



BOWLING GREEN — On an April morning when rain won't stop falling outside South Warren Middle School, the 29 eighth-grade students in Christa Lemily's math class are in the midst of an interesting discussion.

Is investing in classic cars to increase wealth a profitable pursuit? To fuel conversation, the teacher reminds students of their field trip to the nearby National Corvette Museum and, in particular, a 1998 model they saw. Students start to name factors that influence depreciation — wear and tear, desirability of a certain model, the supply of used vehicles, and, most important: is it a convertible?

The discussion sets up the following day's activity: the class will use the Kelley Blue Book car-pricing web site to study the Corvette in question and its value over time.

To some, this is an investigation that might make for interesting everyday conversation. To Lemily, it's a memorable way to teach math.

Car talk becomes an introduction to exponential functions — growth or decay that starts slowly, but picks up considerable speed as time goes by. The mathematical formulas can look intimidating. Examples, however, are easy to imagine: interest on a financial investment compounding, nuclear reactions, the expanding population of microorganisms in a culture, until a nutrient disappears. These examples follow patterns of exponential growth. Retirement funds once payouts start, or the height of soft-drink

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ABOVE: Teacher Christa Lemily shows three boards she combined with a hammer and screwdriver to simulate the algebraic equation $n/2 - 10 = -6$. Students discuss how she can pull the equation apart with inverse operations to find the value of the board labeled "n."

KEEPING THE FOCUS ON KENTUCKY SCHOOLS

This Perspectives Special Report is part of the Prichard Committee's regular newsletter. Visit www.prichardcommittee.org or e-mail us at admin@prichardcommittee.org to add your name to our e-mail list. To find out more about Kentucky's academic standards, visit education.ky.gov/comm/UL/Pages/Kentucky-Core-Academic-Standards.aspx

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bubbles after a glass is poured demonstrate exponential decay.

Middle school students in Bowling Green will test whether the value of a well-preserved '98 Corvette follows an exponential function.

Lemily's move toward more challenging math connected to real-world situations has grown as a result of Kentucky's academic standards. Also accelerating, she said, are the interest and ability of her students. The standards for what all Kentucky students should know and be able to do grade-by-grade can build stronger math skills, Lemily said.

"The standards focus not just on repetition, but on understanding and applying mathematical reasoning," she said. "These standards help teachers focus on how students are taught to reason and think through math as much as they focus on the skills that students are taught. The goal is math thinkers, not just math do-ers."

Kentucky's standards for learning in math and English language arts, adopted in 2010 and now everyday practice for teachers and schools across the state, aim to create more challenging and relevant learning experiences for students. Defined by teachers and experts in each subject area, the standards stress basic skills necessary for college and adult success as well as knowledge and understandings that will help students become stronger at solving problems and making sense of real situations.

NEW TOOLS, APPROACHES IN CLASSROOMS

For adults who remember school as a series of lectures and workbook problems, math and English language arts learning have taken a noticeable turn. Technology and teaching strategies allow better diagnosis of students' individual strengths and needs and can help build skills at an appropriate pace. Teachers can more easily pull engaging and relevant teaching tools — the Kelley Blue Book to examine real car prices, for



example — and group students to dig deeper into new areas of learning. Subject-area standards, meanwhile, emphasize both essential skills and key big-picture concepts to help students become stronger adult thinkers.

In a fifth-grade math class at Pembroke Elementary southwest of Hopkinsville, teacher Jettie Payne said the state's standards are prompting her students to gain a solid understanding of fractions and decimals. In one recent class,

students calculated discounts on real sale products. Her room contains a mix of hands-on tools to help visualize math concepts like fractions.

Asked about how her classroom represents a change from the way she learned not so long ago, the sixth-year teacher was quick with a reply. "I remember sitting in school thinking, 'When will I ever use this?'" she said, adding that her lessons now draw clear connections between math and everyday application.

Across Christian County at Millbrooke Elementary, 31-year veteran teacher Cindy Wyatt said the state's standards have prompted her to select more challenging books for her second graders. That prompted more interesting reflections and conversations in reading groups plus stronger vocabulary. Beyond books, her students read newspapers, manuals, and, recently, even labels on items in their own cupboards or on grocery shelves. Learning about "text features," or ways words can be used as graphic elements, students discussed how to read labels on food, discussing how the information they find helps tell about nutrients like carbohydrates, protein, and more.

Her language arts lessons often crossover to reinforce standards in subjects like social studies and science. She incorporated math standards into food-label classwork, adding the number of calories in serving sizes for items like

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A LOOK AT MATH STANDARDS

Drawn from Kentucky's Core Academic Standards for math, the examples below show some sample concepts and, in large type, the grade levels where students are expected to experience the concepts.

2 Count to 1,000 and skip-count by fives, tens, and hundreds. Add and subtract to 100, knowing place value of ones, tens, and hundreds.

4 Multiply a pair of two-digit numbers or a four-digit number by a one-digit whole number. ... Solve measurement problems in a single system of units.

6 Extend skills of multiplication and division to multiply and divide fractions by fractions. ... Understand positive and negative number values.

8 Evaluate square roots ... Perform operations with numbers expressed in scientific notation. ... Graph proportional relationships.

Finding Solutions: Standards Push Toward Real-Life Problems | Continued

milk plus cereal, and even how percentages of certain nutrients can add up in a day. In the middle school math class at South Warren, the conversation about whether investing in classic cars was a good way to create wealth had been the topic of a writing-and-math assignment in the fall, where Lemily used the eighth-grade standards to produce argumentative math-infused essays, planned in collaboration with a language-arts teacher. Lemily said that nearly all of her math projects now involve a writing component matched to Kentucky standards.

Wyatt said that the standards were created in a format that makes them easy for teachers to use. Beyond providing definition for what students need to know, the standards are organized in a sequence that makes it easy to see where students are ahead or behind grade level, and how she can help them move forward. In addition, Wyatt added, the second-grade standards also show what the similar college- or career-ready standards require over the ensuing decade of schooling.

“I’ve had to up my game,” Wyatt said. “It’s more rigorous, and that’s a good thing. We are reading literature and doing projects that are more rich. I can see them becoming more proficient readers and better writers.”

SEEING THE BIG IDEAS IN MATH

At South Warren Middle, Lemily said the state’s standards blend well with measures in the accountability system and, now, an overhauled evaluation system to help educators focus more clearly on strategies for improving student achievement. Lemily said she pays special attention to the academic growth measure within the state’s accountability results.

Even if a student doesn’t rise from one performance category to another — from “apprentice” to “proficient,” for example — the growth score can show how much progress the student made within a category.

“When you can see that a student moved from the low end of a category to the high end, that can be very motivating for the teacher and the student,” she said. “It matters to me to see that my students are growing as well as performing.”

During a seventh-grade class at South Warren Middle, the day’s lesson demonstrates the teacher’s point about giving students opportunities for “putting math together and taking it apart” as a way to deepen understanding.



‘I tell them upfront that if I end up the only expert in the room, we have a problem.’

— Christa Lemily,
Warren County teacher

At the start of class, Lemily assigns three boards values then screws two together to represent a fraction. She nails those to a third board to show how the quantity is connected to the fraction. She then asks the class to describe the process of taking the boards apart to demonstrate how equations are solved by inverse operations. Prying the nail out reverses the subtraction. Unscrewing the fraction leaves the piece labeled “*n*” by itself, revealing its numerical value.

Next, she hands students cups of pennies for them to place on a handout of a scale at each desk. She asks students to perform a math function repeatedly to

observe how it eventually creates an equal number of pennies on each side.

While the class work reinforces specific math skills, Lemily wants to make sure that students see that nearly all of their work reveals patterns or offers examples of how proportion and ratios work. She said the new standards helped her to see how algebra and geometry are built on applying proportional reasoning.

“We’ve been exploring that big idea, and it’s starting to click for them,” she said. “Beyond memorization, we’re now teaching students how to think algebraically.” She noted that the state’s math standards focus heavily on making sure students understand “number sense” — what numbers mean and what happens when they are combined in different ways. The next step, in middle school, moves into ratios and proportions as they apply in equations of algebra or the logic of geometry.

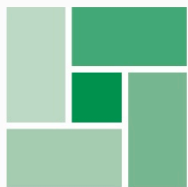
Lemily said that in schools today, more students are challenged to try to work out problems and understand the steps they are taking to work toward answers. That has required helping students to see how they can learn from mistakes and grow smarter as they adapt. Students are often encouraged to work with partners and show each other how math works. “I tell them upfront that if I end up the only expert in the room, we have a problem.”

When the bell rings on the eighth grade conversation about the Corvette’s value and the profitability of old cars, a boy lingers near the doorway to talk with the teacher.

“Have you looked this up?” he asks, pointing toward the projector still showing the car-value web site.

“No, I haven’t had a chance to sit down today,” Lemily answers.

“I’m really eager to figure it out,” he adds, wishing the teacher a good day and heading into the crowded hall toward his next class.



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