Critical Reflection: Art Intervention in ADHD Math Classes — Centering Relationality, Interdisciplinarity, and Neurodiversity Against Datafication

Introduction:

I used to be a mathematics teacher interested in creative practice and inclusive education. Based on my previous working experience and interests, I designed an art-based intervention for one-on-one math classes with ADHD students in 7-12th grade, including sensory art for middle school students and rhythmic/kinetic art for high school students. Inspired by Laura Aldridge's sensory inclusion[2], Andrea English's educative listening[3], and John Dewey's 'confusion as learning'[4], this intervention also takes up some of the key datafication literature (like Neil Selwyn's *What's the Problem with Learning Analytics?*[5] and Elana Zeide's *The Structural Consequences of Big Data-Driven Education*[6]) to reshape those data-driven practices that marginalize neurodiverse learners. Below is my reflection in response to the feedback of instructor towards my blog and core course requirements.

1.Interdisciplinarity: Merging Theory, Neurodiversity, and Anti-Datafication

This intervention, then, can be powerful because it weaves creative practice with critical responses to datafication, which disproportionately does harm to students suffering from ADHD. Selwyn (2019)[5] critiques learning analytics for reducing education to 'proxy indicators' (p.12, Section 3.1), flattening ambiguous, embodied learning into quantifiable data, which ignores ADHD students' sensory-cognitive strengths of tactile engagement and dynamic thinking, that evade standard metrics. Zeide (2017)[6] further warns of 'techno-idealism': the flawed belief that algorithms can solve educational inequities without accounting for neurodiversity (p.167, Equity).

As Dewey (1933/1989)[4] insists, learning benefits from puzzlement: 'Reflective inquiry begins when we are puzzled' (p.121). It can be relevant to Burbules' (2015)[7] aporia — doubt as a necessary passage to learning. The clue is, this sets the development immediately against Selwyn's complaint[5] of 'reductionism' in education (p.12). In the middle school 'Pre-Algebra Terrain' activity, an imaginary 8th grade student, fumbling with the adjustments of the clay slope to pass through a point (2,5), experienced tactile aporia (collapsed clay, too flat gradients) instead of being instructed 'slope = rise/run.' The guiding question by the tutor ('*How does the clay feel when it's too steep?*') encouraged exploration, and preserved for the student the qualitative experience of 'feeling' gradient-something data-driven tools cannot capture.

Farinati & Firth (2017)[8] describe rhythmic listening as 'a bridge between self and others' (p.18). Against the techno-idealism of Zeide, for students with ADHD who struggle with

verbal working memory, Barkley (2015)[9] states, the adaptive platforms tracking 'eye movement engagement' do little to acknowledge the multiple sensory needs of diverse learners. Pairing staccato 2-beat rhythms with factoring, a sampling of the 'Algebraic Beats' high school activity, one 11th grader explained: 'Factoring feels like quick steps-you catch the right terms fast.' This merges sound art with math, relational building in its disregard for one-size-fits-all data logic.

2. Knowledge and Understanding: Unpacking Listening, Feedback, and Relationality

2.1 Nonverbal Observation as Educative Listening: Resisting Black-Boxing

English (2009)[3] defines educative listening as attending to cognitive interruptions (p.72) – unexpected responses that reveal blind spots. The instructor's feedback has nudged me to consider the relationship between tutor observation of clay use with this theory and Selwyn's (2019)[5] 'black-boxing' critique (p.12 Section 3.3): opaque algorithmic decision-making that disempowers students. For ADHD students, verbal expression is often difficult (American Psychiatric Association, 2013)[1] – they may 'feel' clay is 'right' but can't say why. A tutor's observation of a 7th grader swapping soft or hard clay for a right triangle ('*You're using hard clay for the hypotenuse – does it feel stable?*') acknowledges problem-solving that wasn't spoken. This transparent, context-aware practice resists data-driven tools dictating 'next steps' without explanation.

2.2 Feedback Rationale: Critiquing Coerced Labour

Instructor's feedback asked why I avoided direct verbal feedback. This was rooted in ADHD communication needs and

Selwyn (2019)[5] 'coerced labour' (p.14 Section 4.2): students being forced to generate data for platform profit. ADHD students struggle with translating sensory experience into words, so questions like '*Did the clay help?*' yield a lot of vague responses that become exploitative data. Instead, the intervention uses proxy methods for the gathering of data, such as duration of engagement (aim≥15 minutes), creative output analysis, e.g. a slope passing through point (2,5), and also visual *Likert scales*. These studies respect how ADHD students communicate while resisting Zeide (2017)[6] 'pervasive surveillance' (p.169) — with no third-party data collection, no permanent records of mistakes. Future iterations may include a 'material journal' (clay/pipe cleaner collages) to help bridge nonverbal and verbal expression.

2.3 Explicit Relationality: Countering Displaced Decision-Making

Relationality, as understood as mutual and empowering connections, is threatened by 'displaced pedagogical decision-making' (Zeide, 2017, p.169)[6]. In other words, teaching authority shifts from the public educator to private tech provider. This intervention rebalances powers in three ways:

- **Tutor-student:**Confirmation of material selections constructs trust — 'Why sandpaper for negative slopes?' — and inoculates against Zeide's concern that data tools 'constrain teacher autonomy' (165)[6].

Hypothetical Feedback: More student-initiated questions after activity

- **Student-math:**Art rehumanizes math — a 10th grade student called it 'something I can play with' — resisting Selwyn's critique of 'measurable-only indicators' (p.12)[5].
- **Student-self:**Validating the strengths of ADHD group

('I'm good at building — math can be building too')
encourages self-acceptance, sidestepped by
Zeide (2017)[6] 'computable competencies' (170) that
foreground quantifiable competencies.

3. Design Reflection: Challenges and Data-Driven Critiques

Hypothetical testing highlighted two major barriers: material accessibility through solving with household items such as playdough, and neurodiversity trainings for tutors.

Drawing on the literature on datafication, the intervention unpacks three critical harms:

- **Data reductionism:**Rejection of tracking 'correct answer,' qualitative experiences over quantification. This supports Selwyn's call (18)[5], for analytics that reflect lived reality.
- **Permanent records:**Does not record all errors; this protects Zeide's 'intellectual privacy' (Zeide, 2017,165)[6] and promotes the risk-taking needed to learn.
- **Techno-idealism:**Positions art as complementary, not a 'solution', acknowledging no single tool (digital or analogue) would resolve the needs of all neurodiverse
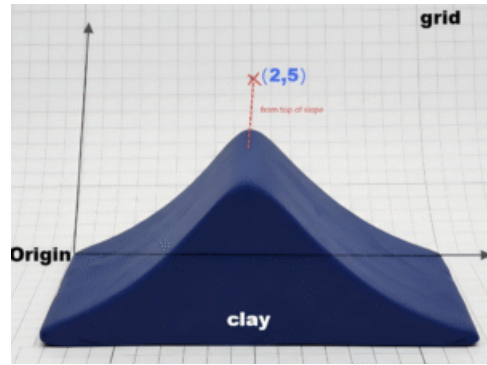
Supporting Resources[*]:

Three hypothetical resources can give rise to the intervention's process.

a. Photos of Clay Terrain:Annotated images of 'confusion traces' (collapsed clay) and 'milestones' slopes through (2,5), illustrating Dewey's aporia.
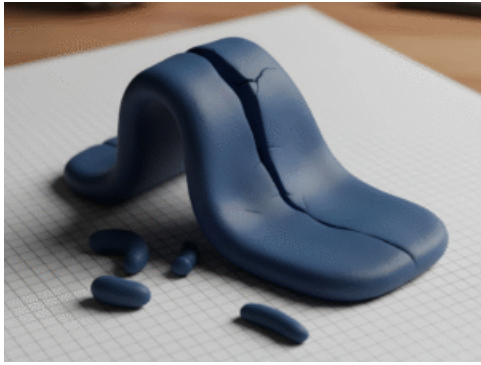
collapsed clay	milestones slopes

b. Algebraic Beats Audio: *A 30-second factoring drumbeat with a material journal reflection, capturing one's rhythmic listening.*

b.1 Factorization beat

https://blogs.ed.ac.uk/s2883198_relationality-creative-practice-and-education-fusion-on-site-2025-2026sem1/wp-content/uploads/sites/11889/2025/11/Factorization-beat.mp3

This beat is designed to map the core logic of polynomial factoring to rhythmic layers: find the greatest common factor (GCF) → split the middle term		
Kick Drum	Finding GCF	Hit on the 1st and 3rd beats; Set to strong velocity to represent this foundational, decisive first move in factoring that requires clarity.
Snare Drum	Trying to split the middle term	Fire on the 2nd and 4th beats. Use medium velocity to correspond to splitting the middle term, while the 4th beat snare is softer to mimic verifying the split result- a quick check to ensure accuracy.
Rhythmic Cycle	Repetitive practice	Repeat for 30 seconds, aligning with the repetitive, step-by-step nature of factoring practice.

b.2 Material journal reflection:

refer to the attached*: Supporting Resources (Hypothetical)

Adaptability Notes for ADHD Students:

- No writing is required; all expression is through hands-on collage, reducing executive function load.
- Sensory-focused: Draws on tactile/visual learning strengths of ADHD students.
- Simple choices: clear, concrete tasks, such as mold/bend, rather than open-ended demands. Low pressure: there's no 'right/wrong'way to create; this invites authentic expression free from feedback stress.

c. Tutor Journal Entry: *Observation of non-verbal messages, showing educative listening versus black-boxing.(refer to attached *: Supporting Resources (Hypothetical))*

Template Design Rationale:

- Observation Cues-Concrete: Prompts tutors to write down what they 'see/hear'and should not assume anything, which is important in students with ADHD, since their non-verbal cues are far more reliable than their verbal responses.
- Educative Listening Focus: Forces separation of 'cues'and 'interpretation' in order to avoid judgment, such as 'frustrated' versus 'unmotivated,' and centers the student's non-verbal "
- Action-forward: Each interpretation leads directly to a specific, modifiable action-no 'dry' observations-so the interventions would address the needs particular to ADHD: sensory, focus, and regulation.
- Anti-black-boxing: Section 'Reflection'enforces transparency in that tutors should indicate how conclusions are based on evidence, eliminating unaccountable decisions.

4. Conclusion

This intervention design has made me deeply realize that inclusive education involves the need to reimagine practices from the perspective of neurodiverse strengths while remaining resistant to datafication tendencies. In this, abstract concepts of mathematics are turned into a sensory and relational experience. Interdisciplinary theories and creative practices amalgamate here, resisting jointly data-driven simplification, surveillance, and the displacement of authority. Future plans for improvement will involve adaptable materials and student-led feedback tools, but the crux remains the same: education must empower rather than pathologize. As Aldridge (2022)[2] expresse, '*Make space for everybody*'. In this way, we resist not only the narrowing of educational datafication, but we also enrich outcomes for all.

References:

1. American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). APA.
2. Aldridge, L. (2022). 'Make space for everybody, make time for difference.'
3. English, A. (2009). Listening as a teacher: Educative listening, interruptions and reflective practice. Philosophical Inquiry in Education, 20(1), 69–82.
4. Dewey, J. (1933/1989). How we think. Southern Illinois University Press.
5. Selwyn, N. (2019). What's the problem with learning analytics? Journal of Learning Analytics, 6(3), 11–19.
6. Zeide E (2017) The structural consequences of big data-driven education. Big Data 5:2, 164–172, DOI: 10.1089/big.2016.0061.

7. Burbules, N. C. (2015). Aporias, webs, and passages: Doubt as an opportunity to learn. Curriculum Inquiry, 45(2), 171–190.
8. Farinati, L., & Firth, C. (2017). The force of listening. Errant Bodies Press.
9. Barkley, R. A. (2015). Attention deficit hyperactivity disorder: A handbook for diagnosis and treatment (4th ed.). Guilford Press.

*: Supporting Resources (Hypothetical)

1. Clay Terrain Photo Series: student-created algebraic landscapesgenerated by following sketch.
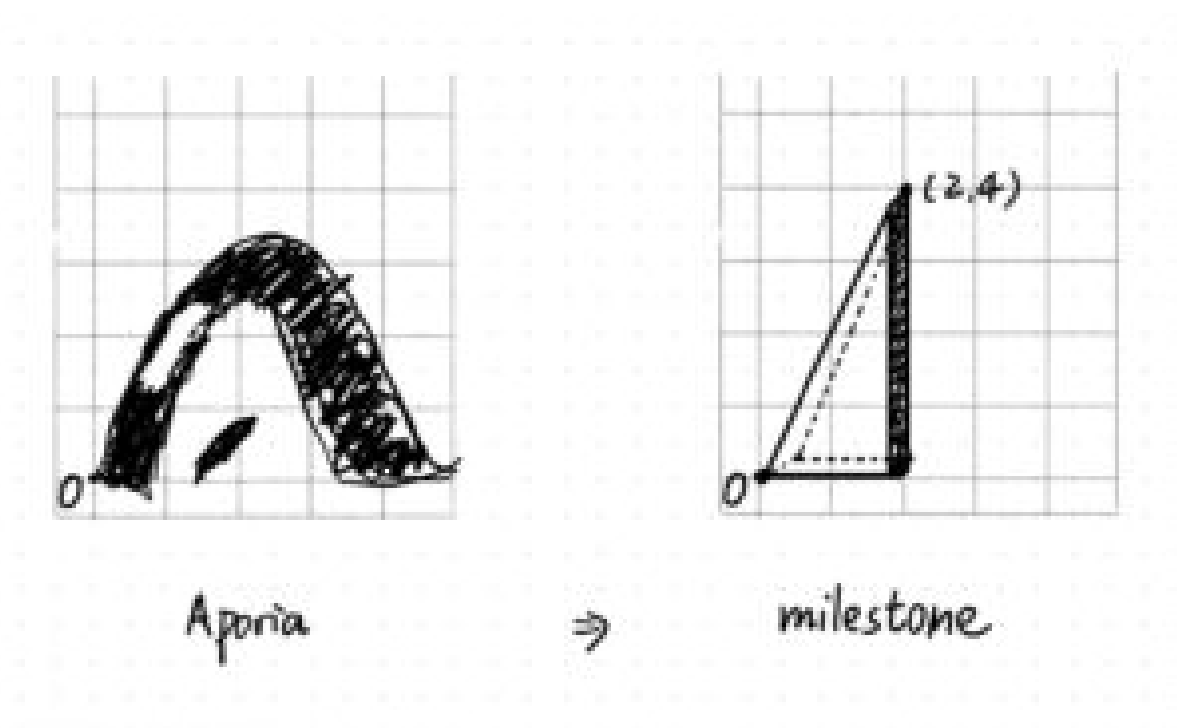
2. Algebraic Beats Audio Clip: Drumbeat composition+ material journal reflection

Drumbeat composition tool: https://www.soundtrap.com/

Material journal reflection template:

Material Journal (Template)

3. Tutor Reflection Journal Excerpt: Nonverbal cue

observations

Core Observation Areas (ADHD-Aligned)	Specific Non-Verbal Cues Observed (Concrete, Visible Details)	Educative Listening Interpretation (No Judgment—Based on Cues)	Action Plan (Grounded in Interpretation)
1. Emotional Engagement (From Collage Interaction)	– Clay Shape (e.g., smooth circle / crumpled ball / abandoned half-mold) – Pipe Cleaners Arrangement (e.g., neat alignment / tangled mess / favorite color focus) – Body Language (eye contact with material, e.g., sustained gaze / frequent distraction / fidgeting with material)	Example: "Crumpled clay + frequent fidgeting with pipe cleaners → student may feel frustrated with math steps; favorite color focus on beat-related collage → retains engagement with auditory cues."	Example: "Simplify step associations (1 clay piece = 1 beat/step); pair material with a visual timer to reduce overwhelm."
2. Learning Comprehension (From Collage Structure)	– Clay Step mapping (e.g., 2 distinct pieces = GCF right / random arrangement / missing steps) – Pipe Cleaners Beat alignment (e.g., steady stick / thin focus / no distinction between beats) – Collage Order: Logical sequence (e.g., favorite part → step mapping / jumbled sections)	Example: "2 distinct clay pieces (matches target step) but uneven placement → student grasps core associations but struggles with step sequence; no beat distinction in pipe cleaners → auditory cue needs reinforcement."	Example: "Use color-coded labels (e.g., red clay = Step 1) for sequence clarity; re-play beat with verbal 'tick—GCF' cues during next session."
3. Sensory Preference (From Material Interaction)	– Time spent (More focus on clay (tactile) / algebra beat (auditory) / equal engagement) – Interaction style: Mold clay repeatedly / bend pipe cleaners rhythmically / avoid touching one material	Example: "Spends 80% of time bending pipe cleaners to beat + ignores clay → strong auditory learning preference; rhythmic bending + beat helps regulate focus."	Example: "Prioritize algebra beat practice first; integrate clay as a 'step check' tool (e.g., after beat practice, use clay to confirm steps) instead of primary material."
4. Attention & Regulation (From Session Behavior)	– Sustained focus (Length of time on one task (e.g., 5 mins / 10 mins / frequent task switching) – Self-regulation: Calming cues (e.g., squeezing clay gently / humming beat / fidgeting uncontrollably)	Example: "Sustains focus for 7 mins on beat-pipe cleaners; → turns beat to self + material supports self-regulation; task switches when clay is too hard → tactile input needs adjustment."	Example: "Keep sessions to 10-min chunks (align with focus window); provide softer clay for next session to reduce frustration."
5. Educative Listening Reflection (Avoid Bias Among)	– What non-verbal cues did I (most) misinterpret? (e.g., "fidgeting = inattention" vs. "fidgeting = regulating focus with material") – How did I ground interpretation in evidence (not guesses)?	Example: "Almost labeled 'task switching' as inattention, but student returned to beat practice repeatedly → switching = self-correction; interpretation tied to rhythmic pipe cleaner bending +..."	Example: "Document cue patterns over 3 sessions to identify consistent needs; avoid vague conclusions (e.g., 'student is unengaged') without specific cue support."

Revised | Art Intervention in One-on-One Math Classes for 7-12th Grade Students with

ADHD

In one-on-one Maths classes, students in Grades 7-12 with ADHD (*Attention Deficit Hyperactivity Disorder*) are often struggling with abstract concepts. This intervention draws on literature, including not only Laura Aldridge's *Make Space* (sensory art for marginalized learners), but also Andrea English's *educative listening* (attending to students' cognitive cues or interruptions). It is also inspired by Farinati & Firth's *rhythmic listening* (collective relational building through sound) and the concept of transforming aporia (the disorientation of doubt) into a learning passage, consistent with Dewey's emphasis on embracing confusion as an integral part of reflective inquiry. It focuses on a creative case study adapted from Aldridge's sensory workshops, providing art interventions to Middle School (7-9th) and High School (10-12th) respectively.

Context:

One-on-one Maths classes for students with ADHD in Grades 7-12.

Impacted Groups:

- ADHD students with strengths in sensory engagement and dynamic thinking
- Maths tutors who are seeking strategies to reduce distraction and deepen conceptual understanding.

Middle School (7—9th Grade)

Informed by the emphasis of sensory inclusion (Aldridge, 2000), students use clay to model linear slopes, sandpaper to represent inequality shading, and foam spheres to build geometric proofs. This aligns with the work of Burbules, where sensory materials are used to transform the student's aporia (the feeling of confusion or being lost in abstraction) into a

tactile passage for exploration

- ## <u>Activities</u>

Pre-Algebra Terrain: Manipulate clay landscapes to solve equations

e.g., by changing and touching the slope of clay, students can feel the difference between gradients. Moreover, students can be instructed to adjust the slope to make the clay pass through one specific point.
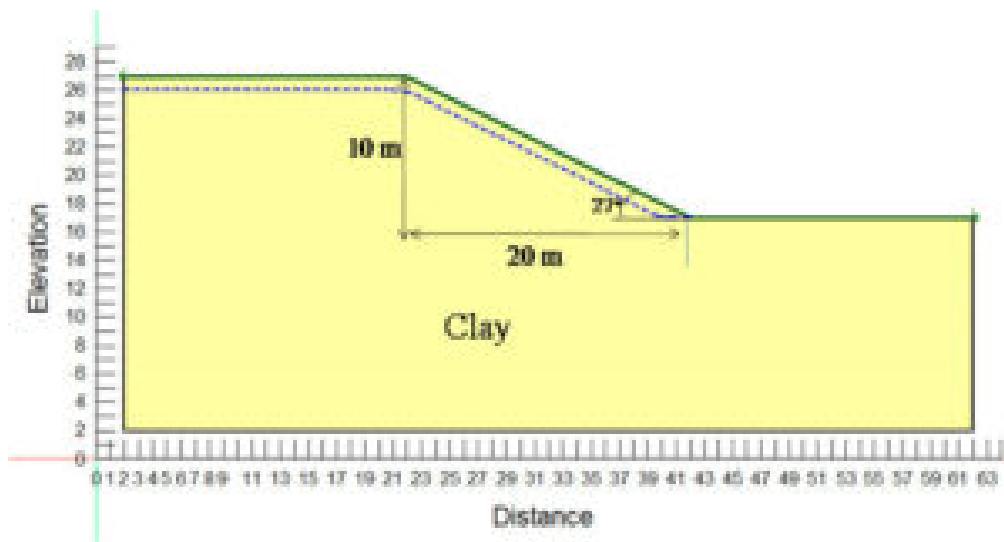
Geometry Sculpture: Construct 3D models of theorems

e.g., when learning Pythagorean Theorem, tutors can use three pipe cleaners with different lengths a, b, c to form a right triangle. Foams are used to construct three rectangles with side lengths a, b and c. By comparing the areas of rectangles, students can investigate the relationship between a^2, b^2 and c^2.

- **<u>Effect Measurement</u>**
  - *Observation*: Track student-initiated problem-solving and engagement duration (aim: ≥15 minutes/activity).
 - *Tutor Reflection*: How did sensory materials change the student's approach to pre-algebra or geometry?

High School (10–12th Grade)

Inspired by Farinati & Firth's emphasis on collective listening, these activities integrate the learner's behavior (rhythm/movement) into the construction of mathematical systems, ensuring ADHD learners' sensory strengths become integral to meaning-making.

- **<u>Activities</u>**

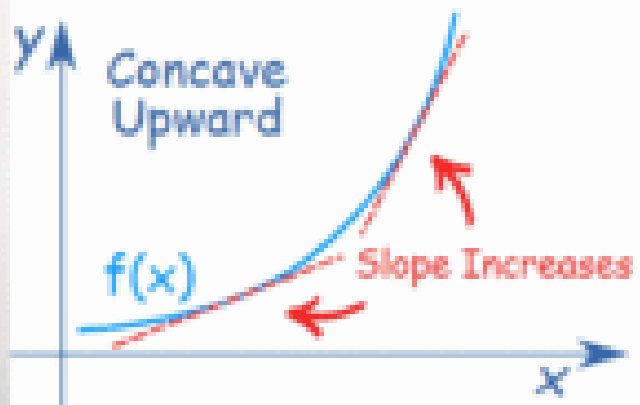 **Algebraic *Beats*: Assign rhythms to algebraic operations**

  e.g., Factoring = 2-beat staccato and explain logic .
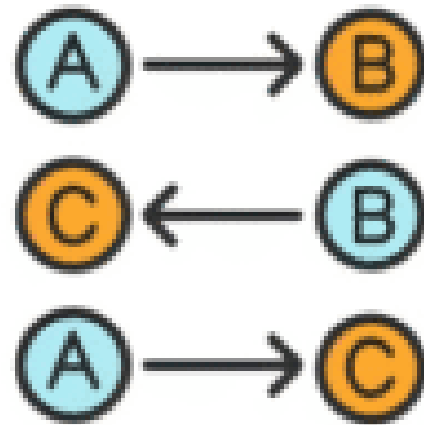
Logic Maths

Kinetic Calculus: Map concepts to physical movement

e.g., Upward curve = arm rising and reflect on connections.

- **Effect Measurement**

    - *Media Analysis*: Count unique rhythms/movements and their alignment with mathematical logic.
    - *Student Survey*: Did rhythm/movement deepen your understanding of algebra/calculus? (Likert scale, 1–5).

Interdisciplinary Alignment & Relationality

- *Middle School*: Sensory landscapes foster tutor-student relationality — tutors 'listen' to material choices.
- *High School*: Rhythmic/kinetic activities build student-math relationality — ADHD learners' sensory strengths become integral to mathematical meaning-making (Aldridge's argument for PMLD learners).

In conclusion, instead of treating ADHD students' sensory-cognitive traits, like liking hands-on work or being sensitive to rhythms, as learning barriers, these interventions can help students grasp Maths and make student-tutor interactions smoother. Furthmore, these designs aren't random but rooted in interdisciplinary research and creative practices.

Reference

1. Farinati, L., and Firth, C. (2017). *The Force of Listening*. Berlin: Errant Bodies Press.
2. Aldridge, Laura. "Make Space for Everybody, Make Time for Difference". Artlink, 2022.
3. English, A. (2009). Listening as a teacher: Educative listening, interruptions and reflective practice. Philosophical Inquiry in Education.
4. Dewey, J. (1933/1989). How We Think. The Later Works. Vol. 8 (pp. 105-352). Carbondale: SUP.
5. Nicholas C. Burbules (2015). Aporias, Webs, and Passages: Doubt as an Opportunity to Learn

Art Intervention in One-on-One Math Classes for 7–12th Grade Students with ADHD

Backgrounds:

In one-on-one math classrooms for 7–12th grade students with ADHD, sustaining focus on abstract concepts like algebra and geometry is a common challenge. This intervention draws on key ideas from course readings:

- Laura Aldridge's **_Make Space_** (sensory art as an engagement tool for marginalized learners)
- Andrea English's **_Educative Listening_** (prioritizing students' sensory-cognitive cues).

This case study is adapted from Aldridge's sensory workshops, reimagined for secondary math's complex topics.

Context:

One-on-one math lessons for 7–12th grade students with ADHD.

Impacted groups:

ADHD students (needing sensory-rich, interactive ways to grasp advanced math) and their tutors (seeking strategies to minimize distraction and deepen conceptual understanding).

Initial Intervention Proposals:

1. Sensory Algebra Sculpting:

Students use materials like wire (stand for linear equations),

foam blocks (stand for quadratic curves), and fabric (stand for inequality shading) to build 3D representations of algebraic concepts. This leverages ADHD learners' sensory strengths, as highlighted in Aldridge's work on ***non-elitist art engagement***.

2. Rhythmic Geometry Proofs:

Tutors introduce hand drums or metronomes to set a rhythm for breaking down geometric proofs (e.g., one beat for state the theorem, three beats for cite congruent triangles).

Tutors practice English's ***educative listening*** by adjusting rhythms based on students' engagement signals (e.g., faster tempo if a student leans forward, slower if they fidget).