Investigations in Productive Struggle:
The Calculus of Corvettes and the Seven Billion People Problem

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What is Productive Struggle?

For students:
Struggling at times with mathematics tasks but knowing that breakthroughs often emerge from confusion and struggle.
(NCTM, 2014, p. 52)

For teaching:
Effective mathematics teaching supports students in struggling productively as they learn mathematics.
Such instruction embraces a view of students’ struggles as opportunities for delving more deeply into understanding the mathematical structure of problems and relationships among mathematical ideas, instead of simply seeking correct solutions.
(NCTM, 2014, p. 48)

Teacher and Student Actions

Support productive struggle in learning mathematics
Teacher and student actions

What are teachers doing?

- Anticipate what students might struggle with during a lesson and being prepared to support them productively through the struggle.
- Giving students time to struggle with tasks, and asking questions that relate to the sources of their struggles and will help students make progress in understanding and solving tasks.

What are students doing?

- Helping students realize that confusion and uncertainty are a natural part of thinking by exhibiting emotions or frustrations, misconceptions, and struggles.
- Praising students for their efforts in making sense of mathematical ideas and perseverence in reasoning through problems.

The Calculus of Corvettes

The driver asked, “How many seconds did it take me to reach a speed of 60 mph?”

The Problem

The Seven Billion People Problem

In November 2011, the 7 billionth person was born.
(a) Is it true that if you laid out all the people on earth end to end, they would encircle the earth 266 times?
(b) Is it true that if all 7 billion people stood shoulder to shoulder, we would all fit into Los Angeles?

Hallmarks of a Good Task

- The problem solver must decide what mathematics to bring in
- The task uses real-life (often messy!) data
- The task requires mathematical modeling

Highlight from Preservice Teachers’ Reflection Responses

A cognitively demanding real-world task such as the Seven Billion People Problem can promote productive struggle and help shape students’ mathematical dispositions. This article explores how both the choice and implementation of a task is important, and highlights preservice teachers’ reactions at different stages of problem solving.

Abstract

A non-routine calculus task using data from a drag racing facility provides flexible learning opportunities to deepen students’ understanding of calculus. Hallmarks of a good problem are identified and student work samples are shared. In the ongoing quest to recognize worthwhile problems to bring to our classrooms, a task such as this not only addresses many content and practice standards simultaneously, but allows students to use mathematical modeling, data analysis, and calculus concepts in ways that are appropriate and meaningful.

References


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