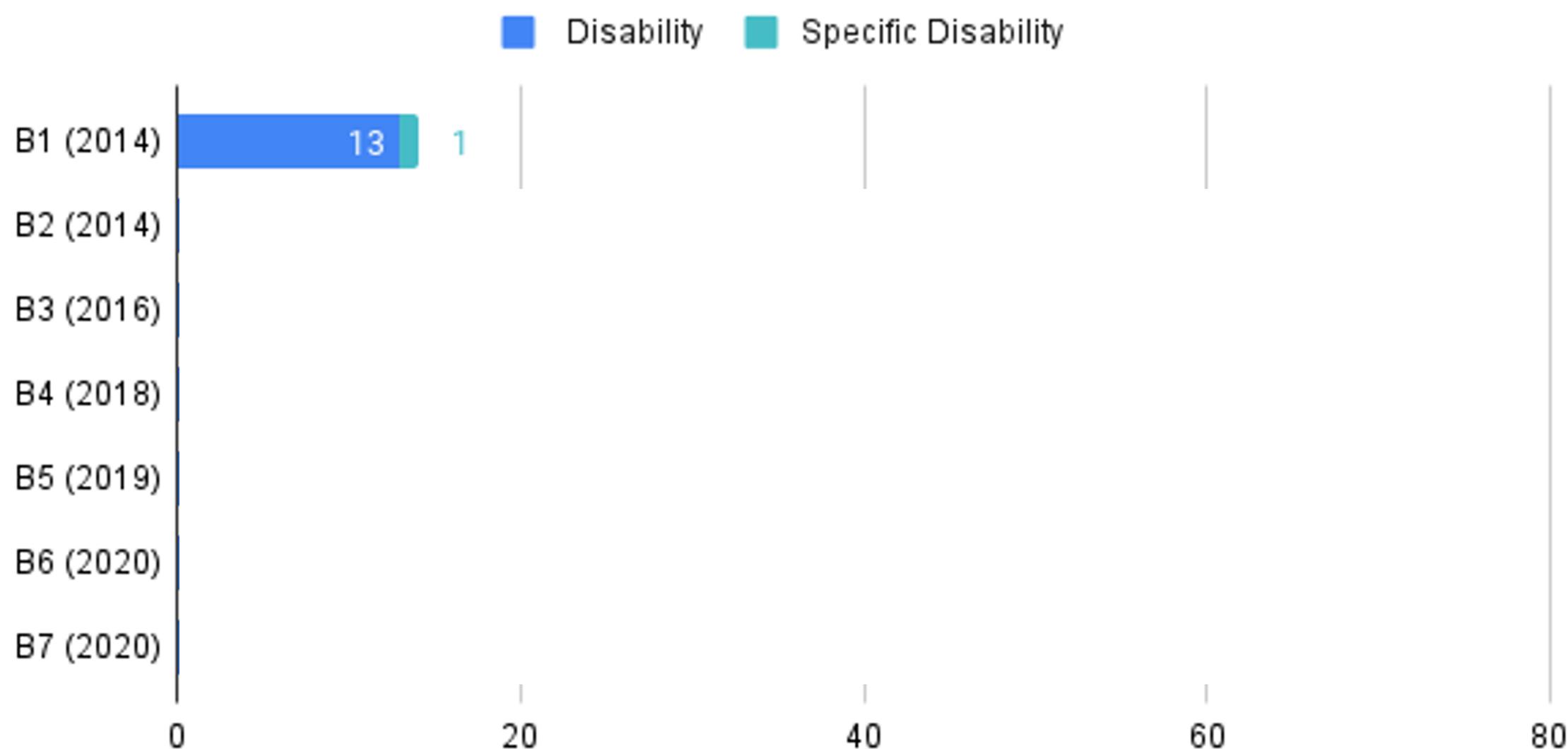
A game game (not a worksheet pretending to be a game)

Number of Mentions of General Disability versus Specific Disability in UDL texts for teachers

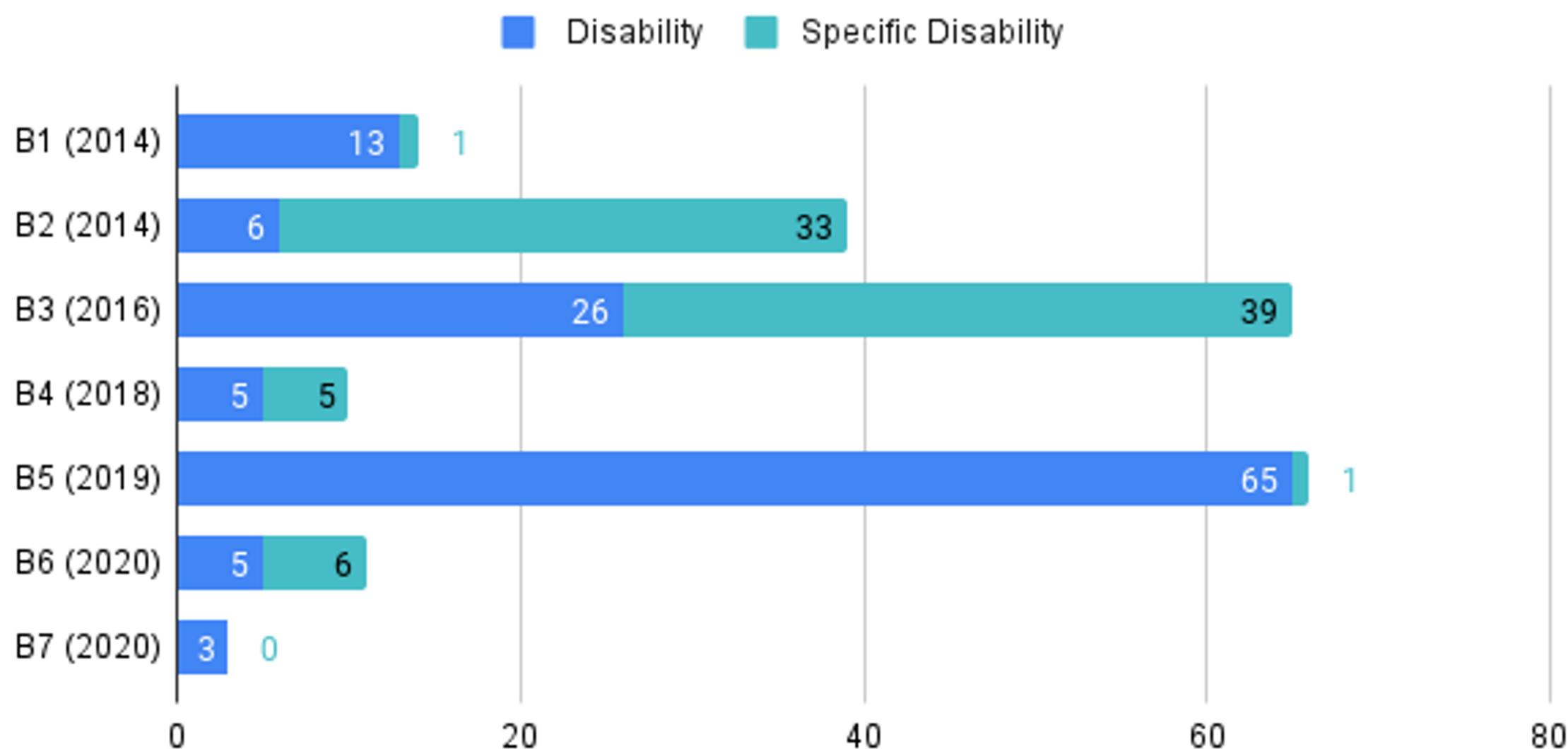
■ Disability ■ Specific Disability



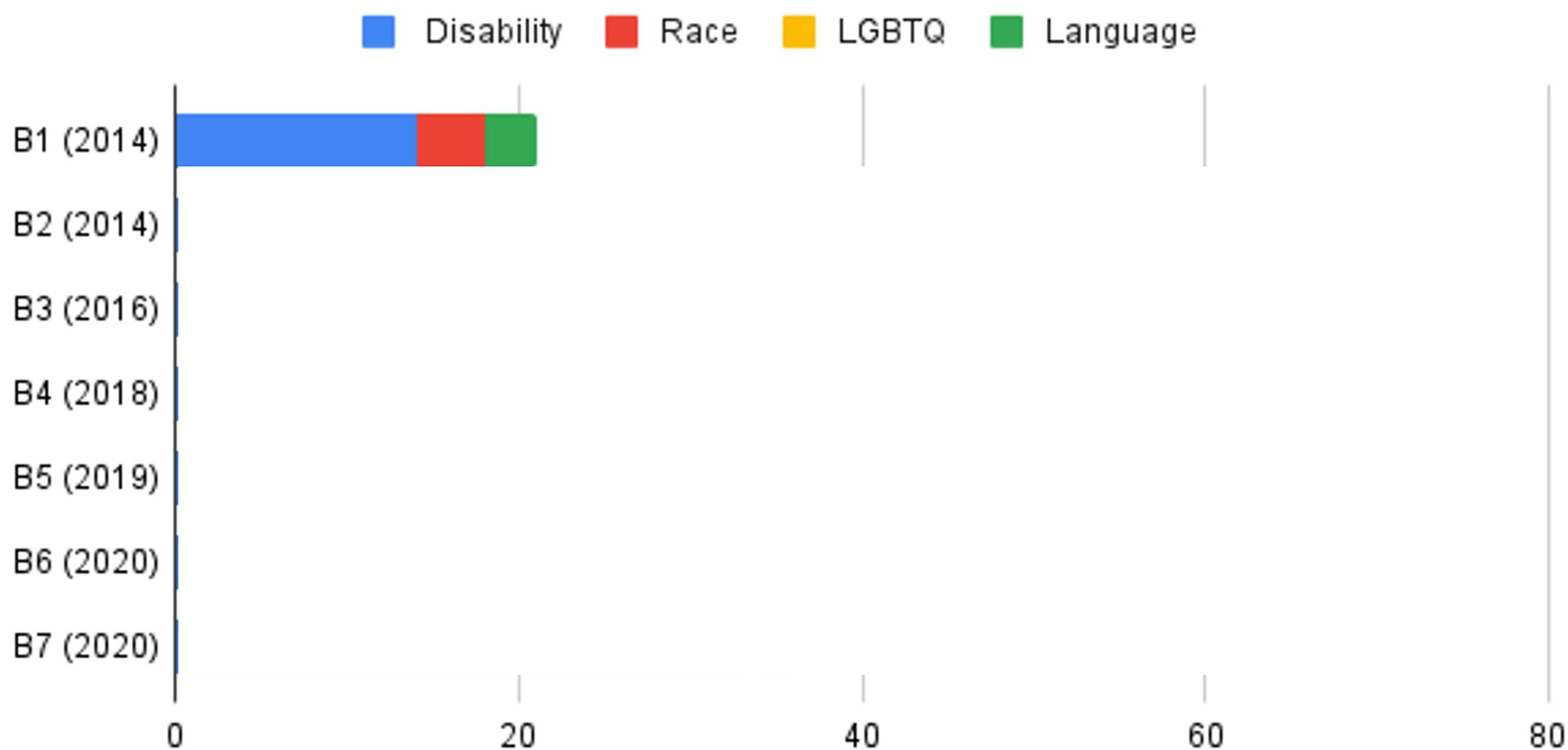
Number of Mentions of General Disability versus Specific Disability in UDL texts for teachers



Number of Mentions of General Disability versus Specific Disability in UDL texts for teachers



Number of Mentions of Disability, Race, LGBTQ and Language in UDL Texts for Teachers



Number of Mentions of Disability, Race, LGBTQ and Language in UDL Texts for Teachers

Disability Race LGBTQ Language

