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Lebanon schools turn algebra into child's play

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Betsy Hammond, The Oregonian
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LEBANON -- Lori Haley and Mya Corbett hunch over a pile of yellow hexagons, trying to figure out how many hexagonal tables it would take to seat 25 guests.

The pair want to get the answer, but what they're really itching to do is to come up with a formula that will tell them how many people they could seat for any given number of tables.

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Suddenly, the girls detect a pattern, and one shouts: " $(t \times 4) + 2 = s!$ " They try it on one table, two tables, eight tables - it works.

They beam, flashing smiles that still feature baby teeth. Lori and Mya just started third grade.

While most high schools in Oregon and across the nation struggle to get freshmen to pass algebra, one school district is trying something very different.

Are you smarter than a fifth-grader? Click on the graphic

Are you smarter than a fifth-grader?
 Here is a story problem titled "mathematical tug of war" that was tackled with great success by fifth-graders at Pioneer School in Lebanon. Use the information given to figure out who will win the third round in a tug of war. It might be helpful to sketch out the problem as you go.
Round 1: On one side are four acrobats of equal strength. On the other side, five neighborhood grandmas, each of equal strength. The result is dead even.
Round 2: On one side is Ivan, a dog. Ivan is pitted against two of the grandmas and one acrobat. Again, it's a draw.
Round 3: Ivan and three grandmas are on one side and the four acrobats are on the other. **Who will win the third round?** Write an explanation of your reasoning.

Answer
 Ivan and the grandmas will win. There are many ways to figure that out. One way: Round 2 shows us that Ivan is as strong as two grandmas and one acrobat. In Round 3, if we substitute those three for Ivan, we see that four acrobats line up against the equivalent of five grandmas and one acrobat. We know from Round 1 that four acrobats tie against five grandmas. Therefore they will lose when lined up against five grandmas plus one acrobat.

What the fifth-graders did



1 Kari Lynn Perdue (left) and Brianna Slinger check whether the way they've balanced the first round will hold up for Round 2. Working in small groups, most students decided to assign numeric values to each figure—some for a grandma, more for an acrobat and even more for the dog.

2 Teacher Sabrina Wood gave students big sheets of yellow paper to work out the problem. Every group drew pictures of acrobats, grandmas and Ivan the dog to help them find the answer and then explain it to the class. No group solved the problem the same way.

3 Ashlyn Baker explains her group's algebraic reasoning to the rest of the class while partner Brandon Suter serves as a human easel to show off their work. Students listened carefully, then asked questions and offered compliments, as each group showed its way of working the problem.

Lebanon, which educates 4,000 students in eight schools, is pushing algebra on students as early as first grade. And the kids are getting it.

More than 80 percent of Lebanon eighth-graders passed the state math test, compared with 66 percent at schools with similar demographics. No other large or medium-size Oregon district outdid its peers by 15 percentage points.

Still, Lebanon leaders say they expect better results this school year and next, as more teachers adopt early algebra and pupils who've been solving for x since primary school advance into higher grades and take state tests.

They also acknowledge that their successes in elementary and middle schools are not matched at Lebanon High, which posts some of the worst math scores in Oregon. Math coach Joe Vore and others say they expect that will turn around as students who got a solid grounding in math during the early grades reach high school and as district efforts to improve math teaching shift to the high school.

No flash cards

Visit a Lebanon elementary math class, and you will see:

First-graders set up and solve formulas such as $9 - x = 5$, as they did when Raylene Sell talked with her class about "some teddy bears" walking away from the classroom rug, leaving five behind.

Third-graders suggest mathematically complex ways to arrive at 9: $-219 + 228$ or $(10 \times 5) - 40 - 1$, or even $(3 \times 3) + (8 \times 8) - ((4 \times 4) + (4 \times 4)) - 32$.

Students don't do worksheets, use flash cards or memorize multiplication tables. Yet by third and fourth grade, most of them add, subtract and multiply quickly and accurately.

Fifth-graders grasp how small one-thousandth is compared with one-tenth, as is reflected on a typical gas meter -- a magnitude of difference that many adults get wrong. And the kids actually seem to like the stuff. When student Dakota Rose closed his folder after the gas meter lesson, he said to no one in particular: "I wish we could do more. That was fun. I liked the dials."

Lebanon officials are loathe to proclaim their program



Betsy Hammond, The Oregonian

Top: Third-graders Mya Corbett (left) and Lori Haley puzzle out an algebra equation to describe the numeric pattern they see. Students at Riverview Elementary and in the rest of the Lebanon school district learn algebra as early as first grade under an innovative teaching approach that has led to strong math achievement among elementary and middle school students in a district where about half the students come from low-income families. **Bottom:** Third-graders Alan Carver (left) and Casey McEuen observe the algebraic relationship between the number of triangles they add to their row and how many edges are exposed. Both boys say working on hard math problems is fun.



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perfect, noting that math instruction is evolving, that some teachers still use traditional methods and that the biggest payoffs are yet to come.

But they say they are confident that their new approach to teaching math is the way to go.

Among the key elements: Begin simple algebra and multiplication by first grade; have every child talk extensively about his or her mathematical reasoning; let students set up their own problems and equations and allow them to use big numbers if they choose; cover few topics in great depth; use lots of visual and hands-on modeling to make math ideas concrete.

"Something happens when they play with numbers every day -- numbers they come up with themselves, equations they write themselves," says Marla Ernst, a teacher who also coaches fellow teachers. She is largely responsible for finding the approach and spreading it districtwide. "They get an innate sense of what is seven, what is a fraction."

Smarter than you think

The Northwest Regional Education Laboratory, a Portland-based research and training agency, helped train more than 60 Lebanon teachers in the new math approach.

It is based largely on a teacher training technique called Cognitively Guided Instruction, or CGI, developed by education researchers at the University of Wisconsin at Madison.

Among the core ideas, according to CGI co-developer Thomas Carpenter:

Young children know more about math than most adults think they do. Ask kids to talk a lot about their mathematical reasoning and then add to what they already know. In Lebanon, teachers strive not to say "That was the wrong answer." They lean toward, "Can you tell me about your thinking?"

Kindergartners intuitively know how to add -- "you can have two more cookies" -- and subtract -- "put three of those toys away." They can create and solve much more interesting problems than $2 + 2$ from their first weeks of school. Children should also be asked to multiply and divide (without necessarily using those terms or the division sign) by first grade.

Perhaps more than anything else: Don't mislead kids, as most schools do, about the meaning of the equal sign.

Part of what converts teachers to the new approach is watching videos in which typical U.S. schoolchildren as old as third and fourth grade invariably give the wrong answer to this simple question: $8 + 4 = _ + 5$. Most answer "12," because they have mistakenly learned that the equals sign means "give me the answer to the problem so far" rather than "make things equal on both sides of me."

Which is why Sell's first-graders are encouraged to think about problems in which the unknown -- the classic x of algebra, often discussed in Lebanon as "some" teddy bears or "some" cookies -- comes at the beginning or middle of the problem, not just at the end.

Other tools in the Lebanon math toolbox include lots of visual modeling of math ideas. Plastic blocks represent hundreds, tens and ones; kid-sized balances show ways make both sides equal to balance the scale; number lines make it easy to see that $3/4$

Lebanon schools shine in math

Percent of students who met state math benchmarks in 2008:

Lebanon:

- Grade 3: 77
- Grade 5: 86
- Grade 8: 82




Similar schools*:

- Grade 3: 77
- Grade 5: 78
- Grade 8: 66


State average:

- Grade 3: 77
- Grade 5: 77
- Grade 8: 69

* Schools similar to Lebanon, where about half the students qualify for federally subsidized meals based on low family income.

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and 0.75 mean the same thing.

Lebanon's approach is in line with recent national reports about what's wrong with U.S. math classes and how to fix them.

The Center for Data-Driven Reform in Education at Johns Hopkins University reported this month that getting teachers to change their daily teaching practices does more to raise math achievement than buying new textbooks or computerized math programs.

-- Source: Analysis by
The Oregonian of Oregon
Department of Education
figures

And the National Math Panel, appointed by the president to find research-backed ways to improve math skills, concluded that the reason so many high school students fail first-year algebra isn't poor teaching in high school; rather, it's that they got through elementary and middle school without grasping the basics, including fractions, percentages and decimals.

In primary classrooms in Lebanon, students deftly use number lines, work with negative numbers and solve basic algebraic equations. Few students sit stumped on the sidelines.

The day that $(2 \times 19) - 16$ was one of the warmup equations in Beth Moore's third-grade classroom, every hand went up when she asked how they'd solved 2 times 19 in their heads so quickly.

Says 9-year-old Casey McEuen : "Sometimes the problems can be very hard and difficult, but we can figure it out."

-- Betsy Hammond; betsyhammond@news.oregonian.com

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 **longshot** December 29, 2008 at 11:03AM

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When my kids were small, I did something similar to this. It started out as just a simple math game, that I made slightly harder each time we played it. I pretty soon realized that I had a 4 and a 6 year old doing high school level algebra. Both kids (girls) have liked math ever since.

[Reply](#) [Post new](#)[Inappropriate?](#) [Alert us.](#)**tlove702**

December 30, 2008 at 10:54AM

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I agree with post above. Start easy and advance slowly! Think about it! To have a good sports team of any type or to have any music (marching or concert band) of any type, then start early to develop skills and interest.

[Reply](#) [Post new](#)[Inappropriate?](#) [Alert us.](#)**borenson**

December 30, 2008 at 2:35PM

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The approach suggested here seems to be very sound. These students seem to be having fun with mathematics and to be engaging in high-order thinking skills. It is also clear that computational skills are not being left behind.

Borenson and Associates has conducted more than 1500 Making Algebra Child's Play(R) workshops over the past ten years. I can testify that teachers are very excited when presented with hands-on methods that work to produce results. They are excited when complex ideas are presented in such a manner that those ideas are intuitively obvious.

Our experience is that all 4th graders, including inner city students, can succeed with equations such as $4x + 3 = 3x + 9$ when presented using the approach of Hands-On Equations in which the students make sense of the various elements of the equation and then use physical gestures to solve the equation.

The National Math Panel Report referred to in the article above mentioned that "the" foundational skill for success in algebra is "fluency in the use of symbols." To the extent that the students mentioned in this article are developing a love for mathematics, and are thinking about challenging problems, and actually coming up with formulas, they and their teachers are to be congratulated.

[Reply](#) [Post new](#)[Inappropriate?](#) [Alert us.](#)**hbuffalo**

December 30, 2008 at 3:51PM

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It's about time.

I teach college math and try to get students to understand the connection to the real world.

Math is a language and our language acquisition is at its height at early ages, 3-8.

Teaching the language of algebra and connection of algebra to the real world makes infinite sense.

Jim

[Reply](#) [Post new](#)[Inappropriate?](#) [Alert us.](#)**momwithabrai**

January 01, 2009 at 3:06PM

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I always run when I hear that schools aren't using things like flash cards, etc. It sounds like they are rejecting rote memorization.

I'm a math tutor and I find kids do best when they memorize basic math facts. Learning Algebra will come. Learning algebra is far easier when a student knows their math facts and can recall them quickly. When schools misguide students to putting the cart before the horse, it doesn't work well.

I see and work with kids all the time. Kids who know their basic math facts have confidence and the ability to perform more complex math concepts.

If you truly want to know how to help kids become successful in mathematics, go back to the basics. You can incorporate some algebra in early grades but it CANNOT come at the expense of basic math skills. Unfortunately that's exactly what happens in many of Fuzzy math programs.

Check : <http://www.ezcasts.com/estreamingmedia/doors/bcp/default.asp?producer=980>

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haleydom

January 03, 2009 at 3:25PM

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I am a kindergarten teacher at this school and would like to comment on the post by Momwith Abrai above. I'm not sure where you read from this article that we are not teaching basic math facts. Basic math facts are incorporated into everything we do...just not in rote fashion as you are accustomed. Have you read any research with gifted children and the poison of teaching by rote? You should check it out...In kindergarten, by the end of the year, my students had exposure to addition, subtraction, multiplication, division, negative numbers, and basic algebraic sentences, in addition to the rest of the Oregon standards. If I had stuck to my basic textbook, they would never have seen a number above 20. I had one student last year who could operate in the billions with understanding (in kindergarten) because I didn't close the ceiling for him. Kids come away stronger and more confident with this language of math that we are speaking. In kindergarten, they learn to count by 1's, 2's, 5's, 10's, count forward and backward, write equations, etc. We have many math discussions and solve a lot of difficult problems and I for one will never go back to the old way of teaching math. That doesn't sound so fuzzy now, does it??

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peterdalbert

January 04, 2009 at 7:40PM

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I am a math tutor with a background in psychology. I have studied the research on learning math as described in the book Efficiency in Learning by Ruth Clark and thought a great deal about what should be happening in the schools (as opposed to what happened when I attended.)

When I read the article my reaction was "Whoopie! They are getting it right!" My experience as a tutor has shown me that the systems "failures" are smart enough to learn math--they are really failures of the system. Learning is a naturally process that normally produces pleasure and enthusiasm--I've seen this routinely in people who thought they could not do math, but discovered otherwise.

THAT SCHOOL IN LEBANON IS GETTING IT RIGHT. The process is right (and well researched.) The student's enthusiasm is a natural result. Yes, kids are smarter than we used to think! HATS OFF TO THE TEACHERS IN LEBANON!

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chaffee

January 11, 2009 at 1:40PM

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My mother, Sue Monell, was using an approach similar to this back in the late sixties teaching a mixed 6,7,8 year old class at the Bank Street School for children, where she was well-known. (Google her) She primarily used the Cuisenaire Rods. One of her morning routines was to ask each child to come up with a different number name for the number representing the day of the month. The children were allowed to use the rods as long as they wanted to, though as soon as they were secure, they would forego them. Each child had a "math journal, in which she would periodically write a new set of equations in each child's book based on what he/she had done previously. It was like a personal conversation. Much of this came from the "new math" program, which failed because teachers were inadequately trained in its use and because it didn't transition into computation well enough, so instead of fixing it, it was scrapped. Then Mathland came along and suffered a similar fate in many places because it ran into people with momwithabrai's attitude and ignorance.

I used much of this approach myself as a Kindergarten teacher with great success.

The problem with teaching math by algorithm is that while this may seem to produce quicker results at first, the kids get "locked into" this rote approach, and then get resistant when asked to approach problems conceptually. Then, when the math at around middle school delves into higher thinking, they falter. Other advanced countries teach fewer new concepts at each age, but in greater depth. This is why our math scores start to drop at around middle school, compared to them.

Another problem is with Principles who are detached from the classroom process who always want to introduce some "hot" new program so it looks good on their portfolios. Teachers who take the time to understand the program,work out the kinks and integrate into other programs are thereby discouraged because everything they have done has to be thrown out every few years. They then come to think of themselves as curriculum implementers only and not as developers.

Right on, Lebanon!

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Emma Kaye July 31, 2010 at 3:54PM

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