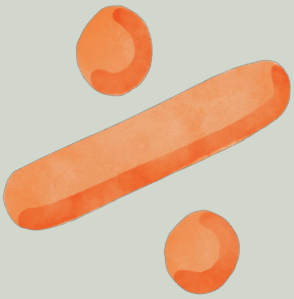


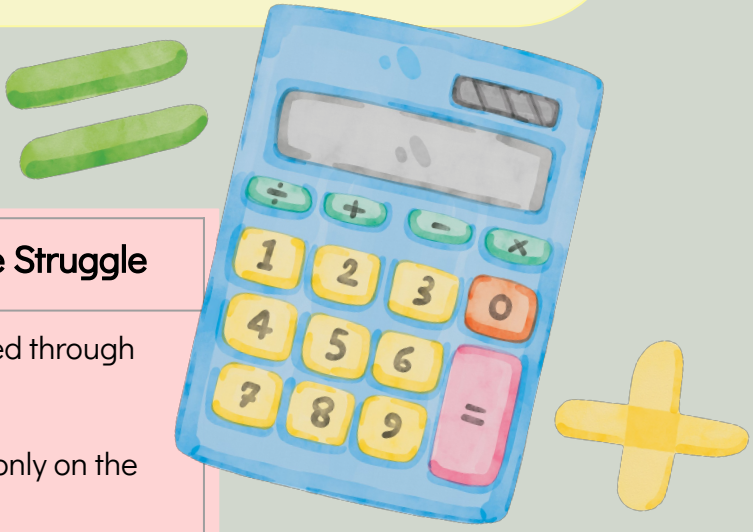
A Handbook on Productive Struggle in Elementary School Classrooms

Broek MacDonald, 2025

What is Productive Struggle?

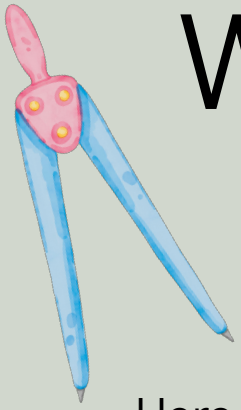
Productive struggle can be thought largely of persevering in an unclear challenge so that one makes progress and learns along the way (SanGiovanni et al., 2020). It involves having the determination and grit to persevere and work towards a goal. In mathematics, conceptual understanding and learning can occur throughout the process of productive struggle in a challenging math problem, and not just through the completion of the task. Productive struggle focuses on the process of learning, rather than the product of learning. To engage in authentic problem solving, there needs to be struggle. This struggle helps foster a mathematical disposition and honours "getting stuck" as an essential and important part of mathematical learning that needs to be normalized for our students (Biccard, 2021; Marjorie Henningsen et al., 1997; Mason et al., 2010). Productive struggle is about fostering resiliency in learning.

It is important to note that not all struggle is productive, and therefore engaging in productive struggle in the classroom requires thoughtful consideration from teachers (Kapur, 2016)



Productive Struggle	NOT Productive Struggle
-Students have time to struggle	-Students are rushed through problems
-Learning through the process	-Learning focused only on the product
-Collaborating with peers	-Seeking teacher affirmation
-Getting stuck and moving through it	-Getting stuck and giving up
-Multiple and creative approaches welcomed	-A single approach to a problem
-Teachers providing feedback on perseverance, strategies, and giving probing guidance	-Teachers praising smarts and telling students the prescribed method

Reflection: Consider a time when you persevered in trying something new?



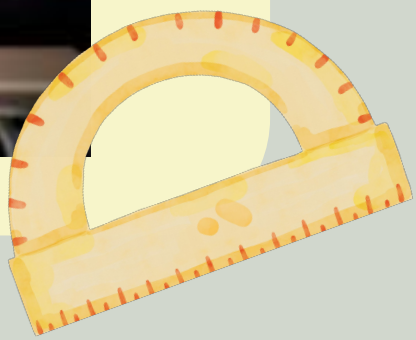
What is Productive Struggle?

Here are some more video resources that help explain what productive struggle is and what it looks like in a classroom.

(Reimagine Learning, 2017)

(McGraw Hill PreK-12, 2017)

(Edutopia, 2021)



The WHY of Productive Struggle

The National Council of Teachers of Mathematics published eight effective teaching practices. Two of these can be directly connected to placing students in authentic problem solving situations and supporting their productive struggle as they grapple with the challenge (NCTM, 2015).

By engaging in the hard work of persevering through a challenging task, the following benefits occur for students:

- Students learn throughout the process
- Students begin to see themselves as capable of solving challenging problems
- Students engage in creative thinking, rather than rote memorization
- Students develop a growth mindset

Productive Struggle leads to better learning!

Reflection: Can you think of something that you were not very good at when you first started, but have since improved in?

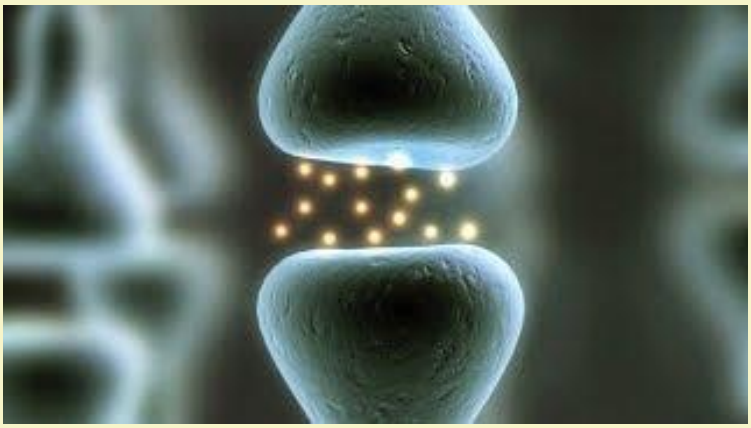
(Boaler, 2022)

The WHY of Productive Struggle

Productive struggle is a disposition that is closely related to fostering a growth mindset. Although a common term in the Educational sphere, the research behind Growth Mindset is not always well understood. Carol Dweck (Boaler & Dweck, 2015) is a leading mind behind Growth Mindset and emphasizes its value in fostering a disposition of learning.

Fixed Mindset

Growth Mindset



(Ted Talk, 2014)

First Steps: Fostering a Mathematical Classroom Community

Whether we intend to or not, the choices we make as teachers directly impact the culture of our classroom. This is known as the "Enculturation Model of Teaching"(Tishman et al., 1993). While it may seem daunting that our actions as teachers have such an impact on the culture of our classroom, it is actually a powerful tool when we understand how we can shape classroom culture to the benefit of students.

To reaffirm a disposition that teachers want to be part of their classroom culture, teachers can implement three reaffirming strategies.

3 Strategies for Fostering a Disposition in your Classroom Culture

1. Provide exemplars of the disposition
2. Facilitate opportunities for the students to engage in the disposition
3. Directly teach the disposition

Tishman et al, 1993

Fostering Productive Struggle with these 3 Strategies

1. Teacher models struggling in a problem and persevering
2. Teacher plans tasks in which students can engage in productive struggle
3. Teacher directly teaches lessons on what productive struggle is and why it is important

First Steps: Fostering a Mathematical Classroom Community

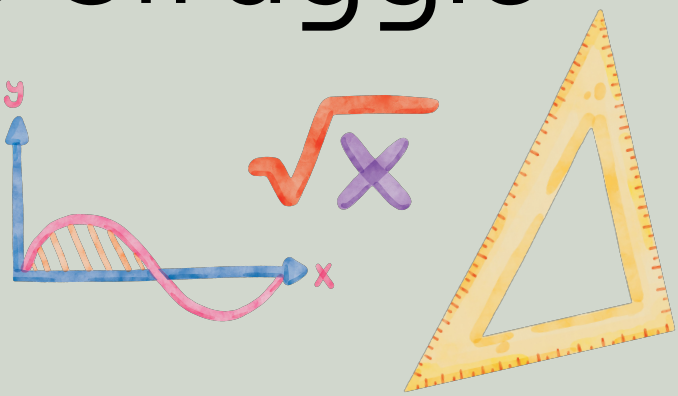
In order to foster a classroom culture that is conducive to promoting a mathematical disposition of Productive Struggle, teachers may wish to teach a short unit that focuses on establishing the dispositions, attitudes, and habits that you wish your students to embody. Keep the "Enculturation Model of Teaching" (Tishman et al., 1993) in mind when planning your lessons.

Reflection: What do you think would be the three most important lessons for fostering a culture of productive struggle?

A list of Possible Lessons to include in a unit for Establishing your Mathematical Classroom Community

- There's no such thing as a "Math Person" (Boaler, 2024)
- Everyone Makes Mistakes (Boaler, 2024)
- Math is about Creativity (Boaler, 2024)
- Math is about Communication (Lempp, 2022)
- Math is about respecting others' ideas (Sangiovanni et al., 2020)
- Math is about taking risks (Sangiovanni et al., 2020)
- What can you do when you get stuck (Sangiovanni et al., 2020)
- Having a growth mindset (Boaler & Dweck, 2015)
- What is Productive Struggle
- Math is about Collaboration (Lempp, 2022)
- Speed does not equal success (Boaler, 2024)
- Math is about reasoning
- Math is about justifying
- Math is about using tools

How to Find or Create lessons that foster Productive Struggle



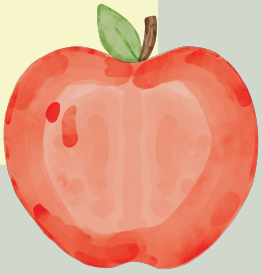
Checklist for a Task that would Foster and Support Productive Struggle in Students:

- ❑ The task is open-ended and allows for multiple creative approaches (Boaler, 2021)
- ❑ The task may include multiple correct responses (Boaler, 2021)
- ❑ The task is within your student's zone of proximal development and will provide a reasonable amount of challenge without leading to unproductive struggle (Kapur, 2016; Kirschner et al., 2006; SanGiovanni et al., 2020)
- ❑ The task can be accessed by all of your students with scaffolding and support, but does not require the teacher to provide different tasks to different students (Kang, n.d)
- ❑ Allows the teacher to confer with students and provide informative feedback (Kang, n.d)
- ❑ Allows students adequate time to engage in the problem solving (Clarke et al., 2014; Henningsen et al., 1997; Sullivan et al., 2015)

Places to find Productive Struggle Tasks

- Professional Book Resources
- Websites, such as youcubed.org
- Adapting tasks you already use in your classroom
- Published Curriculum supports
- The Resources section of this handbook

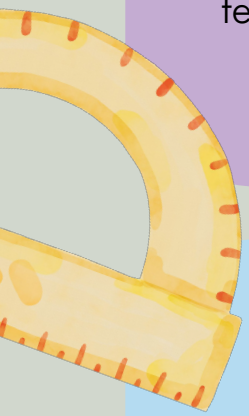
Reflection: Think of a lesson you can adapt to meet this criteria?



Role of the Teacher

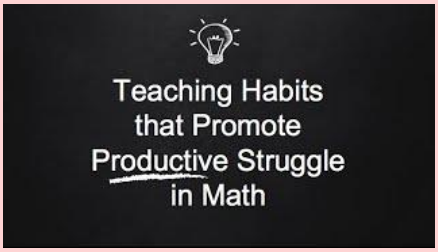
Once you have found or created tasks that would be conducive to students engaging in productive struggle, it is up to you as the teacher to implement them in a manner that continues the culture of productive struggle. This is to say that just because a task meets the requirements of the checklist for Productive Struggle tasks does not mean that Productive Struggle will be fostered in your students.

The actions you take as a teacher to scaffold, question, and provide feedback while students are engaged with the task are the true keys to fostering Productive Struggle. These teacher moves are also the most intricate element of fostering Productive Struggle in the classroom. It requires proactive planning, teacher responsiveness, and anticipation of student struggles and needs to ensure you are prepared to attend to student struggle.

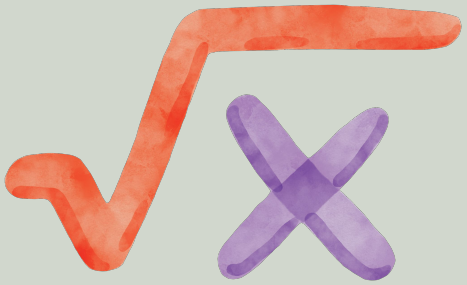


Some Key Pedagogical Moves for Fostering Productive Struggle

- Providing students with adequate time to grapple with the challenge (Clarke et al., 2014; Henningsen et al., 1997; Sullivan et al., 2015)
- Opportunities for classroom discussion to share strategies and student thinking (Clarke et al., 2014; Henningsen et al., 1997; Sullivan & Mornane, 2014)
- Teacher Questioning (Clarke et al., 2014; van de Pol, 2010)

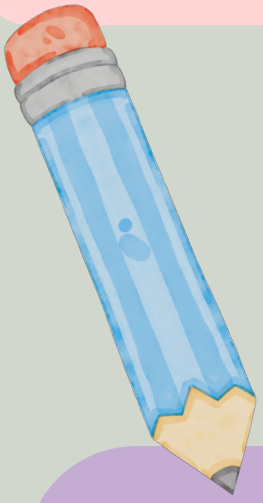


(Mind Education, 2016)



Role of the Teacher: Planning and Scaffolding

Through teacher planning and scaffolding, teachers can navigate the balance between attending to student struggle to move the learning forward and avoiding rescuing students from their struggle by providing them with too much support and diminishing the challenge. These pages provide examples of teacher roles that support student struggle.



Example One: Pre-Planning

Prior to engaging in a task, teachers can proactively set their students up for struggle by reminding them of the value of struggle and reviewing strategies at their disposal during times of struggle. Additionally, teachers may spend time anticipating student struggles with a task before implementing in the classroom and think of ways in which they will attend to these struggles in the moment. (SanGiovanni et al., 2020)

Example Two: Student Collaboration

As a teacher circulating and conferring with students during a Productive Struggle task, you may notice students who have encountered a moment of being stuck that another student had previously encountered. You may encourage that student to collaborate with their peer in order to attend to their struggle and support their forward momentum. (SanGiovanni et al., 2020)

Scaffolds, Questioning, and Feedback: Role of the Teacher

Example Three: Classroom Debrief

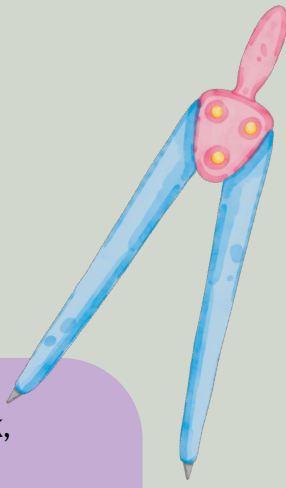
With this strategy, a teacher may pause the problem solving and gather the class to debrief the struggles they've encountered and what they have figured out so far. This sharing of ideas can help reset students to re-engage with the Productive Struggle task and learn from their peers. (SanGiovanni et al., 2020)

Reflection: which of these examples could you see being most effective in your classroom? Can you think of other examples that could work?

Example Four: Number Swap

Sometimes students may geet stuck in a problem because of the challenge of grappling with complex numbers. In order to help a student move through this struggle, it may be beneficial for the teacher to swap the numbers out. This allows students to gain a better understanding of the process of the problem, and then re-engage with the more complex numbers once an understanding of the context of the problem is achieved. (SanGiovanni et al., 2020)

Role of the Teacher: Scaffolding and Questioning



Depending on how students are situated within a productive struggle task, teacher prompts and responses may need to vary. Based on the work of Warshauer (2015), and SanGiovanni's (2020) adaptation of this continuum, the following responses to struggle can be used to attend to student struggle and to scaffold them towards continued learning throughout the process. Although teacher responses vary on this continuum based on individual students and varying tasks, probing guidance is an approach that encourages process over product and is a "sweet spot" moment for productive struggle to occur, although all responses have their appropriate time and place.

Telling — **Directed Guidance** — **Probing Guidance** — **Affordance**

Reflection: Can you think of an instance where you may use each of these responses to struggle?

Role of the Teacher: Scaffolding and Questioning

Telling

This response to struggle involves the teacher supplying information and pointing students in a specific direction. This response can be useful in correcting a critical error in student work and then redirecting students back to engaging in struggle. It important to note that this approach lessens cognitive demand on students (Warshauer, 2015 & SanGiovanni et al., 2020).

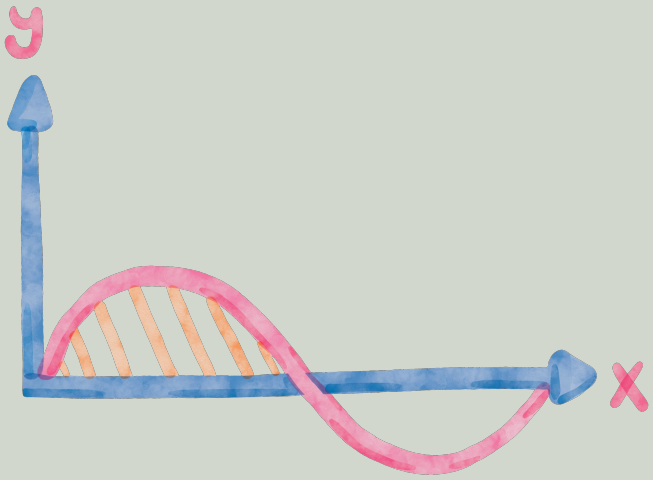
Directed Guidance

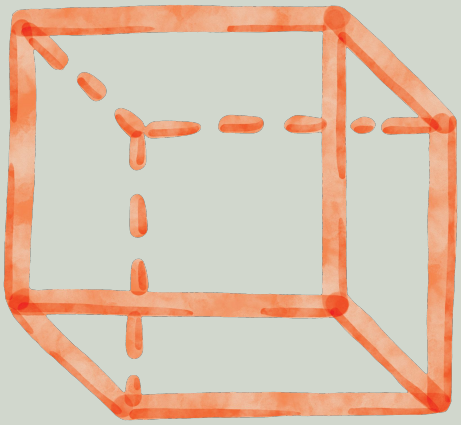
This response to struggle redirects student thinking. The teacher suggests something specific the student can try to continue their forward momentum in the struggle. This approach likely lessens or maintains cognitive demand (Warshauer, 2015 & SanGiovanni et al., 2020).

Role of the Teacher: Scaffolding and Questioning

Probing Guidance

This response to struggle involves having students justify their thinking or actions and prompts students to go deeper in their thinking and understanding. The teacher uses questioning to help students get "unstuck" without offering a specific pathway to try. This maintains the cognitive load of a task (Warshauer, 2015 & SanGiovanni et al., 2020).





Affordance

This response to struggle involves affording students more time to grapple with a task and build on their own understanding. This response involves very little teacher intervention and encourages peer discussion and reflection on strategies implemented. This response raises the cognitive load on students (Warshauer, 2015 & SanGiovanni et al., 2020).

Role of the Teacher: Teacher Feedback

As students engage in their tasks, teachers should be providing feedback to students as they work. This feedback and praise should be aligned with the disposition of Productive Struggle we are trying to foster in our students. Therefore, the feedback should focus on the process that the student is engaged in, rather than the outcome or product of their work, or any inherent ability they may possess. For instance, teachers should not tell students they are smart or tell focus on the speed in which they completed a task. This feedback should also celebrate mistakes and getting stuck as part of the learning process.

(Carol Dweck., 2022)

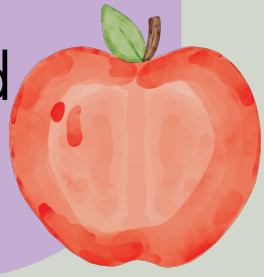
Reflection: Can you think of 3 process feedback ideas?

Teacher Process Feedback

- What would you like me to notice?
- I am giving you this feedback because I believe in you!
- That's a lovely idea!
- You are thinking creatively!
- You are thinking ahead!
- You are persevering!
- You are being mindful of your strategies!
- You are using your tools strategically!
- You are trying multiple approaches!
- You are using your best effort!
- What will you work on next?

Classroom Resources

In order to truly have a classroom community that fosters a disposition of Productive Struggle in students, the physical environment should reflect these beliefs, teacher questioning should reinforce the importance of productive struggle, and teacher feedback should reinforce the value of struggle in learning. While a comprehensive appendix of resources is provided in this handbook, the next few pages also include reproduceables that can be used in classroom settings to reinforce the value and importance of Productive Struggle in learning mathematics. The resources include classroom posters, teacher feedback quick reference sheet, and teacher questioning prompts.



Mistakes make your brain grow!

Mistakes are proof that you are trying!

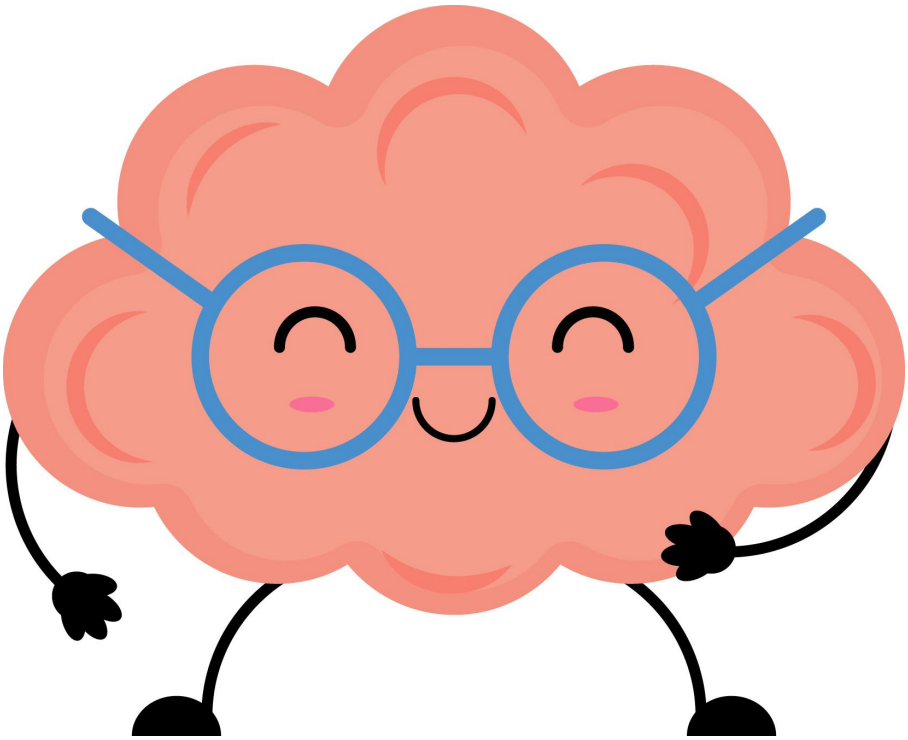
Have a growth mindset!

Sometimes what we call “failure” is really just the necessary struggle called “learning”.

Mistakes are proof that you are trying!

Have a GROWTH mindset!

Mistakes make your brain grow!



Teacher Prompts for Attending to Student Struggle

Depending on how students are situated within a productive struggle task, teacher prompts and responses may need to vary. Based on the work of Warshauer (2015) the following prompts can be used to attend to student struggle and to scaffold them towards continued learning throughout the process.

Telling	Directed Guidance	Probing Guidance	Affordance
Teacher Prompt: -Could you try using _____ strategy? -I need to show you something about your work before you continue with your struggle.	**Teacher prompt:** -Sounds like you've tried ____ strategy, are there other strategies you could try?	**Teacher Prompt:** -Tell me what you are thinking? -I hear that you are thinking ____, an idea connected to your thinking would be ____. -Can you explain your thinking to me?	**Teacher Prompt:** -Why does that strategy work? -Can you prove your thinking? -Take some more time to deepen your understanding. -Why does that answer make sense?

Teacher Process Feedback

- What would you like me to notice?
- I am giving you this feedback because I believe in you!
- That's a lovely idea!
- You are thinking creatively!
- You are thinking ahead!
- You are persevering!
- You are being mindful of your strategies!
- You are using your tools strategically!
- You are trying multiple approaches!
- You are using your best effort!
- What will you work on next?

Most importantly, avoid praise on speed and "being smart"

Idea of Process based Feedback: Mueller & Dweck, 1998

Appendix of Resources

Podcasts

1. Making Math Moments Podcast
2. Learning Through Problems and Struggle
3. The Psychology Podcast with Carol Dweck
4. Family 360 with Jo Boaler

Professional Reading Resources

1. Productive Math Struggle: A 6-Point Action Plan for Fostering Perseverance
2. Mindset: The New Psychology of Success
3. Mindset Mathematics Series K-8
4. Mathematical Mindsets
5. Mathematics Tasks for the Thinking Classroom

Websites

1. Youcubed.org
2. Mathematical Mindset Teaching Resources
3. Simcoe County School District First 20 Days of Math
4. Math for Love Rich Tasks
5. Open Middle Challenging Tasks
6. nRich Math

Online Professional Learning

1. John SanGiovanni NCTM PD Notes
2. NCTM PD Notes on Supporting Student Productive Struggle
3. Mindset Mathematics Course

Citations

Biccard, P. (2021). Productive struggle in mathematics. *For the Learning of Mathematics*, *41*(1), 39–41.

Boaler, J. (2024, July). *How to Move Beyond Damaging Labels*. *Mathematical Mindsets*.

Boaler, J., Munson, J., & Williams, C. (2021). *Mindset mathematics: Visualizing and investigating big ideas. grade 1*. Jossey-Bass, a Wiley Brand.

Boaler, J., Munson, J., & Williams, C. (2021). *Mindset mathematics: Visualizing and investigating big ideas. grade 2*. Jossey-Bass, a Wiley Brand.

Boaler, J., & Dweck, C. (2015). *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching*. John Wiley & Sons, Incorporated. http://ebookcentral.proquest.com/lib/ualberta/detail.action?docID=4444210

Clarke, D., Roche, A., Cheeseman, J., & van der Schans, S. (2014). Teaching Strategies for Building Student Persistence on Challenging Tasks: Insights Emerging from Two Approaches to Teacher Professional Learning. *Mathematics Teacher Education and Development*, *16*(2). https://login.ezproxy.library.ualberta.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=edsaed&AN=rmitplus214061&site=eds-live&scope=site

Edutopia (2021, October 14). *How Productive Struggle Fires Up Learners.* [Video]. Youtube. https://www.youtube.com/watch?v=ZEaJ_VASrR0

Kang, H. (n.d.). 8 Teaching Habits that Block Productive Struggle in Math Students. *Mind Research Institute*. January 18, 2025, https://blog.mindresearch.org/blog/productive-struggle-in-math

Kapur, M. (2016). Examining Productive Failure, Productive Success, Unproductive Failure, and Unproductive Success in Learning. *Educational Psychologist*, *51*(2), 289–299. https://doi.org/10.1080/00461520.2016.1155457

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, *41*(2). https://doi.org/10.1207/s15326985ep4102_1

Marjorie Henningsen, Henningsen, M. A., Mary Kay Stein, & Stein, M. K. (1997). Mathematical Tasks and Student Cognition: Classroom-Based Factors That Support and Inhibit High-Level Mathematical Thinking and Reasoning. *Journal for Research in Mathematics Education*, *28*(5), 524–549. https://doi.org/10.2307/749690

Mason, J., Burton, L., & Stacey, K. (2010). *Thinking mathematically* (2nd ed). Pearson.

Math Workshop: Five Steps to Implementing Guided Math, Learning Stations, Reflection, and More (Lempp, 2017)

MccGraw Hill PreK-12 (2017, July 18) *What is Productive Struggle and why is it important?* [Video]. Youtube. https://www.youtube.com/watch?v=1OooQcdh6IQ

Mind Education (2016, April 28). *Teaching Habits that Promote Productive Struggle in Math.* [Video]. Youtube. https://www.youtube.com/watch?v=HAd8n5x0LxU

Mueller, C. M., & Dweck, C. S.: (1998). Praise for intelligence can undermine children's motivation and performance. Journal of Personality and Social Psychology, 75(1), 33–52.

Principles to actions: Ensuring mathematical success for all. (2015). The National Council of Teachers of Mathematics.

Reimagine Learning. (2017, July 24). *Productive Struggle.* [Video]. Youtube. https://www.youtube.com/watch?v=WUxTLo_yiqI&list=PLuc2LC9-QlnI_yC4_4h46tJQ0fb-B1fe2&index=5

SanGiovanni, J. J., Katt, S., & Dykema, K. J. (2020). *Productive Math Struggle: A 6-Point Action Plan for Fostering Perseverance*. Corwin Press. http://ebookcentral.proquest.com/lib/ualberta/detail.action?docID=6262011

Sullivan, P., Askew, M., Cheeseman, J., Clarke, D., Mornane, A., Roche, A., & Walker, N. (2015). Supporting teachers in structuring mathematics lessons involving challenging tasks. *Journal of Mathematics Teacher Education*, *18*(2). https://doi.org/10.1007/s10857-014-9279-2

Sullivan, P., & Mornane, A. (2014). Exploring teachers' use of, and students' reactions to, challenging mathematics tasks. *Mathematics Education Research Journal*, *26*(2), 193–213. https://doi.org/10.1007/s13394-013-0089-0

Ted Talk (2014, December 17). *The Power of Believing that You can Improve Carol Dweck Ted.* [Video]. Youtube. https://www.youtube.com/watch?v=_X0mgOOSpLU&t=316s

Tishman, S., Jay, E., & Perkins, D. N. (1993). Teaching Thinking Dispositions: From Transmission to Enculturation. *Theory Into Practice*, *32*(3), 147–153.

van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in Teacher—Student Interaction: A Decade of Research. *Educational Psychology Review*, *22*(3), 271–296.

Warshauer, H.K. Productive struggle in middle school mathematics classrooms. *J Math Teacher Educ* **18**, 375–400 (2015). https://doi.org/10.1007/s10857-014-9286-3

Clipart: ShinDesignsArt, MurphyandFrank, DoodlesFirst