PRODUCTIVE STRUGGLE IN POLYNOMIAL AND TRANSCENDENTAL FUNCTIONS

by

Aaron Harris & James Lee
College of Southern Nevada
AMATYC 2019 Milwaukee, WI
“Of course you have problems! You’re a math teacher.”

© 2012 Jonny Hawkins
DO YOUR HOMEWORK.
Purpose of Session

› Develop an understanding of the value of productive struggle in mathematics as a research-based approach to support student learning.

› Obtain ideas and examples of what productive struggle might look like in the classroom.
Overarching Issues

› What makes a difficult video game or puzzle so appealing to students that they will work at it for hours?
› What makes practicing a backhand in tennis worth the time and effort? A jumpshot? Skiing?
› Why do so many students not have the same determination surrounding learning difficult mathematics problems?
› Why is struggling to learn mathematics viewed in a negative light?
What are some factors that may prevent students and teachers from viewing struggle in mathematics as a positive and productive practice?

› School schedules and curriculum-pacing guides.
› Classrooms valuing behaviors that do not support good problem-solving routines.
› The flawed belief that you are either good at mathematics or you are not, and struggling with a mathematical task is not viewed as an opportunity to learn but rather a weakness.
› Cultural perspectives and story of Jim Sigler.
What Factors Influence a Student’s Disposition to “Struggle?”

- Students’ mathematical self-image.
- Do they find the task interesting? Does it have familiar or real-life context to make it meaningful?
- Do they believe that solving it is worth the effort?
What is Productive Struggle?

› Productive struggle—the process of effortful learning that develops grit and creative problem solving.

› Productive vs unproductive struggle—think about bench press with spotter.
Why is Productive Struggle Important?

› Perseverance, or continuing forward irrespective of struggle or difficulty, is an essential element in problem solving because the first or second approach or strategy may not result in a reasonable solution (Pasquale, 2015).

› The new brain evidence tells us that the most productive classrooms are those in which students work on complex problems, are encouraged to take risks, and can struggle and fail and still feel good about working on hard problems (Boaler, 2015).
Psychologist Jason Moser studied the neural mechanisms that operate in people’s brains when they make mistakes (Moser et al., 2011). Moser and his group found something fascinating. When we make a mistake, synapses fire. A synapse is an electrical signal that moves between parts of the brain when learning occurs.
Research Continued

› Moser found that when people make a mistake the brain has two potential responses. The first, called an ERN response, is increased electrical activity that is thought to occur when the brain experiences conflict between a correct response and an error. Interestingly, this brain activity occurs whether or not the person making the response knows they have made an error. The second response, called a Pe, is a brain signal thought to reflect conscious attention to mistakes. This happens when there is awareness that an error has been made and conscious attention is paid to the error.

› When I have told teachers that mistakes cause your brain to spark and grow, they have said, “ Surely this only happens if students correct their mistake and go on to solve the problem correctly.” But this is not the case. In fact, Moser’s study shows us that we don’t even have to be aware we have made a mistake for brain sparks to occur (Boaler, 2015)
Productive Struggle Tasks

› Cognitive demand of the mathematical task should be high to the extent that it provides a cognitive stretch for the student and builds on student thinking (think Vygotsky’s Zone of Proximal Development).

› Student struggle must be supported so that it is a positive endeavor and not one full of difficulties and frustration (Warshauer, 2014).
How to Support Productive Struggle

› Think about teaching a child to ride a bike. Do you ride it for them?

› Warshauer (2015) Suggest Four Strategies:
  – Teachers ask questions that help students focus on their thinking and identify the source of their struggle, then encourage students to look at other ways to approach the problem.
  – Teachers encourage students to reflect on their work and support student struggle in their effort and not just in getting the correct answers.
  – Teachers give time and help students manage their struggles through adversity and failure by not stepping in too soon or helping too much and thus take the intellectual work away from the students.
  – Teachers acknowledge that struggle is an important part of learning and doing mathematics.
Group Assignments

› Your group is assigned one problem.
› You will present your perspectives on the problem, such as
  – What do you project the hypothetical learning trajectory to be?
  – Where do you anticipate the students to struggle.
  – What questions could prompt students/groups that are “stuck?” (Please share those insights you noted)
  – What kind of background knowledge do you need to make sure it is within their “Zone of Proximal Development?”
  – How would you arrange the groups?
› If you finish and your group is ready to present, go ahead and look at the other problems.
References


References Continued

