West Virginia math4life

PLC Guide

Educators' Guides for Mathematics

Grades 9-12

West Virginia DEPARTMENT OF EDUCATION

#math4lifeWV

Analyzing Data for Schoolwide and Individual Student Improvement

Session 1

Before exploring and discussing school data, teachers should discuss their perceptions about why students have achieved Proficiency (score Meets Standard or Exceed Standard) in mathematics on assessment tests and why students have not.

As a staff, teachers should reflect privately and then record the answers to key questions such as:

- In your opinion, what are the causes of achievement gaps at your school?
- What am I doing in my classroom to promote learning that is most effective?
- Where do I need to improve my teaching practice?
- How well do I know my content standards?
- Do I fully understand the progressions within the standards and how to help students achieve mastery of the standards?
- How am I effectively and intentionally teaching to the standards?
- How do I scaffold within the standard ensuring students are learning deeply and to mastery?
- How am I using Multi-Tiered Systems of Support to effectively reach all students?
- What can I do to improve parent participation?

Action Step

Teachers should compile and analyze three to five years of data to establish mastery and non-mastery trends. Compiling the data in tables and charting the of changes of scores over time in line graphs or bar graphs may provide a clearer representation of mathematics performance levels.

Session 2

As a staff, address questions such as:

- What percentage of each grades' students were proficient (Meets Standard or Exceeds Standard) in each year?
- Did students' scores improve when compared with the previous year's scores?
- Do your students' mathematics test scores improve as time in the school's educational program increases?
- What instructional strategies and intervention activities have been employed?
- What mathematics skill areas need greatest reinforcement?
- What are the mathematics concepts that students have mastered and not effectively mastered at each grade level?
- High school: How does completion of specific mathematics courses affect mastery of mathematics concepts?
- Is additional data needed to successfully answer these questions?

Reflection Questions

- How am I connecting the Mathematical Habits of Mind and the grade-level content standards?
- Am I teaching to the intended depth and rigor of the standards?

Action Step

The math4life website provides resources to support teacher practice. Find your course's Educator Guides under "Grade Specific Resources." *https://wvde.us/math4life/*→Educators→Grade Specific Resources→Choose Your Grade or Course→Educators' Guide.

> ***"What separates the schools that will be successful in their reform efforts from the ones that won't is the use of one, often neglected, essential element – data."***
>
> ***Victoria Bernhardt***

Exploring the West Virginia Educators' Guides for Mathematics

The underlying principles of the West Virginia College- and Career-Readiness Standards Mathematics, hold the promise of preparing all West Virginia students for college, careers, and civic life—and developing mathematically competent individuals who can use mathematics as a tool for making wise decisions in their personal lives, a foundation for rewarding work, and a means for comprehending and influencing the world in which they will live. The West Virginia Educators' Guides for Mathematics support these ambitious goals by emphasizing mathematical instruction and learning that focus on key topics, build mathematical understanding and fluency in a coherent manner, and develop students' ability to apply mathematics creatively to analyze and solve complex problems.

Session 3

Purpose of the Educators' Guides for Mathematics

The West Virginia Educators' Guides for Mathematics are meant to guide teachers in curriculum development and instruction as they work to ensure that all students meet or exceed the West Virginia College- and Career-Readiness Standards. The West Virginia College- and Career-Readiness Standards are statements of what students are expected to learn; curriculum is the means used to help students meet the standards. The Educators' Guides provide educators and developers of instructional materials with a context for implementing the standards. Building on the standards, the Educators' Guides address how all students in West Virginia schools can best meet those standards.

Implementation of the West Virginia College- and Career-Readiness Standards provides an opportunity to ensure that West Virginia's students are held to the same high expectations in mathematics as their national and global peers. Educators and administrators, as well as parents, guardians, and community members, are challenged to become familiar with the standards and to support raising the bar for student achievement through rigorous curriculum and instruction that develops students' conceptual understanding, procedural skill and fluency, and application of mathematics.

Overview: Educators' Guides for Mathematics (Credit-bearing Courses)

Educators' Guides for Mathematics for the high school credit-being courses are organized into two pathways: Integrated and Traditional. The mathematics standards identified in courses in the Integrated Pathway (Mathematics I, Mathematics II, Mathematics III) are identical to the standards identified in the Traditional Pathway (Algebra I, Geometry, Algebra II). The content is simply grouped differently among the three years. In the Integrated Pathway, students are immersed in the different areas of mathematics throughout each of the three years; developing connections among the different areas of mathematics is a focus. In the Traditional pathway, a targeted focus is place on different areas of mathematics – Algebra in the first and third years, and Geometry in year 2.

The Mathematical Habits of Mind are interwoven throughout high school mathematics. Instruction should focus equally on developing students' ability to engage in the Mathematical Habits of Mind and on developing conceptual understanding of and procedural fluency in the Mathematics Content

Standards. The Mathematical Habits of Mind are the same at each grade level. In the high school mathematics courses, the levels of sophistication of each of the Mathematical Habits of Mind increase as students integrate grade-appropriate mathematical practices with the content standards. Examples of the Mathematical Habits of Mind appear in each high school mathematics course narrative.

The mathematics content standards in the Integrated Pathway and in the Traditional Pathway specify the mathematics that all students should study in order to be college- and career-ready.

The Educators' Guides for the credit-bearing high school courses are organized into courses according to two pathways:

TRADITIONAL PATHWAY — consists of the higher mathematics standards organized along more traditional lines into Algebra I, Geometry, and Algebra II courses. In this sequence, almost the entire Geometry conceptual category is separated into a single course and treated as a separate subject. Although these courses have the same names as their traditional counterparts, it is important to note that the nature of the West Virginia College- and Career-Readiness Standards for Mathematics yields very different courses. In the past, the label "Geometry" referred to a specific course, but now it may also refer to the conceptual category. Care will be taken throughout the Educators' Guides to make the distinction clear.

INTEGRATED PATHWAY — consists of the courses Mathematics I, II, and III. The integrated pathway presents higher mathematics as a connected subject, in that each course contains standards from all six of the conceptual categories. For example, in Mathematics I, students will focus on linear functions. Students contrast linear functions with exponential functions, solve linear equations, and model with functions. They also investigate the geometric properties of graphs of linear functions (lines) and model statistical data with lines of best fit. This is the way in which most other high-performing countries present higher mathematics, and it maintains the theme developed in kindergarten through grade eight of mathematics being a connected, multifaceted subject.

The Educators' Guides are new and vital documents that West Virginia teachers should reference often; they are not documents offering "business as usual." The Educators' Guides for Mathematics embody the belief that all students can learn mathematics and contains essential information for teachers and other stakeholders about teaching strategies, assessment, technology, and modeling. The Educators' Guides also provide school and district administrators with information about how to support high-quality instruction. It is important for teachers of a specific course to read not only their respective course Educators' Guide, but also the Educators' Guide for the course immediately preceding and following their particular area of focus. This will help teachers in planning a logical and rigorous course of study.

Each of the West Virginia Educators' Guide begins with a description of the skills and understandings of students as they **enter a given grade** and outlines the skills and understandings that will be **developed throughout the grade.** Throughout, there are examples that illustrate the mathematical ideas and connect the Mathematical Habits of Mind to the content standards.

Action Step

Explore the Educators' Guide for your course. Carefully read the first two or three pages of the document for a summary of prior learning and an overview of what students learn at that grade level to answer the following prompts:

- Describe the skills and understandings of students **entering** your grade or course.

- Identify the skills and understandings that are essential for students in your course to master.

The Educators' Guides highlight the importance of addressing grade-level and course content standards and note that neglecting grade-level or course content standards will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in later grades. Each of the Educators' Guides concludes with Essential Learning for the Next Grade that provides an overview of the fluencies and conceptual understandings necessary to be prepared for the next grade and/or future courses.

- Identify the skills and understandings are essential for students to master in your grade to be prepared for the next grade and/or future courses.

Session 4

Action Step

In the Educators' Guide for your course, explore the table in the section titled Connecting Mathematical Habits of Mind and Mathematics Content that shows how the Mathematical Habits of Mind can be integrated into tasks appropriate for students in your course.
As you read through the content of the Educators' Guides, notice the recurring references to the Mathematical Habits of Mind (MHM) as the content standards of the course are addressed. As you plan lessons, several Mathematical Habits of Mind will be evident in each lesson as they interact and overlap with each other. The Mathematical Habits of Mind describe ways in which developing students of mathematics increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years. The Mathematical Habits of Mind must be taught as carefully and practiced as intentionally as the Mathematics Content Standards are. Neither type should be isolated from the other; mathematics instruction is most effective when these two aspects of the West Virginia College- and Career-Readiness Standards for Mathematics come together as a powerful whole.

- Which of the Examples and Explanations presents a picture of what it looks like for students to do mathematics in your classroom?

Action Step

Analyze one of your upcoming lessons and reflect on the opportunities you have with your students to develop one or more of the Mathematical Habits of Mind. At Session 5, be prepared to share your experiences of implementing the lesson.

Session 5

This session may be repeated for multiple conceptual categories.

In Session 4, you were asked to analyze and reflect on developing one or more of the Mathematical Habits of Mind in an upcoming lesson.

- Identify the Mathematical Habits of Mind that served as your focus. Describe your experiences in addressing the Mathematical Habit of Mind in your lesson.

- How were you able to make connections with the content of the lesson and the Mathematical Habits of Mind?

Teachers must provide students the opportunity to master each of the course content standards. It is important to understand that neglecting course content standards will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in this and later courses.

Reflect on and answer the following questions:

- Based on the data in Session 1 and 2, identify specific concepts in your grade-level mathematics in which students struggle. Determine a conceptual category where several of these concepts are addressed.

Action Step

In the Educators' Guide for your course, carefully review the standards and examples that align with this conceptual category or these standards. Reflect on the following questions:

- What connections stand out among standards or solution techniques?

- How did your perception of the standards change as you read the section of the Educators' Guide?

"The highest form of pure thought is mathematics."

Plato
(427–347 BCE)

Mathematics Progressions

Session 6

The progression from kindergarten standards to standards for higher mathematics, beginning with Mathematics I or Algebra I, exemplifies the logical mathematical connections that are central to the West Virginia College- and Career-Readiness Standards for Mathematics.

In kindergarten through grade five (K–5), the focus is on addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals, with a balance of concepts, skills, and problem solving. Arithmetic is viewed as an important set of skills and as a thinking subject that prepares students for higher mathematics. Measurement and geometry develop alongside number and operations and are tied specifically to arithmetic along the way.

In middle school, multiplication and division develop into the powerful forms of ratio and proportional reasoning. The properties of operations take on prominence as arithmetic matures into algebra. The theme of quantitative relationships also becomes explicit in grades six through eight, developing into the formal concept of a function by grade eight. Meanwhile, the foundations of deductive geometry are laid in the middle grades. Finally, the gradual development of data representations in kindergarten through grade five leads to statistics in middle school: the study of shape, center, and spread of data distributions; possible associations between two variables; and the use of sampling in making statistical decisions.

In higher mathematics, algebra, functions, geometry, and statistics develop with an emphasis on modeling. Students continue to take a thinking approach to algebra, learning to see and make use of structure in algebraic expressions of growing complexity. Mathematics is a logically progressing discipline that has intricate connections among the various domains and clusters in the standards. Sustained focus and practice is required to master grade-level and course-level content.

Seeing the start and end of a progression in print is often startling to teachers, even those who are very familiar with the progression of the concept and with the associated grade-level standards. For example, in creating a progression of students' introduction and development of skills and understandings related to operations with fractions, one may create the table on the following page.

Action Step

Carefully review the vertical progression in the standards for one domain. Examine the course or grade-levels above and below your own course or grade-level.

Reflect on the following questions:

- How do the concepts in the domain develop? How can you use this knowledge to inform your instruction?
- Were there any surprises regarding the necessary depth and rigor of student mastery regarding the standard(s) as students progress through concepts and content in the domain?

Grade Level	Domain	Findings Regarding Vertical Progression of Concept
3	**Numbers and Operations - Fractions**	In grade three, **students develop an understanding of fractions as numbers. They begin with unit fractions by building on the idea of partitioning a whole into equal parts.** (Student proficiency with fractions is essential for success in more advanced mathematics such as percentages, ratios and proportions, and algebra.)
4	**Numbers and Operations - Fractions**	Student proficiency with fractions is essential to success in algebra. In grade three, students develop an understanding of fractions as built from unit fractions. **A critical area of instruction in grade four is fractions, including developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers.** In grade four, fractions include those with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.
5	**Numbers and Operations - Fractions**	Student proficiency with fractions is essential to success in algebra in later grade levels. In grade five, **a critical area of instruction is developing fluency with addition and subtraction of fractions, vincluding adding and subtracting fractions with unlike denominators.** Students also **build an understanding of multiplication of fractions and of division of fractions in limited cases** (unit fractions divided by whole numbers and whole numbers divided by unit fractions).
6	**The Number System**	In grade six, **students complete their understanding of division of fractions and extend the concept of number to the system of rational numbers, which includes negative numbers.** Students also work toward fluency with multi-digit division and multi-digit decimal operations.
7	**The Number System**	In grade seven, **students extend addition, subtraction, multiplication, and division to all rational numbers by applying these operations to both positive and negative numbers.** Adding, subtracting, multiplying, and dividing rational numbers is the culmination of numerical work with the four basic operations. Because there are no specific standards for arithmetic with rational numbers in later grades, fluency in arithmetic with rational numbers should be a primary goal.

Session 7

In session 6, you reviewed standards and examples from the Educators' Guides. Discuss your answers to the reflection questions listed in the Action Step of Session 6.

The National Council of Teachers of Mathematics (NCTM) discusses the importance of personal and collective professional growth towards effective teaching and learning of mathematics.

"As professional, mathematics teachers recognize that their own learning is never finished and continually seek to improve and enhance their mathematical knowledge for teaching, their knowledge of mathematical pedagogy, and their knowledge of students as learners of mathematics." (Principles to Action, NCTM, 2014)

- Did the Educators' Guide for your course offer opportunities to enhance your mathematical knowledge for teaching? Identify and explain this growth in mathematical understanding.

- Might these opportunities encourage you to continue to acquire mathematical knowledge related to the same concepts? How could you go about researching these concepts?

- How did the Educators' Guide for your course provide opportunities to enhance your knowledge of mathematical pedagogy? Explain how this new knowledge can serve to inform classroom instruction.

- Did the Educators' Guide for your course provide opportunities to enhance your knowledge of students as learners of mathematics? What new insights regarding student reasoning developed as a result of this exploration?

Steven L. Paine, Ed.D.
West Virginia Superintendent of Schools