Mathematics Learning: A Journey, Not a Sprint

By Matthew Larson posted yesterday

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One of the questions I am frequently asked goes something like this: “What do you think about acceleration?” The question is often asked in the context of teachers working with parents who want their child to skip grade level work or entire courses so they can get into the next grade or course more quickly. The parental goal more often than not is to ensure their child can complete calculus in high school. As a school district math curriculum administrator, I faced “acceleration pressure” from parents nearly weekly.

Should we support acceleration? This question, like many questions in mathematics education, does not have a binary answer. The answer is “it depends.” Sometimes acceleration is appropriate and sometimes it isn’t. What does the answer depend on? Here the answer is clearer: it depends on the student’s demonstrated significant *depth of understanding* of all the content that would be skipped. If a student demonstrates significant depth of understanding of some but not all the content that would be skipped, then this is more appropriately an opportunity for enrichment rather than acceleration.

Last fall NCTM released a new position statement titled *Providing Opportunities for Students with Exceptional Mathematical Promise* (recently endorsed by the National Association for Gifted Children) In this position statement NCTM argues that “when considering opportunities for acceleration in mathematics, care must be taken to ensure that opportunities are available to each and every prepared student and that no critical concepts are rushed or skipped, that students have multiple opportunities to investigate topics of interest in depth, and that students continue to take mathematics courses while still in high school and beyond.”

At the elementary level, and even into secondary school, **speed completing computational tasks or carrying out routine symbolic manipulations cannot be the basis for acceleration**. Too many parents, and others for that matter, still have a narrow definition of mathematics as computation and symbolic manipulation.

We must emphasize to parents, teachers, counselors, administrators, and students that the goals of learning mathematics are multidimensional and balanced: students must develop a deep conceptual understanding (why), coupled with procedural fluency (how), but in addition they also need the ability to reason and apply mathematics (when), and all while developing a positive mathematics identity and high sense of agency. All four goals are critical components of what it means to be mathematically literate in the 21st century.

There is evidence that students who speed through content without developing depth of understanding are the very ones who tend to drop out of mathematics when they have the chance (Boaler, 2016). Acceleration potentially decreases student access to STEM careers if it results in students dropping mathematics as quickly as possible, rather than cultivating and developing the joy of doing and understanding mathematics. This is important to point out to parents, as dropping out of mathematics is clearly not an outcome parents want to encourage.

Acceleration can also potentially reveal inequitable practices, bias, or structural obstacles within a school or district. It is critical to remember, as argued in the NCTM position statement, that "exceptional mathematical promise is evenly distributed across geographic, demographic, and economic boundaries." If the demographics of students accelerated in mathematics in your school or district are not evenly distributed across racial and economic boundaries, then reflection and analysis are necessary to determine why, and actions should be taken to remove whatever bias or structural barriers led to this inequitable outcome.

Here are some questions you can ask: What are the demographics of students in eighth grade algebra? Do they match your district's overall demographics? What are the demographics of students in calculus or AP Statistics? How do the demographics change from eighth grade algebra to AP Statistics or calculus enrollment? Was the instructional climate not supportive of each and every student? Was the instructional focus not on developing depth of understanding? Were students accelerated into eighth grade algebra on the basis of computational proficiency, but without the conceptual foundation necessary to be successful in the long run? These are some of the critical questions that need to be asked and addressed.

The recent Mathematical Association of America [MAA] Study of College Calculus and related article in the *Mathematics Teacher* addresses the issue of acceleration to calculus in K-12 schools. In his article addressing the MAA study, Bressoud (October, 2015) questions the wisdom of the rush to calculus in U.S. schools. Bressoud specifically advocates for "an alternative to calculus in high school that focuses on strengthening students' understanding of algebra, geometry, trigonometry, and functional relations while building problem solving skills …" Again, the recommendation is that our first and foremost goal should be to ensure students' depth of understanding of grade level or course-based mathematics before recommending a student be accelerated.

A joint position statement of MAA and NCTM states that the "ultimate goal of the K-12 mathematics curriculum should not be to get students into and through a course in calculus by twelfth grade but to have established the mathematical foundation (and disposition toward mathematical work) that will enable students to pursue whatever course of study interests them when they get to college." In addition, it is

worth noting that not every student's mathematical journey is best served by calculus. Statistics is arguably the subject within mathematics utilized by the widest variety of careers and is clearly a critical tool of analysis necessary for full participation in our democratic society.

As Jo Boaler (2016, p. 192) has written, "mathematics learning is not a race, and it is mathematical depth that inspires students and keeps them engaged and learning mathematics well, setting them up for high-level learning in the future." But for some parents the metaphor of mathematics as a race is deeply embedded in their expectations for mathematics teaching and learning. We have to remember that many of the parents of our students attended school themselves at a time when they experienced a mathematics curriculum that was repetitive and less challenging. We need to help parents see that standards today are more rigorous, focused, and coherent.

As we work to change cultural expectations for mathematics teaching and learning—which admittedly will take time—one strategy we can use with parents when addressing acceleration and the "race" metaphor is to clarify what type of "race" *might* be more appropriate to mathematics learning. If parents want to see mathematics as a race, then we need to convince them that it is a marathon and not a sprint. Having a great 100-meter time is rarely helpful if we are on a lifelong journey to deepen our understanding of mathematics and use it productively in our lives.

Mathematics should be taught deeply and in a balanced way, with equal attention paid to procedural fluency, conceptual understanding, reasoning and problem solving and the development of a positive mathematics identity. When these goals are achieved, students will benefit from mathematics learning that will serve them for their entire life.

Acceleration should not happen at the expense of creating gaps in student understanding by skipping foundational learning standards. Skipping or rushing through instruction in ways that fail to develop depth of understanding may lead students eventually to drop out of mathematics, cut off their future mathematical opportunities, thus denying them the potential to be fully actualized as members of our democratic society.

We need to engage students in ways so that they can embrace their own mathematical journeys and be empowered by mathematics in their own lives. Yes, acceleration may be appropriate if a student has demonstrated significant, deep, and complete understanding of grade level or course-based mathematics. We certainly want each and every student to be appropriately challenged.

I encourage you to post a reply and share with others how you have addressed the "acceleration issue" in your school or district.

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#acceleration