The Virginia Council for Mathematics Supervision (VCMS) supports the research provided by the Virginia Mathematics Pathways Initiative (VMPI) that informs the revision of the Mathematics Standards of Learning and modernizing mathematics for all Virginia students. This organization of mathematics leaders believes in the need to modernize mathematics curriculum and instruction, which has not changed significantly since the conception of public education by the Committee of Ten in the late 1800s. While there are challenges that arise with significant modifications to curriculum and instruction, these modifications are necessary in order to prepare students for success in postsecondary life in the 21st century. We, as an organization, are committed to offering support in overcoming these challenges and ensuring modernization of mathematics in Virginia.

Why VCMS Supports Modernizing Mathematics

The current system of instruction of mathematics is failing to adequately prepare students for 21st century society. As stated by the National Council of Teachers of Mathematics (2018), “[t]he digital age inundates us with numbers in the form of data, rates, quantities, probabilities, and averages, and this fact of twenty-first-century life increases the importance of and need for today’s students to be mathematically and statistically literate consumers, if not producers, of information” (p. 1). Digital tools have changed the nature of learning mathematics. Calculations that were previously more necessary are now done digitally. This evolution of society has caused a change in the definition of college-and-career-ready in regards to mathematics. Data suggests that our current “race to calculus” is not an appropriate path for the majority of students. In fact, “math and science professionals are beginning to question how helpful current high school calculus courses really are for advanced science fields. The ubiquitous use of data in everything from physics and finance to politics and education is helping to build momentum for a new path in high school math—one emphasizing statistics and

data literacy over calculus." (Sparks, 2018, para. 2). There is a greater need in society and the workplace for statistical literacy as opposed to calculus. Thus, in the current setup, "[s]tudents are often misprepared for the mathematics they will need to take in college" (Fitzpatrick & Sovde, 2019, p. 98). The authors "define 'mispreparedness' as misalignment of mathematics course-taking requirements and student aspirations" (Fitzpatrick & Sovde, 2019, p. 98).

VCMS supports the creation of specialized courses that provide opportunities for students to explore mathematics in equally rigorous courses that are different but in addition to calculus. The standards revision should prepare for these courses through the essential concepts, the integration of content from Grade 8 Mathematics, Algebra I, Geometry, and Algebra II, and the inclusion of intra- and interdisciplinary connections. Additionally, connections to everyday life and future careers are suggested by the stakeholder feedback gathered by VMPI committees, and the change in foundational concepts is a wise choice and fully supported by VCMS. The design of the essential concepts courses would allow the time and curricular connections for teachers and students to work through tasks that are contextualized and cognitively demanding. Teaching through context and connections allows students to "engage more quickly with the material" and "can provide immediate meaning for students and simultaneously increase their desire and/or willingness to struggle and persevere with a task" (Boersma & Savina, 2019, pp. 16-17). Well-chosen tasks, implemented with effective instruction, allow students of varying abilities to be challenged at an appropriate level and provide all students the opportunity to connect the various strategies that can be used to solve these tasks. Task-based instruction promotes discourse in the mathematics classroom that leads to deeper understanding of the content and utilization of mathematics.

As Sheffield (2017) states, "mathematics experiences that emphasize multi-faceted, complex problem solving are much more effective than simply going faster through classes that are based on memorized rules and algorithms" (p. 22). Mathematics is not a checklist of skills to be taught and left behind. Connections among concepts within mathematics and with

mathematics and other subjects require deep understanding of concepts. Modernizing mathematics must support a rich, not rushed curriculum where students are no longer provided an inch-deep, mile-wide experience. VCMS supports this desire to provide all students with deeper learning versus surface, procedural skills. Previous solutions for students who are procedurally proficient have included acceleration or advancement. Acceleration involves students being taught all of the necessary skills but at a quicker rate. Advancement involves the skipping of content. When done properly and for the appropriate students, this can be successful. The current race to calculus causes some students to be accelerated beyond their most appropriate placement. Picciotto (2016) warns against “hyper-acceleration.” Sheffield (2017) describes hyper-acceleration as “students taking high school mathematics classes in middle school 2 or more years before they are typically taught, noting that this frequently results in gaps because of missed topics from middle school mathematics, and a shallow, poorly understood, easily forgotten series of mathematics topics that emphasized memorization, speed and regurgitation” (p. 21). Sheffield (2017) concludes that, “[t]his is not to say that K-12 students should not have access to the highest-level mathematics classes possible. It simply means that faster is not always better...Accelerating math classes for more than 1 year...has not been shown to be beneficial for the majority of top students” (pp. 21-22). It is important that the Virginia Mathematics Standards of Learning allow for opportunities for all students to extend learning within a grade level while continuing to prepare students for the next level of mathematical learning. When the standard is no longer a checklist of skills, but requires a deep understanding of the content, students will no longer need to rush into the next grade level mathematics.

Bressoud, Camp, and Teague (2017) conclude that “the United States has fallen into a seriously dysfunctional system for preparing students for careers in science and engineering, guaranteeing that all but the very best rush through essential parts of the mathematics

curriculum and then are forced to sit and spin their wheels while they try to compensate for what was missed. It will take time and work by all involved to repair the transition from high school to college. We cannot afford to wait" (p. 81).

What VCMS Believes Still Needs to Happen in Standards Revision

VCMS acknowledges there is much work to be done to reach the goals of modernizing mathematics education in Virginia. The greatest needs include upgrading assessments, providing professional learning around differentiation, and adjusting instruction to provide opportunities for students to explore rich tasks.

In the standardized testing era of education it has been said, "you teach what you test". This is evident in mathematics instruction as assessment items privilege quick grading potential over that of students' ability to demonstrate deep understanding of concepts. Darling-Hammond (2015) notes, "teachers begin teaching to the test simply to raise scores, often at the expense of meaningful learning activities." She suggests that instead, "Many states are incorporating performance-based assessments into their standardized tests or adding assessment vehicles such as student portfolios and presentations as additional measures of student understanding. These rigorous, multiple forms of assessment require students to apply what they're learning to real world tasks" (para. 3). VCMS supports the modification of mathematics state assessments to allow students to show their depth of understanding of mathematical concepts.

Differentiation, tailoring instruction to meet individual student needs using a variety of teaching techniques while providing options in process, product, environment, and depth of content, is the responsibility of all teachers. Tracking has created the misconception that students accelerated will achieve at greater rates than those not; however, in Ma's 2005 study, it was found that "[t]he rate of growth in achievement in mathematics was almost identical

between accelerated and non-accelerated gifted students" (p. 121). VCMS supports providing professional development in the field of differentiation, early and often.

The Mathematical Process Goals for Students—Mathematical Problem Solving, Mathematical Communication, Mathematical Reasoning, Mathematical Connections, and Mathematical Representations—are best demonstrated by students through engagement in rich mathematical tasks. Clarke and Roche (2018) describe "exemplary contextualized tasks" as those that "are likely to connect with contexts of interest to students, involve substantial student thinking, address important mathematics across a range of mathematical domains, offer a variety of solutions and solution paths, and engage students to persist, even when the task is cognitively demanding" (p. 106). This is not a new idea. The Virginia Department of Education has long included the Mathematical Process Goals in the Mathematical Standards of Learning for Virginia Public Schools and describes them as the focal processes with which students should learn the content of the standards (most recently, September 2016, p. v). As far back as 2011, Virginia educators were concentrating on process goals at the VDOE Standards of Learning Institute centered on facilitating students' mathematical understanding through a focus on process goals for students. These process goals are fostered and developed through rich mathematical tasks. Rich tasks were the focus of the 2013 VDOE Standards of Learning Institute, where mathematics educator attendees were asked to return to their divisions and change instructional pedagogy. Every subsequent SOL Institute has highlighted the process goals through the use of rich tasks as well as specific teaching practices provided by the National Council of Teachers of Mathematics. The VDOE Institute Resources can be found at the VDOE Mathematics Webpage in the Professional Development Resources section. Over the past several years, the VDOE undertook a monumental project of creating rich mathematical tasks, supporting rubrics, and exemplars for grades K – Algebra II. These are available at Rich Mathematical Tasks. VCMS supports the continued use of rich mathematical tasks as effective instructional practice for implementation of the process goals.

What support VCMS can offer to the Modernization of Mathematics in Virginia

As with any substantial change in education, information and training for all stakeholders will be essential. As NCTM stated in a 2016 position statement, “for students with exceptional mathematical promise to have learning environments and opportunities as described here, the preparation and ongoing professional development of teachers of mathematics must address the specific learning needs of these students,” including “[m]ethods of recognizing, nurturing, and challenging” these students. (para. 5). As a mathematics education organization in Virginia, we are committed to assisting in providing the necessary support to ensure the success of modernizing mathematics. Our commitment to professional development for in-service teachers, pre-service teachers, coaches, supervisors, and administrators is part of our organization’s purpose, “to collaborate to support mathematics leaders in improving the teaching and learning of mathematics in the Commonwealth of Virginia.”

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