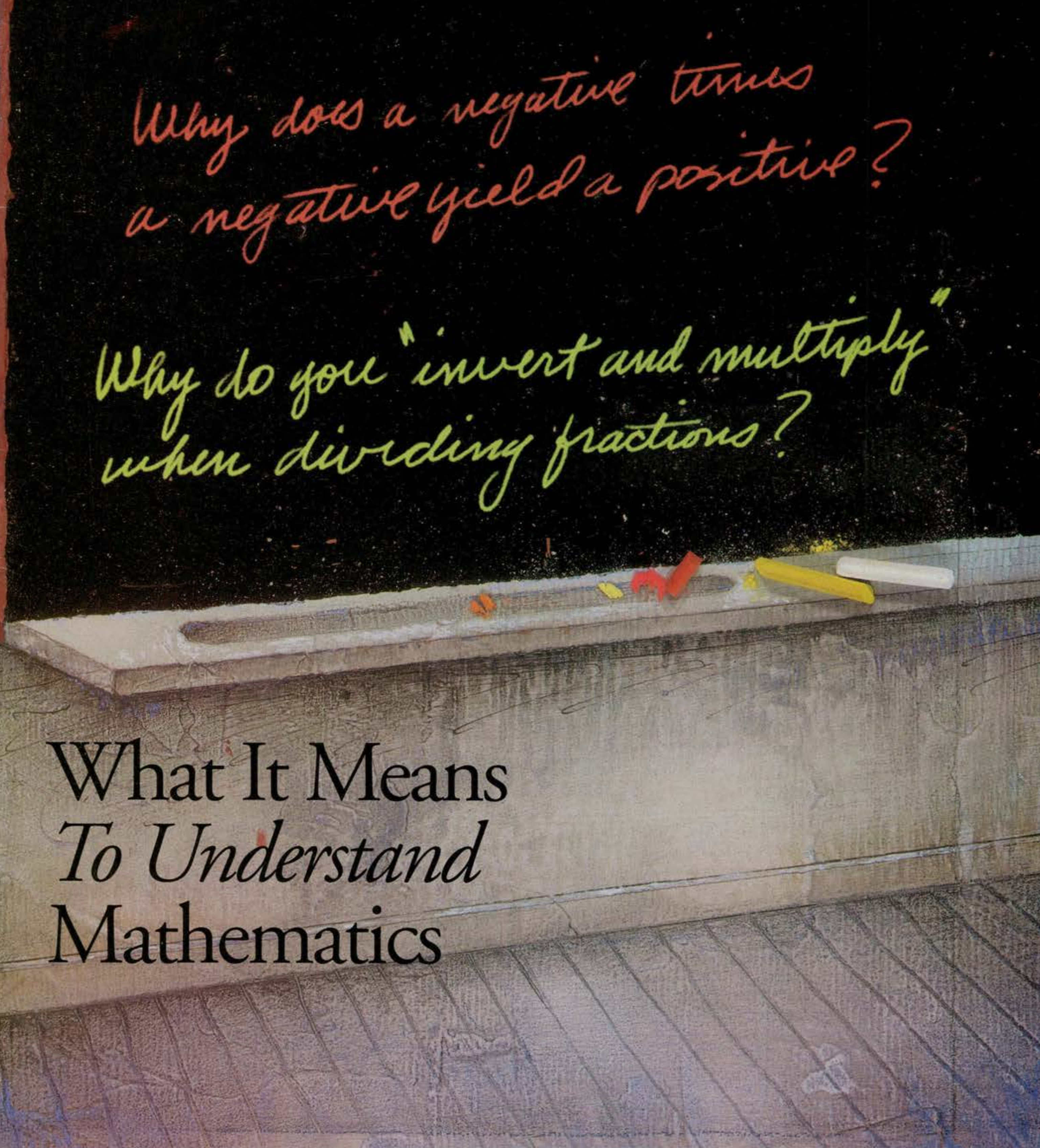
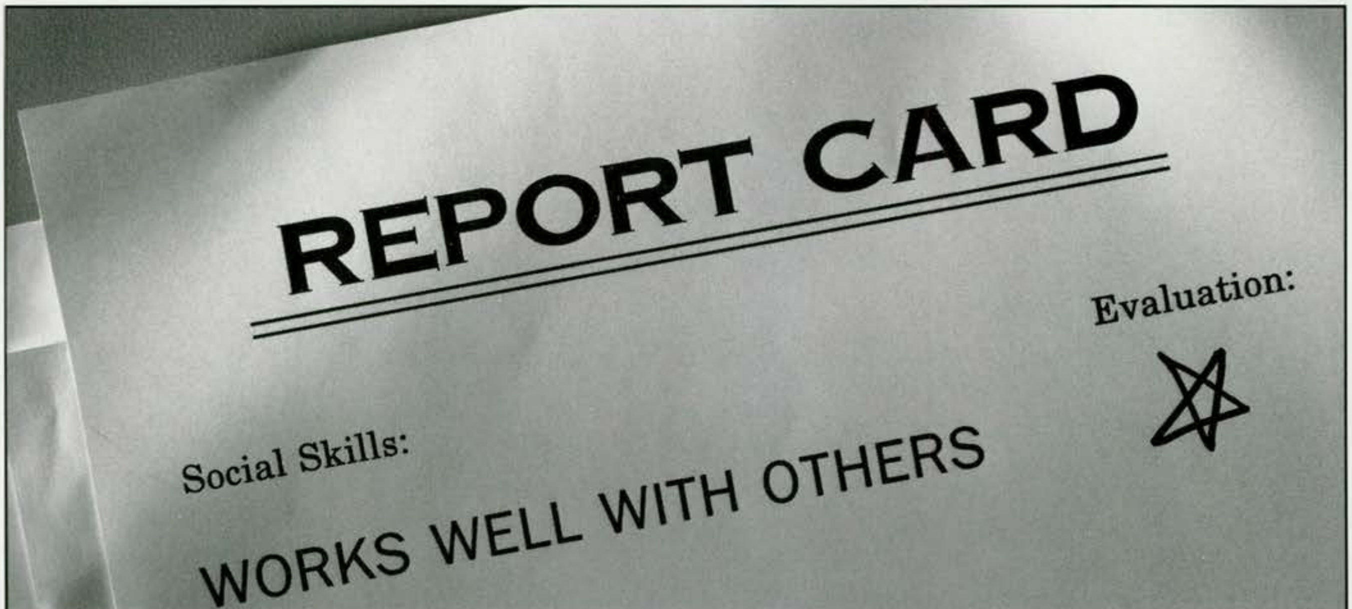
AMERICAN Educator

AMERICAN FEDERATION OF TEACHERS
FALL 1999



What It Means *To Understand* Mathematics



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AMERICAN Educator

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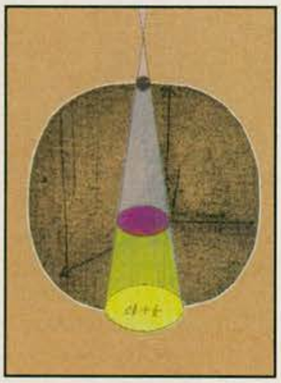

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By Richard Askey

Elementary school mathematics, it turns out, is not so elementary. This means that teaching it well requires much deeper mathematical knowledge than almost everyone has thought. There will be no math reform unless we provide teachers with the training, textbooks, time, and support needed to develop this knowledge.

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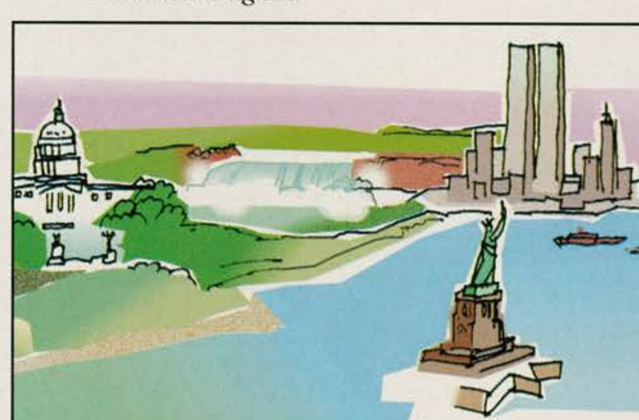

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by Yuri Vaschenko

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LETTERS

TEACHING ABOUT THE HOLOCAUST

On reading Jan Peczkis's letter in the Summer 1999 issue of *American Educator*, I was shocked, but not surprised, to read his admission that " . . .many contemporary Poles dislike Jews." His lame excuse for this is that Jews have historical biases when teaching about the Holocaust. That is hardly the reason for Polish anti-Semitism. Though he is right about some Poles courageously helping Jews during the Nazi occupation of Poland, he ignores the long and dishonorable record of Polish anti-Semitism and persecution predating Hitler.

The huge exodus of Jews from Poland prior to World War II was not solely due to economic hardship but to religious persecution by Polish gentiles.

All would be served better if Poles faced up to the despicable treatment afforded to fellow human beings because they were Jews.

—STEPHEN PART
Albuquerque, New Mexico

THE GUN DISPUTE

As a member of AFT and a teacher for 34 years, I hope that the AFT does *not* endorse Robert Spitzer's views on gun control, which I find distasteful to say the least. I am also a member of that much-maligned organization, the NRA, and find Spitzer's opinion about the Second Amendment laughable.

When I think of a society unwilling to protect itself, or unable to, I get a mental picture of the refugees in Kosovo or the thousands of other people unable to protect themselves from outside tyranny. Is it wrong for me to want to defend myself or my family or friends if the need would ever arise?

Do we need to ban guns, just as we've banned drugs, with the same dismal results? If we would quit giving people excuses and punish the offenders swiftly and surely, I believe many of our so-called gun problems would be helped.

The much-touted Brady Law has produced so few prosecutions as to be almost laughable. Our government refuses to punish the 200,000-plus people the Brady Law has supposedly kept from getting guns. Why? Why has crime taken a drop in many states where concealed-carry laws have passed?

My students will have the luxury of hearing both sides of this issue. I doubt that the *American Educator* has the decency to give a spokesman from the NRA equal time with Mr. Spitzer. Mr. Heston would shed light on the other side of the coin.

—DON BALD
Lebanon, Illinois

Robert J. Spitzer's article on guns was quite informative, but I notice that it, like every article I've seen in years in gun magazines (and other magazines) and newspapers, cites the constitutional reference to the militia only in the Second Amendment. Other parts of the Constitution clarify the position of the militia. Specifically, in Article I, Section 8, Congress's powers include "to provide for calling forth the militia to execute the laws of the union, suppress insurrections and repel invasions; to provide for organizing, arming, and disciplining the militia, and for governing such part of them as may be employed in the service of the United States, reserving to the states respectively, the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress . . . ." Then, in Article II, Section 2, on the functions of the president: "The President shall be commander in chief of the Army and Navy of the United States, and of the militia of the several states, when called into the actual service of the United States. . . ."

Separately and together, these statements clearly provide the basis for court decisions that the Second Amendment does not allow for private armies or guarantee each individual arms rights. It also refutes the argument I've seen in some gun

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magazines, that the founding fathers intended the militia as a private armed force to be used against the government. Had they so intended, they would hardly have put the militia under both state and federal control.

—FRANK W. OGLESBEE
Charleston, Illinois

Robert J. Spitzer makes an excellent case for limiting and controlling access to guns, which often end up in the hands of criminals or disturbed children. However, he does not address the rationale for right-to-carry laws, which he notes have been enacted in a large number of states.

Statistical support for these laws has been provided in John R. Lott Jr.'s book *More Guns Less Crime.* He finds that where responsible citizens are given the right to carry concealed weapons, crimes against the person decline. Though only a small percentage of persons choose to carry [arms], predators cannot be sure if their intended victim is able to defend him- or herself. Consequently crimes are less likely to be perpetrated against individuals, while "safe" crimes against property increase.

Lott claims that the reduction in personal crimes more than offsets any detrimental effects of more gun ownership, such as accidental shootings.

Though I abhor guns and wouldn't own one if I could, Mr. Lott is no crank. His statistical methods appear to be sound, and he is a Visiting Law and Economics Fellow at the University of Chicago.

The NRA seeks to do away with all gun regulation by conflating any regulation with legitimate gun ownership. The anti-gun lobby makes the same mistake by seeking to eliminate almost all handguns, thus contributing to a dialogue of the deaf. Right-to-carry laws are not incompatible with strict gun control, and recognition of this might encourage the emergence of a middle ground which would support responsible control.

—RICHARD LYNN
Millwood, New York

Professor Spitzer's article causes me to remember when I was an undergraduate political science major. My professors insisted that I do research and document my sources. I would refer my union brother to the 23-page opinion by Judge Sam Cummings of the U.S. District Court for the Northern District of Texas, in the case against Dr. Timothy Emerson. This decision cited the Second Amendment as an individual right.

I might also note that the U. S. Supreme Court has addressed this issue several times. Please refer to: *Scott v. Sanford,* 1857; *United States v. Cruikshank,* 1876; *Pressor v. Illinois,* 1886; *Miller v. Texas,* 1894; *Beard v. United States,* 1895; *Robertson v. Baldwin,* 1897; *Patsone v. Pennsylvania,* 1914; *United States v. Miller,* 1939. The individual nature of the first eight amendments might be checked out in: *Twining v. New Jersey*, 1908; *Powell v. Alabama,* 1932; *Duncan v. Louisiana,* 1968; and *Planned Parenthood v. Casey,* 1992.

You might also be interested in *Scarborough v. U.S.,* 1977 and *Lewis v. United States,* 1980. They both seem to say that a person enjoys a fundamental right to arms until his first conviction for a felony offense, whereupon he loses that right. You might also find interesting the case of *United States v. Verdugo-Urquidez,* 1990, which seems to define "the people," as used in the Preamble and the Bill of Rights. The Virginia Colony Law that required heads of households to be armed when they took their families to church might also be of interest.

I defend your First Amendment rights to express your opinion; however, we should not avoid resources that counter our hypotheses.

—C.R. NYSTROM
Associate Professor,
College of Lake County
Grayslake, Illinois

YOUNG MURDERERS

Your Summer 1999 issue is superb! The article "Young Murderers" is the best analysis of the violence problem among children and adolescents that I have read, and I have followed the literature on the subject for years.

In deep appreciation for your outstanding contribution to the welfare of all children.

—CARL L. KLINE, M.D.
Clinical Professor Emeritus
Faculty of Medicine
University of British Columbia, Canada

JAPANESE EDUCATION

It seems to be a trend to admire the Japanese model of education and see it as one that should be followed or adapted in other systems around the world.

I do not agree with this perception.The crisis that Japan is encountering today is in some measure due to the methods used to educate their citizens. Too much uniformity, preconditioning, and predetermination of social roles leave little room for creativity, independence, and entrepreneurship.

The number of small businesses that Americans have created over the last few years have had a tremendous impact on the growth of our economy. Somewhere Americans are developing traits of individualism, creativity, and productivity conducive to a tremendous economic boom.

A most interesting topic of research would be the extent of our school system's influence in forging these traits. The undeniable fact that we are having problems in our schools does not mean that our students are not being educated and moving on in life.

—ANGEL HERRERO
Miami, Florida

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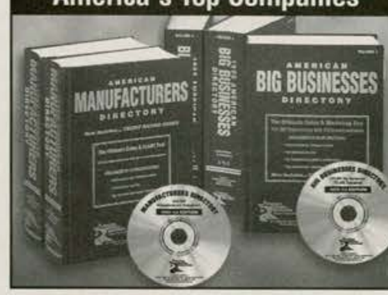

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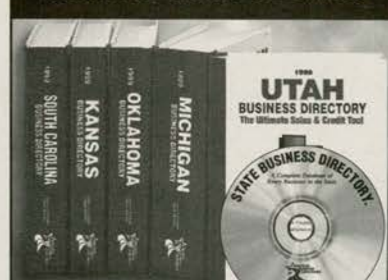

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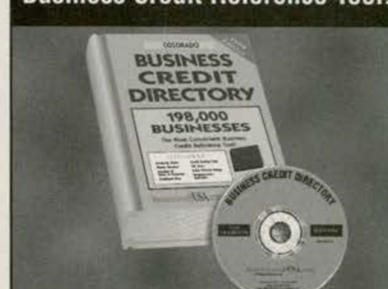

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Knowing and Teaching Elementary Mathematics

By Richard Askey

THE TITLE of this article is also the title of a remarkable new book written by Liping Ma.[1] The basic format of the book is simple. Each of the first four chapters opens with a standard topic in elementary school mathematics, presented as a part of a situation that would arise naturally in a classroom. These scenarios are followed by extensive discussion by teachers regarding how they would handle each problem, and this discussion is interspersed with commentary by Liping Ma.

Here are the four scenarios:

Scenario 1: Subtraction with Regrouping

Let's spend some time thinking about one particular topic that you may work with when you teach: subtraction with regrouping. Look at these questions:

$$\begin{array}{r} 52 \\ \underline{-\ 25} \end{array} \qquad \begin{array}{r} 91 \\ \underline{-\ 79} \end{array}$$

How would you approach these problems if you were teaching second grade? What would you say pupils would need to understand or be able to do before they could start learning subtraction with regrouping?

* * *

Scenario 2: Multidigit Multiplication

Some sixth-grade teachers noticed that several of their students were making the same mistake in multiplying large numbers. In trying to calculate

$$\begin{array}{r} 123 \\ \times\ \underline{645} \end{array}$$

the students seemed to be forgetting to "move the numbers" (i.e., the partial products) over on each line. They were doing this:

$$\begin{array}{r} 123 \\ \times\ \underline{645} \\ 615 \\ 492 \\ \underline{738} \\ 1845 \end{array}$$

instead of this:

$$\begin{array}{r} 123 \\ \times\ \underline{645} \\ 615 \\ 492 \\ \underline{738} \\ 79335 \end{array}$$

While these teachers agreed that this was a problem, they did not agree on what to do about it. What would you do if you were teaching sixth grade and you noticed that several of your students were doing this?

* * *

Scenario 3: Division by Fractions

People seem to have different approaches to solving problems involving division with fractions. How do you solve a problem like this one?

$$1\tfrac{3}{4} \div \tfrac{1}{2}$$

Imagine that you are teaching division with fractions. To make this meaningful for kids, something that many teachers try to do is relate mathematics to other things. Sometimes they try to come up with real-world situations or story problems to show the application of some particular piece of content. What would you say would be a good story or model for $1\frac{3}{4} \div \frac{1}{2}$?

* * *

Scenario 4: The Relationship Between Perimeter and Area

Imagine that one of your students comes to class very excited. She tells you that she has figured out a theory that you never told the class. She explains that she has discovered that as the perimeter of a closed figure increases, the area also increases. She shows you this

Richard Askey is John Bascom Professor of Mathematics at the University of Wisconsin-Madison. In addition to work on special functions, he has a long term interest in the history of mathematics, and of the life and work of the great Indian mathematician Srinivasa Ramanujan.

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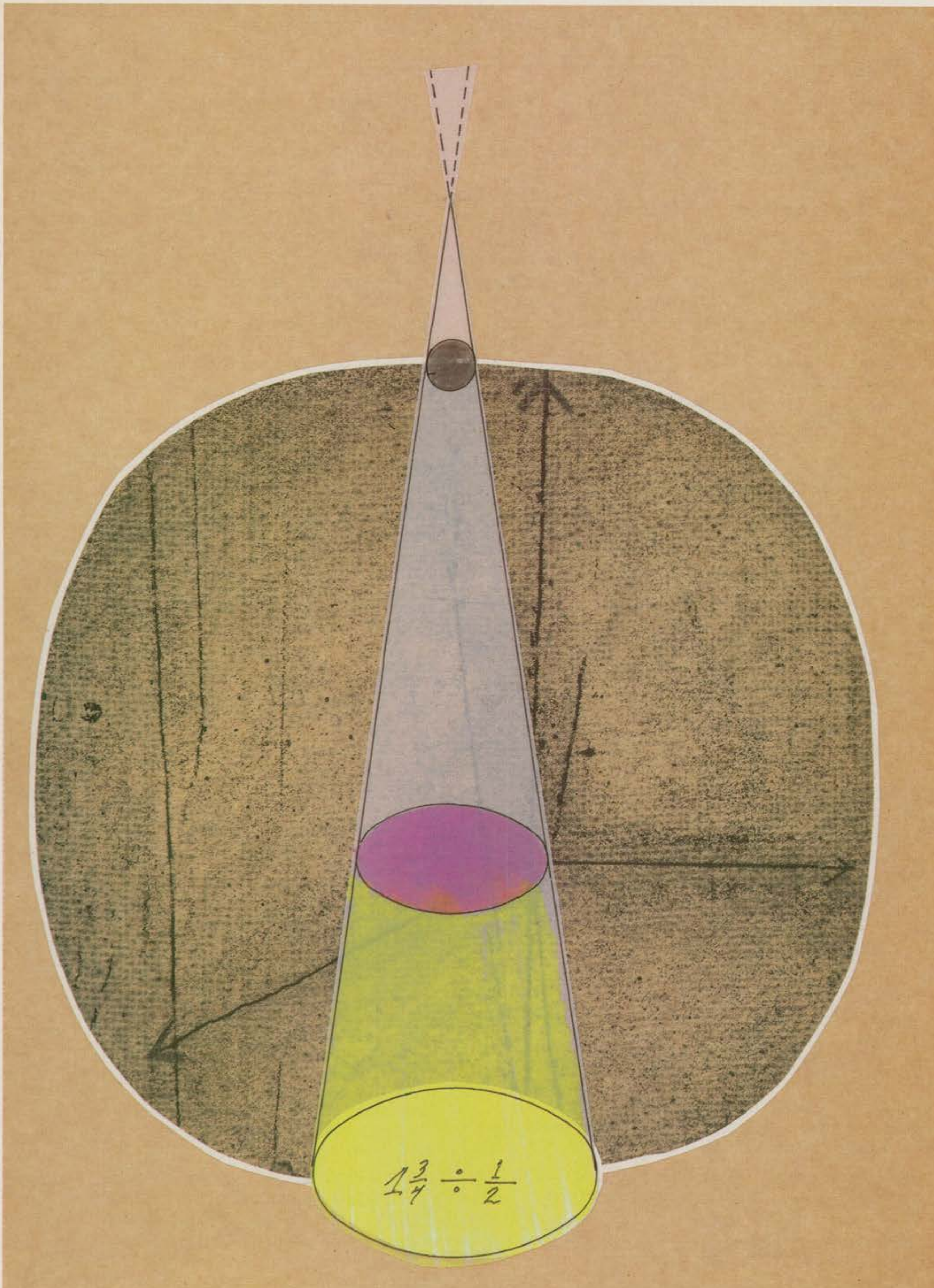
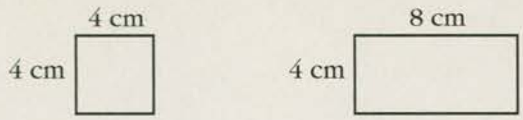

1 3/4 ÷ 1/2

picture to prove what she is doing:



Perimeter = 16 cm   Perimeter = 24 cm
Area = 16 square cm   Area = 32 square cm

How would you respond to this student?

* * *

The 20- to 30-page discussions that follow each of these four problems are the richest examples I have encountered of teachers explaining what it means to really know and be able to teach elementary school mathematics. As the word "understanding" continues to be bandied about loosely in the debates over math education, this book provides a much-needed grounding. It disabuses people of the notion that elementary school mathematics is simple—or easy to teach. It cautions us, as Ma says in her conclusion, that "the key to reform...[is to] focus on substantive mathematics." And at the book's heart is the idea that student understanding is heavily dependent on teacher understanding. We can all learn from this book.

The problem that best illustrates the insights in this book is the one about the division of fractions. For that reason and because of space limitations, I will confine my comments in this article to that problem.

The teachers Ma interviewed composed numerous story problems to illustrate fractional division. They also explained the mathematical reasoning that underlies the calculation of division of fractions. And they provided mathematical proofs for their calculation procedures.

Before giving examples of story problems composed by the teachers Ma interviewed, it is worthwhile to give a general picture of different types of division problems, using whole numbers:

- 8 feet / 2 feet = 4 (measurement model)
- 8 feet / 2 = 4 feet (partitive model)
- 8 square feet / 2 feet = 4 feet (product and factors)

Now if we substitute fractions, using $1\frac{3}{4}$ in place of 8 and $\frac{1}{2}$ in place of 2, these categories can be illustrated by the following examples:

- How many $\frac{1}{2}$ foot lengths are there in something that is 1 and $\frac{3}{4}$ feet long?
- If half a length is 1 and $\frac{3}{4}$ feet, how long is the whole?
- If one side of a $1\frac{3}{4}$ square foot rectangle is $\frac{1}{2}$ feet, how long is the other side?

Many other examples are given in Ma's book to represent this division problem. Here are two examples that use the measurement model:

> Given that a team of workers construct $\frac{1}{2}$ km of road each day, how many days will it take them to construct a road $1\frac{3}{4}$ km long?
>
> Given that $\frac{1}{2}$ apple will be a serving, how many servings can we get from $1\frac{3}{4}$ apples? (p. 73)

Many of the teachers favored the partitive model of division. Here are some of the story problems they composed based on that model:

> Yesterday I rode a bicycle from town A to town B. I spent $1\frac{3}{4}$ hours for $\frac{1}{2}$ of my journey; how much time did I take for the whole journey?
>
> A factory that produces machine tools now uses $1\frac{3}{4}$ tons of steel to make one machine tool, $\frac{1}{2}$ of what they used to use. How much steel did they used to use for producing one machine tool?
>
> We want to know how much vegetable oil there is in a big bottle, but we only have a small scale. We draw $\frac{1}{2}$ of the oil from the bottle, weigh it, and find that it is $1\frac{3}{4}$ kg. Can you tell me how much all the oil in the bottle originally weighed? (p. 79)

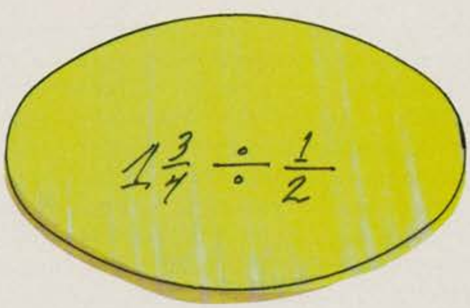
These are illuminating examples. They show the teachers' deep mathematical knowledge and their ability to represent mathematical problems to students. The latter has been called "pedagogical content knowledge."

It is important for students to learn both how to translate mathematical expressions into verbal problems and how to translate verbal problems into mathematical expressions that can be worked with. It is also important for students to understand how to do the calculation of division of fractions, and why this calculation works. Just telling students to "invert and multiply" is not enough. The following quotation from one of the teachers Ma interviewed starts with a brief statement about the relationship between division and multiplication. This statement provides a background for the story problem that follows.

> Division is the inverse of multiplication. Multiplying by a fraction means that we know a number that represents a whole and want to find a number that represents a certain fraction of that. For example, given that we want to know what number represents $\frac{1}{2}$ of $1\frac{3}{4}$, we multiply $1\frac{3}{4}$ by $\frac{1}{2}$ and get $\frac{7}{8}$. In other words, the whole is $1\frac{3}{4}$ and $\frac{1}{2}$ of it is $\frac{7}{8}$. In division by a fraction, on the other hand, the number that represents the whole becomes the unknown to be found. We know a fractional part of it and want to find the number that represents the whole. For example, if $\frac{1}{2}$ of a jump rope is $1\frac{3}{4}$ meters, what is the length of the whole rope? We know that a part of the rope is $1\frac{3}{4}$ meters, and we also know that this part is $\frac{1}{2}$ of the rope. When we divide the number of the part, $1\frac{3}{4}$ meters, by the corresponding fraction of the whole, $\frac{1}{2}$, we get the number representing the whole, $3\frac{1}{2}$ meters.... But I prefer not to use dividing by $\frac{1}{2}$ to illustrate the meaning of division by fractions. Because one can easily see the answer without really doing division by fractions. If we say $\frac{4}{5}$ of a jump rope is $1\frac{3}{4}$ meters, how long is the whole rope? The division operation will be more significant because then you can't see the answer immediately. The best way to calculate it is to divide $1\frac{3}{4}$ by $\frac{4}{5}$ and get $2\frac{3}{16}$ meters. (p. 74)

This is a rich passage. The teacher begins by reminding her students that division is the inverse of multiplication. She then reviews what it means to multiply fractions, a topic that her students have already studied. Then building on their previous knowledge, the teacher offers an example that moves her class smoothly and logically to the division of fractions.

As the word 'understanding' continues to be bandied about loosely in the debates over math education, this book provides a much-needed grounding.



But this teacher is not content with the problem the interviewer gave her, $1\frac{3}{4} \div \frac{1}{2}$. She fears it will allow her students to "see the answer without really doing division by fractions." She substitutes a different problem—$1\frac{3}{4} \div \frac{4}{5}$— one that her students cannot easily visualize, thus forcing them deeper into the mathematics of the division of fractions.

This teacher is telling us something important about the level of knowledge needed if that knowledge is to be stable rather than fragile. If all that is expected of students is that they have a picture of how to deal with simple fractions like $\frac{1}{2}$ and $3\frac{1}{2}$, their knowledge will not be deep enough to build on. Likewise, if their knowledge is limited to the computational procedure without any idea why the procedure works, this is also not enough to build on. Students need both.

Like the teacher quoted above, many of the other teachers Liping Ma interviewed used the explanation that division is the inverse of multiplication. However, Ma points out that the teachers who used this explanation preferred the phrase "dividing by a number is equivalent to multiplying by its reciprocal." That is, one can do division by multiplying by the reciprocal (or *inverse*) of the number being divided by. This is the mathematical reasoning that lies behind the "invert and multiply" computation.

Some of the teachers interviewed offered a formal mathematical proof to show why the algorithm for division of fractions works:

> OK, fifth-grade students know the rule of "maintaining the value of a quotient." That is, when we multiply both the dividend and the divisor with the same number, the quotient will remain unchanged. For example, dividing 10 by 2 the quotient is 5. Given that we multiply both 10 and 2 by a number, let's say 6, we will get 60 divided by 12, and the quotient will remain the same, 5. Now if both the dividend and the divisor are multiplied by the reciprocal of the divisor, the divisor will become 1. Since dividing by 1 does not change a number, it can be omitted. So the equation will become that of multiplying the dividend by the reciprocal of the divisor. Let me show you the procedure:
>
> $$\begin{aligned} 1\tfrac{3}{4} \div \tfrac{1}{2} &= (1\tfrac{3}{4} \times \tfrac{2}{1}) \div (\tfrac{1}{2} \times \tfrac{2}{1}) \\ &= (1\tfrac{3}{4} \times \tfrac{2}{1}) \div 1 \\ &= 1\tfrac{3}{4} \times \tfrac{2}{1} \\ &= 3\tfrac{1}{2} \end{aligned}$$
>
> With this procedure we can explain to students that this seemingly arbitrary algorithm is reasonable. (p. 60)

This is what Ma said of the teachers who offered proofs: "Their performance is mathematician-like in the sense that to convince someone of a truth one needs to prove it, not just assert it."

Many of the teachers Ma interviewed emphasized the necessity of thorough mastery of a topic before moving on to the next. In this instance, solid command of the multiplication of fractions was considered a "necessary basis" for approaching the division of fractions.

> The meaning of multiplication with fractions is particularly important because it is where the concepts of division by fractions are derived.... Given that our students understand very well that multiplying by a fraction means finding a fractional part of a unit, they will follow this logic to understand how the models of its inverse operation work. On the other hand, given that they do not have a clear idea of what multiplication with fractions means, concepts of division by a fraction will be arbitrary for them and very difficult to understand. Therefore, in order to let our students grasp the meaning of division by fractions, we should first of all devote significant time and effort when teaching multiplication with fractions to make sure students understand thoroughly the meaning of this operation.... Usually, my teaching of the meaning of division of fractions starts with a review of the meaning of multiplication with fractions. (p. 77)

This description shows an appreciation of how new knowledge is built on old knowledge. The insistence on mastery of a topic before moving on to the next stands in sharp contrast to the curriculum organization known as the "spiral curriculum." In the "spiral" approach to learning, mastery is not expected the first

(Continued on page 12)

Why does a negative × a negative = a positive?

(including how to explain it to your younger brother or sister)

For too many people, mathematics stopped making sense somewhere along the way. Either slowly or dramatically, they gave up on the field as hopelessly baffling and difficult, and they grew up to be adults who—confident that others share their experience—nonchalantly announce, "Math was just not for me" or "I was never good at it."

Usually the process is gradual, but for Ruth McNeill, the turning point was clearly defined. In an article in the Journal of Mathematical Behavior, *she described how it happened:*[1]

> What did me in was the idea that a negative number times a negative number comes out to a positive number. This seemed (and still seems) inherently unlikely—counterintuitive, as mathematicians say. I wrestled with the idea for what I imagine to be several weeks, trying to get a sensible explanation from my teacher, my classmates, my parents, anybody. Whatever explanations they offered could not overcome my strong sense that multiplying intensifies something, and thus two negative numbers multiplied together should properly produce a *very* negative result. I have since been offered a moderately convincing explanation that features a film of a swimming pool being drained that gets run backwards through the projector. At the time, however, nothing convinced me. The most commonsense of all school subjects had abandoned common sense; I was indignant and baffled.
>
> Meanwhile, the curriculum kept rolling on, and I could see that I couldn't stay behind, stuck on negative times negative. I would have to pay attention to the next topic, and the only practical course open to me was to pretend to agree that negative times negative equals positive. The book and the teacher and the general consensus of the algebra survivors of society were clearly more powerful than I was. I capitulated. I did the rest of algebra, and geometry, and trigonometry; I did them in the advanced sections, and I often had that nice sense of "aha!" when I could suddenly see how a proof was going to come out. Underneath, however, a kind of resentment and betrayal lurked, and I was not surprised or dismayed by any further foolishness my math teachers had up their sleeves.... Intellectually, I was disengaged, and when math was no longer required, I took German instead.

Happily, Ruth McNeill's story doesn't end there. Thanks to some friendships she formed in college, her interest in math was rekindled. For most of our students, there is no rekindling. This is a tragedy, both for our students and for our country. Part of the reason students give up on math can be attributed to the poor quality of most of the math textbooks used in the United States. Many texts are written with the premise that if they end a problem with the words, "Explain your answer," they are engendering "understanding." However, because these texts do not give students what they would need to enable them to "explain," the books only add to students' mystification and frustration.

Here is an example of how a widely acclaimed contemporary math series handles the topic that baffled Ruth McNeill: After a short set of problems dealing with patterns in multiplication of integers from 5 to 0 times (-4), the student is asked to continue the pattern to predict what (-1)(-4) is and then to give the next four equations in this pattern. There are then four problems, one of them being the product of two negative numbers. In the follow-up problems given next, there are four problems dealing with negative numbers, the last of which is the only one treating multiplication of negative numbers. This is how it reads: "When you add two negative numbers, you get a negative result. Is the same true when you multiply two negative numbers? Explain."

The suggested answer to the "explain" part is: "The product of two negative numbers is a positive." This is not an explanation, but a claim that the stated answer is correct.

Simply asking students to explain something isn't sufficient. They need to be taught enough so that they can explain. And they need to learn what an explanation is and when a statement is not an explanation.

The excerpt that follows is taken from a serious but lively volume entitled Algebra *by I.M. Gelfand and A. Shen, which was originally written to be used in a correspondence school that Gelfand had established. Contrast the inadequate treatment of the multiplication of negative numbers described above to the way Gelfand and Shen handle the topic.*[2] *Although their presentation would need to be fleshed out more if it's being presented to students for the first time, it provides us with a much better model for what "explain" might entail, offering as it does both an accessible explanation and a formal proof.*

—Richard Askey

The multiplication of negative numbers

To find how much three times five is, you add three numbers equal to five:

$$5 + 5 + 5 = 15.$$

The same explanation may be used for the product $1 \cdot 5$ if we agree that a sum having only one term is equal to this term. But it is evidently not applicable to the product $0 \cdot 5$ or $(-3) \cdot 5$: Can you imagine a sum with a zero or with minus three terms?

However, we may exchange the factors:

$$5 \cdot 0 = 0 + 0 + 0 + 0 + 0 = 0,$$

$$5 \cdot (-3) = (-3) + (-3) + (-3) + (-3) + (-3) = -15.$$

So if we want the product to be independent of the order of factors (as it was for positive numbers) we must agree that

$$0 \cdot 5 = 0, \quad (-3) \cdot 5 = -15.$$

Now let us consider the product $(-3) \cdot (-5)$. Is it equal to -15 or to $+15$? Both answers may have advocates. From one point of view, even one negative factor makes the product negative—so if both factors are negative the product has a very strong reason to be negative. From the other point of view, in the table

$3 \cdot 5 = +15$	$3 \cdot (-5) = -15$
$(-3) \cdot 5 = -15$	$(-3) \cdot (-5) = ?$

we already have two minuses and only one plus; so the "equal opportunities" policy requires one more plus. So what?

Of course, these "arguments" are not convincing to you. School education says very definitely that minus times minus is plus. But imagine that your small brother or sister asks you, "Why?" (Is it a caprice of the teacher, a law adopted by Congress, or a theorem that can be proved?) You may try to answer this question using the following example:

$3 \cdot 5 = 15$	Getting five dollars three times is getting fifteen dollars.
$3 \cdot (-5) = -15$	Paying a five-dollar penalty three times is a fifteen-dollar penalty.
$(-3) \cdot 5 = -15$	Not getting five dollars three times is not getting fifteen dollars.
$(-3) \cdot (-5) = 15$	Not paying a five-dollar penalty three times is getting fifteen dollars.

Another explanation. Let us write the numbers

$$1, 2, 3, 4, 5, \ldots$$

and the same numbers multiplied by three:

$$3, 6, 9, 12, 15, \ldots$$

Each number is bigger than the preceding one by three. Let us write the same numbers in the reverse order (starting, for example, with 5 and 15):

$$\begin{array}{ccccc} 5, & 4, & 3, & 2, & 1 \\ 15, & 12, & 9, & 6, & 3 \end{array}$$

Now let us continue both sequences:

$$\begin{array}{ccccccccccc} 5, & 4, & 3, & 2, & 1, & 0, & -1, & -2, & -3, & -4, & -5, \ldots \\ 15, & 12, & 9, & 6, & 3, & 0, & -3, & -6, & -9, & -12, & -15, \ldots \end{array}$$

Here -15 is under -5, so $3 \cdot (-5) = -15$; plus times minus is minus.

Now repeat the same procedure multiplying 1, 2, 3, 4, 5,... by -3 (we know already that plus times minus is minus):

$$\begin{array}{ccccc} 1, & 2, & 3, & 4, & 5 \\ -3, & -6, & -9, & -12, & -15 \end{array}$$

Each number is three units less than the preceding one. Now write the same numbers in the reverse order:

$$\begin{array}{ccccc} 5, & 4, & 3, & 2, & 1 \\ -15, & -12, & -9, & -6, & -3 \end{array}$$

and continue:

$$\begin{array}{ccccccccccc} 5, & 4, & 3, & 2, & 1, & 0, & -1, & -2, & -3, & -4, & -5, \ldots \\ -15, & -12, & -9, & -6, & -3, & 0, & 3, & 6, & 9, & 12, & 15, \ldots \end{array}$$

Now 15 is under -5; therefore $(-3) \cdot (-5) = 15$.

Probably this argument would be convincing for your younger brother or sister. But you have the right to ask: So what? Is it possible to *prove* that $(-3) \cdot (-5) = 15$?

Let us tell the whole truth now. Yes, it is possible to prove that $(-3) \cdot (-5)$ *must be* 15 *if* we want the usual properties of addition, subtraction, and multiplication that are true for positive numbers to remain true for any integers (including negative ones).

Here is the outline of this proof: Let us prove first that $3 \cdot (-5) = -15$. What is -15? It is a number opposite to 15, that is, a number that produces zero when added to 15. So we must prove that

$$3 \cdot (-5) + 15 = 0.$$

Indeed,

$$3 \cdot (-5) + 15 = 3 \cdot (-5) + 3 \cdot 5 = 3 \cdot (-5 + 5) = 3 \cdot 0 = 0.$$

(When taking 3 out of the parentheses we use the law $ab + ac = a(b + c)$ for $a = 3$, $b = -5$, $c = 5$; we assume that it is true for all numbers, including negative ones.) So $3 \cdot (-5) = -15$. (The careful reader will ask why $3 \cdot 0 = 0$. To tell you the truth, this step of the proof is omitted—as well as the whole discussion of what zero is.)

Now we are ready to prove that $(-3) \cdot (-5) = 15$. Let us start with

$$(-3) + 3 = 0$$

and multiply both sides of this equality by -5:

$$((-3) + 3) \cdot (-5) = 0 \cdot (-5) = 0.$$

Now removing the parentheses in the left-hand side we get

$$(-3) \cdot (-5) + 3 \cdot (-5) = 0,$$

that is, $(-3) \cdot (-5) + (-15) = 0$. Therefore, the number $(-3) \cdot (-5)$ is opposite to -15, that is, is equal to 15. (This argument also has gaps. We should prove first that $0 \cdot (-5) = 0$ and that there is only one number opposite to -15.) □

[1] Ruth McNeill, "A Reflection on When I Loved Math and How I Stopped." *Journal of Mathematical Behavior*, vol. 7 (1988) pp. 45-50.

[2] *Algebra* by I. M. Gelfand and A. Shen. Birkhauser Boston (1995, Second Printing): Cambridge, Mass. © 1993 by I. M. Gelfand. Reprinted with permission.

(Continued from page 9)

time, and the same topics are revisited in two, three, and even four successive years.

In her discussion of the division of fractions, Ma mentions other methods of doing the calculation, including changing the problem to decimals, and dealing with numerators and denominators separately. The teachers who suggested these methods also noted that they were not always easier than the standard textbook method of multiplying by the reciprocal. The level of knowledge expected is illustrated by the following quotation:

> The teachers argued that not only should students know various ways of calculating a problem but they should also be able to evaluate these ways and to determine which would be the most reasonable to use. (p.64)

Throughout her book, Ma provides illustrations that help show how the topic under consideration fits into the larger picture of elementary mathematics. For example:

> The learning of mathematical concepts is not a unidirectional journey. Even though the concept of division by fractions is logically built on the previous learning of various concepts, it, in turn, plays a role in reinforcing and deepening that previous learning. For example, work on the meaning of division by fractions will intensify previous concepts of rational number multiplication. Similarly, by developing rational number versions of the two division models, one's original understanding of the two whole number models will become more comprehensive. (p. 76)

AS THE reader might have suspected from the measurement units used in some of the story problems, the teachers who were quoted are from a country that uses the metric system. The country is China, and these teachers live in Shanghai and neighboring areas of China. Liping Ma grew up in Shanghai until she was in the eighth grade, when China's "Cultural Revolution" sent her to the countryside for "re-education" by the peasants. In the poor rural village in South China where she was sent, the mostly illiterate villagers wanted their children to get an education. Ma was asked to teach, which she did for seven years, and later became elementary school superintendent for the county. Later she returned to Shanghai and started to read the classical works in the field of education. This eventually led her to Michigan State University (MSU) where she began working on a doctoral degree.

While at MSU, Liping Ma worked on a project run by Deborah Ball, which was a study to find out more about the mathematical knowledge of elementary school teachers in the United States. The four questions Ma used in her interviews with Chinese teachers were originally developed by Ball as part of the MSU study, and first used to interview U.S. teachers.[2] In her book, Ma draws on this database of U.S. teacher interviews as a point of comparison to the Chinese teachers.

The U.S. teachers fared poorly when compared to their Chinese counterparts. For the division of fractions problem discussed in this article, some of the U.S. teachers had difficulties with the calculations. None of them could adequately explain the mathematical reasoning embedded in the algorithm, provide appropriate real-world applications, or offer proofs.

It was not surprising to find that our elementary teachers' mathematical knowledge is not nearly as robust as that of the Chinese teachers. How could it be otherwise? Where could our teachers possibly have acquired the knowledge base that the Shanghai teachers demonstrated? Not from their own K-12 schooling, which focused mainly on developing a little skill on routine problems. Not from the math methods courses U.S. colleges offer, since these are light on math content. And—what may be surprising to many people—not even from the math courses they might have taken from a university mathematics department. At most colleges and universitites, there is a major disconnect between what is taught in these courses and the kind of math elementary school teachers need. As H. Wu has written: "There is an alarming *irrelevance* in the present preservice professional development in mathematics."[3]

A high school teacher who took a course from the well-known mathematician George Polya put it another way:

> The prospective teacher is badly treated both by the mathematics department and by the school of education. The mathematics department offers us tough steak which we cannot chew and the school of education vapid soup with no meat in it.[4]

It is not just the courses for high school math teachers that are problematic. Courses for prospective elementary school teachers, for example, frequently slight material dealing with fractions since whole number arithmetic is the main focus in our elementary schools. Middle school teachers frequently fall between the cracks. The material they will be teaching is not taught in detail to either prospective elementary school teachers or to prospective high school teachers; there are no courses specifically for middle school teachers.

If not from their pre-college education and not from their college education, where else might a U.S. teacher have acquired a deep understanding of mathematics? Perhaps from the textbooks and teachers' guides they use in their teaching. Liping Ma reports that Chinese teachers spend considerable time studying the textbooks:

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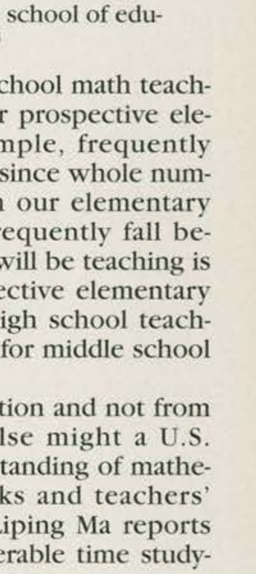
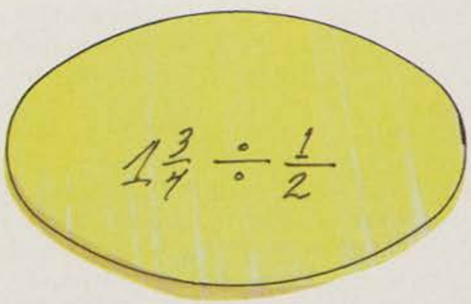


Knowing and Teaching Elementary Mathematics by Liping Ma is available in paperback from Lawrence Erlbaum Associates for $19.95 plus $2 handling charges by sending a check to Lawrence Erlbaum Associates Inc., 10 Industrial Avenue, Mahwah, NJ 07430-2262. For more information, call 800/926-6579 or e-mail: orders@erlbaum.com.

Unfortunately, there are very few of our textbooks that a teacher would profit much from studying.



> Teachers study textbooks very carefully; they investigate them individually and in groups, they talk about what textbooks mean, they do the problems together, and they have conversations about them. Teachers' manuals provide information about content and pedagogy, student thinking, and longitudinal coherence. (p. 149)

Unfortunately, there are very few of our textbooks that a teacher would profit much from studying.

The U.S. Department of Education has just announced the results of an exercise to identify "exemplary" and "promising" texts. *Connected Mathematics,* a series for grades 6-8, is one the department has deemed exemplary. I do not understand why it deserves that rating. I am quite familiar with this series, as I reviewed it as part of a textbook adoption process. Regarding fractions, for example, *Connected Math* has some material on the addition and subtraction of fractions, but nothing as systematic as described by the Chinese teachers interviewed by Ma. There is less on multiplication of fractions, and *nothing* on the division of fractions. If our students go through grade 8 without having studied the division of fractions, where are our future primary teachers going to learn this? The criteria used by the Department of Education review should be rewritten now that Liping Ma's book has provided us with a model of what school mathematics should look like.

Another recent development that leaves me less than encouraged is the way fractions are addressed in the draft of the revised K-12 mathematics standards released last year by the National Council of Teachers of Mathematics (*Principles and Standards for School Mathematics: Discussion Draft*[5]). Most of the work on fractions has been put in the grades 6 to 8 band. Students are to "develop a deep understanding of rational number concepts and reasonable proficiency in rational-number computation." It is the adjective "reasonable" that bothers me. *Proficiency* should be the goal. It is hard to imagine the Chinese teachers that Ma interviewed settling for "reasonable" proficiency with fractions for their students. These lower expectations show in every international comparison.

Furthermore, the only problem used to illustrate division of fractions in NCTM's draft revision is how many pieces of ribbon $\frac{3}{4}$ yards long can be cut from $4\frac{1}{2}$ yards of ribbon. The text continues with: "The image is of repeatedly cutting off $\frac{3}{4}$ of a yard of ribbon. Having students work with concrete objects or drawings is helpful as students develop and deepen their understanding of operations." It seems that we are back again to simple fractions and concrete objects that students can visualize. Contrast this with what Liping Ma observed:

> The concept of fractions as well as the operations with fractions taught in China and the U.S. seem different. U.S. teachers tend to deal with "real" and "concrete" wholes (usually circular or rectangular shapes) and their fractions. Although Chinese teachers also use these shapes when they introduce the concept of a fraction, when they teach operations with fractions they tend to use "abstract" and "invisible" wholes (e.g., the length of a particular stretch of road, the length of time it takes to complete a task...). (p. 76)

THE LAST three chapters in Liping Ma's book deal with *when* the Chinese teachers acquired the knowledge they showed, and a description of what Ma calls "Profound Understanding of Fundamental Mathematics," or PUFM. Here is part of her description:

> A teacher with PUFM is aware of the "simple but powerful" basic ideas of mathematics and tends to revisit and reinforce them. He or she has a fundamental understanding of the whole elementary mathematics curriculum, thus is ready to exploit an opportunity to review concepts that students have previously studied or to lay the groundwork for a concept to be studied later. (p. 124)

From their pre-collegiate studies, the Chinese teachers Ma interviewed had a firm base of knowledge on which to build. However, PUFM did not come directly from their studies in school, *but from the work they did as teachers.* These teachers did not specialize in mathematics in "normal" school, which is what their teacher preparation schools are called. But after they started teaching, most of them taught only mathemat-

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Basic Skills Versus Conceptual Understanding

A Bogus Dichotomy in Mathematics Education

By H. Wu

EDUCATION SEEMS to be plagued by false dichotomies. Until recently, when research and common sense gained the upper hand, the debate over how to teach beginning reading was characterized by many as "phonics vs. meaning." It turns out that, rather than a dichotomy, there is an inseparable connection between decoding—what one might call the skills part of reading—and comprehension. Fluent decoding, which for most children is best ensured by the direct and systematic teaching of phonics and lots of practice reading, is an indispensable condition of comprehension.

"Facts vs. higher order thinking" is another example of a false choice that we often encounter these days, as if thinking of any sort—high or low—could exist outside of content knowledge. In mathematics education, this debate takes the form of "basic skills or conceptual understanding." This bogus dichotomy would seem to arise from a common misconception of mathematics held by a segment of the public and the education community: that the demand for precision and fluency in the execution of basic skills in school mathematics runs counter to the acquisition of conceptual understanding. The truth is that in mathematics, skills and understanding are completely intertwined. In most cases, the precision and fluency in the execution of the skills are the requisite vehicles to convey the conceptual understanding. There is not "conceptual understanding" and "problem-solving skill" on the one hand and "basic skills" on the other. Nor can one acquire the former without the latter.

It has been said that had Einstein been born at the time of the Stone Age, his genius might have enabled him to invent basic arithmetic but probably not much else. However, because he was born at the end of the 19th century—with all the techniques of advanced physics at his disposal—he created the theory of relativity. And so it is with mathematics. Conceptual advances are invariably built on the bedrock of technique. Without the quadratic formula, for example, the theoretical development of polynomial equations and hence of algebra as a whole would have been very different. The ability to sum a geometric series, something routinely taught in Algebra II, is ultimately responsible for the theory of power series, which lurks inside every calculator. And so on.

The analogue of the same phenomenon in the artistic domain is even more transparent. A violinist who still worries about fingering positions cannot hope to impress with the beauty of tone or the elegance of phrasing, and an opera singer without the requisite high notes would try in vain to stir our souls with searing passion. In good art as in good mathematics, technique and conception go hand in hand.

The desire to achieve understanding in a technical subject such as mathematics while minimizing the component of skills is a most human one. There are situations where efforts to this effect are called for and, indeed, brilliantly executed. One can think of the classics of Courant and Robbins (*What Is Mathematics?*)[1] and Hilbert and Cohn-Vossen (*Geometry and the Imagination*).[2] In the context of school mathematics, however, such a desire cannot be indulged without doing great harm to students' education. There are many reasons. Sometimes a simple skill is absolutely indispensable for the understanding of more sophisticated processes. For example, the familiar long divi-

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ILLUSTRATED BY YURI VASCHENKO


skills
understanding

sion of one number by another provides the key ingredient to understanding why fractions are repeating decimals. Or, the fact that the arithmetic of ordinary fractions (adding, multiplying, reducing to lowest terms, etc.) develops the necessary pattern for understanding rational algebraic expressions. At other times, it is the *fluency* in executing a basic skill that is essential for further progress in the course of one's mathematics education. The automaticity in putting a skill to use frees up mental energy to focus on the more rigorous demands of a complicated problem. Such is the case with the need to know the multiplication table (for single-digit numbers) before attempting to tackle the standard multiplication algorithm, a fact we will demonstrate in due course. Finally, when a skill is bypassed in favor of a conceptual approach, the resulting conceptual understanding often is too superficial. This happens with almost all current attempts at facilitating the teaching of fractions.[3]

Let us illustrate the last statement with the example of the division of fractions. Recall the familiar method of "invert and multiply":

$$\frac{a}{b} \div \frac{c}{d} = \frac{d}{c} \times \frac{a}{b}$$

Nowadays, "invert and multiply" has become almost synonymous with rote learning. Among recent attempts to inject conceptual understanding into this topic, the following approach is not untypical.[4]

> Rather than relying on algorithms, where memorization of rules is the focus, the Mathland approach relies heavily on active thinking. To solve problems such as $\frac{1}{4} \div \frac{1}{2}$, students need to be able to verbalize the question: How many halves are there in one-fourth? This kind of fluency enables students to use their own logical and visual thinking skills to really know what the solution ($\frac{1}{2}$) means in relation to the problem. *How many halves are there in $\frac{1}{4}$? There is one-half of $\frac{1}{2}$ in $\frac{1}{4}$.*

Many pictures go with the explanation because it is easy to represent one-half, one-fourth, etc., by squares. Three pages down (p. 132), the "invert and multiply" algorithm is introduced and students are urged to "see if the answers you get by using [the algorithm] match up with answers you got earlier this week.... Allow plenty of time to experiment with the standard algorithm, then ask [students] to choose one problem that they worked with both ways and write about how the two solution methods compare." The problems suggested for practice are all of the type $\frac{5}{6} \div 16$, $\frac{1}{2} \div \frac{1}{6}$, $3 \div \frac{1}{6}$, etc. With conceptual understanding thus restored—or so it seems—the mathematical exposition on the division of fractions comes to an end.

If only *simple* fractions such as those given above are involved, the preceding approach emphasizing the visual aspect of division is for the most part adequate. The worm in the apple is the need to deal with division problems when the fractions are not at all simple. For example, what do the above brand of logical and visual thinking skills have to say about $\frac{2}{97} \div \frac{31}{17}$? Nothing, of course. A natural consequence of such an approach is that children develop a sense of extreme insecurity upon the sight of any fraction other than the simplest possible.

It is good to start with simple fractions that children can visualize, and they should do many such problems, until they have a firm grasp of what they are doing when they divide fractions. But we should not make students feel that the only problems they can do are those they can visualize. We should explain to them that of course they cannot draw a picture of $\frac{2}{97} \div \frac{31}{17}$; it is doubtful that anyone can. But this does not mean they cannot do the problem! Or that more complex problems like this one are not essential.

An analogy to addition may be helpful. When children were first learning to add, perhaps they counted out three blocks and then counted out four blocks and joined them to get seven blocks. But we didn't tell them that, when faced with the problem 1,272 + 846, their only choice was to gather up hundreds of blocks or draw hundreds of dots on their paper and count them. Nor did we tell them the problem was too difficult for them or not important. No, we told them there was a *mathematical* route to the answer. And not a "rote, meaningless" one, but a procedure based on simple but sound mathematical principles. And we *taught* it to them.

And so we can do with fractions. From the intuitive to the abstract, and from primitive skills to sophisticated ones, such is the normal progression in mathematics. The way to approach the division of non-simple fractions is not to bypass "invert and multiply," but to confront it. We begin by asking what it means to say a fraction

$$\frac{x}{y}$$

equals

$$\frac{a}{b} \div \frac{c}{d},$$

and realize that perhaps we have not fully come to terms with the meaning of the division of whole numbers. Children are taught, for example, that $24 \div 3 = 8$ means that if you "divide 24 objects into 3 equal portions, each portion would have 8 objects." However, such a grouping of the 24 objects shows that it is $8+8+8$, which is therefore the same as 3×8. So in this case, "$24 \div 3 = 8$" means exactly that $24 = 3 \times 8$. This reasoning turns out to be general, in the sense that if we analyze any other example, say $80 \div 16 = 5$, then repeating the preceding reasoning leads to a similar conclusion that it is the same as $80 = 5 \times 16$. Along this line, fifth-graders should have no trouble understanding that, in general, for whole numbers m, n and k, the statement

$$m \div n = k$$

says exactly the same thing as

$$m = n \times k.$$

This then provides an abstract point of view to understand division in terms of multiplication. It is common to express this interpretation of division as "division is the inverse operation of multiplication."

With the new insight at hand, we can now reprise the division of fractions: To the extent that whole numbers and fractions are just "numbers," they must share the same properties in terms of the basic operations such as multiplication or division. Thus looking at each fraction as a number and imitating the case of whole numbers, we see that the division

$$\frac{a}{b} \div \frac{c}{d} = \frac{x}{y}$$

ought to mean

$$\frac{a}{b} = \frac{c}{d} \times \frac{x}{y}.$$

This is then how we want to *define* the division of fractions. Multiplying both sides by

$$\frac{d}{c}$$

immediately leads to

$$\frac{x}{y} = \frac{d}{c} \times \frac{a}{b}.$$

In other words,

$$\frac{a}{b} \div \frac{c}{d} = \frac{d}{c} \times \frac{a}{b}.$$

Thus the method of "invert and multiply" is a result of a *deeper understanding* of fractions than that embodied in the naive logical and visual thinking skills above. We see clearly the concordance of skills and understanding in this instance.

There is at present a desire in a large segment of the education community to achieve understanding of fractions—the bugbear of elementary mathematics education—by avoiding the traditional skills and by restricting attention only to very simple fractions and a naive visual reasoning of the type described above. While the intention is laudable, the inevitable net result is that skills and understanding both are given short shrift. The following passage is another example that sets forth such an agenda:[5]

> The mastery of a small number of basic facts with common fractions (e.g., $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$; $\frac{3}{4} + \frac{1}{2} = 1\frac{1}{4}$ and $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$)... contributes to students' readiness to learn estimation and for concept development and problem solving. This proficiency in the addition, subtraction, and multiplication of fractions and mixed numbers should be limited to those with simple denominators that can be visualized concretely and pictorially and are apt to occur in real-world settings; such computation promotes conceptual understanding of the operations. This is not to suggest however that valuable time should be devoted to exercises like $\frac{17}{24} + \frac{5}{18}$ or $5\frac{3}{4} \times 4\frac{1}{4}$, which are much harder to visualize and unlikely to occur in real-life situations. Division of fractions should be approached conceptually.

Without going into details (which are not unlike those related to the division of fractions), it is again the case that if students only have enough understanding of fractions to do simple operations such as $\frac{1}{4} + \frac{1}{4}$, $\frac{3}{4} + \frac{1}{2}$, $\frac{1}{2} \times \frac{1}{2}$, etc., but nothing else, then this understanding is fragile and defective. In this context, it may be worthwhile to point out, in a different way, how the good intention of promoting understanding by suppressing skills can ultimately diminish students' understanding. Both examples of computations, $\frac{17}{24} + \frac{5}{18}$ and $5\frac{3}{4} \times 4\frac{1}{4}$, which students are advised to avoid, are in fact extremely simple to perform. For example, if students have a firm grasp of the distributive law, then:

$$5\tfrac{3}{4} \times 4\tfrac{1}{4} = (5+\tfrac{3}{4}) \times (4+\tfrac{1}{4}) = (5\times 4) + (5 \times \tfrac{1}{4}) + (\tfrac{3}{4} \times 4) + (\tfrac{3}{4} \times \tfrac{1}{4}).$$

Because the resulting multiplications and additions on the right are easy to do by any standard, the original computation is also accomplished therewith. The exhortation not to do this computation—although well-intentioned—ends up slighting a very important weapon in students' conceptual arsenal: the distributive law.

We should not make students feel that the only problems they can do are those they can visualize.

There is yet another reason why division of fractions should not be limited to only those problems that students can visualize, which is apparently what the passage quoted above means when it says "approached conceptually." If students are not fed a steady diet of increasing abstraction, how can they hope to cope with algebra a year or two later? The "algebra for all" battle cry will be an empty promise unless it is backed up by an insistence on elevating education in grades 5 to 7 to periodic heights of abstraction.

LET US now take up the issue of the teaching of the standard algorithms in elementary school, where the confrontation of skills vs. understanding is most intense. We are told that these algorithms are by their very nature nothing more than rote, meaningless mathematical maneuvers.

Indeed, the very mention of the teaching of standard algorithms causes open hostility in some mathematics education circles. In a recent article, the president of the southern section of the California Mathematics Council put forth the view that the explicit presence of algorithms in the new California Mathematics Standards is nothing less than an advocacy for knowledge to be taken "as a collection of bits or facts to be learned by memorization and impressed upon the child from the outside," which then results in children trying to "mechanically memorize meaningless facts and skills."[6]

This view echoes one that is held by many educators, among them Constance Kamii. Kamii is generally acknowledged to be a leading advocate of this point of view. A much quoted recent article co-authored by Kamii and Ann Dominick is provocatively entitled "The Harmful Effects of Algorithms in Grades 1-4."[7] Its main thesis is this:

> Algorithms not only are not helpful in learning arithmetic, but also hinder children's development of numerical reasoning....

Why not consider the alternative approach of teaching these algorithms *properly* before advocating their banishment from classrooms?

> We have two reasons for saying that algorithms are harmful: (1) They encourage children to give up their own thinking, and (2) they "unteach" place value, thereby preventing children from developing number sense....
>
> The persisting difficulty [with standard algorithms] lay in the column-by-column, single-digit approach that prevents children from thinking about multidigit numbers.

This then brings us to an impasse, according to Kamii and Dominick: Children can have conceptual understanding of numbers without learning algorithms, or they become mathematical error-prone robots. Which do we prefer? Invoking Piaget's constructivism [*sic*], Kamii and Dominick recommend that

> Children in the primary grades should be able to invent their own arithmetic without the instruction they are now receiving from textbooks and workbooks.

We are thus led to believe that there is no way to teach a simple addition such as 89 + 34 (a problem Kamii and Dominick consider) using the standard algorithm except by ramming it down children's throats. Could these authors be unaware of the fact that the addition algorithm, like all other standard algorithms, contains mathematical reasoning that would ultimately enhance children's understanding of our decimal number system? Why not consider the alternative approach of teaching these algorithms *properly* before advocating their banishment from classrooms? Let us see what we can do with the addition algorithm in the special case of 89 + 34.

In a third-grade class, say, let us assume that the children already know how to add single-digit numbers fluently. To teach them the addition of 89 to 34, one may begin with a simpler problem: 59 + 34. This is because 59 + 34 would avoid any mention of the hundreds digit. Now, one must emphasize at all times that 59 is 50 + 9 and 34 is 30 + 4. So 59 + 34 can be added separately in this way:

$$\begin{array}{rcrl} 50 & + & 9 & \\ 30 & + & 4 & (+ \\ \hline 80 & + & 13 & \end{array} \qquad (1)$$

Because each "vertical" addition involves only single digits, the individual steps should offer no difficulty to children. Now add 13 to 80 to get 93; again this should present no difficulty, because the children can repeat the above process if necessary:

$$\begin{array}{rcrl} 80 & & & \\ 10 & + & 3 & (+ \\ \hline 90 & + & 3 & \end{array} \qquad (2)$$

Give several such problems to allow the children to practice addition in this long-winded manner. Because they understand this simple skill, such extended practice to perfect the skill is both necessary and *desirable*. After the students have become thoroughly familiar with the method, point out to them that what they have been doing each time is to add the ones digits *separately*, and then the tens digits *separately:* 9 + 4 and 5 + 3 in step (1), and 8 + 1 and 0 + 3 in step (2). Let them do a few more such additions and take note of this fact each time. Allow some time for this idea to sink in before introducing them to the first simplification: Building on the newly acquired idea of adding the digits in different "places" separately, point out to them that they could save some writing in step (2) because they can simply line up the ones and tens digits vertically and directly add since the ones digit in 80 would always be 0:

$$\begin{array}{rl} 80 & \\ 13 & (+ \\ \hline 93 & \end{array} \qquad (3)$$

Again give the students time to get used to this idea. Make them do many practice problems of this type: 40 + 12, 60 + 18, etc.

Children welcome any suggestions that save labor. It is therefore time to introduce another one. When they can do step (2) in the format of step (3) *fluently*, tell them that in fact they could combine steps (1) and (2) into one step by bringing down the "13" to the next line and add as in step (3):

$$\begin{array}{rcrl} 50 & + & 9 & \\ 30 & + & 4 & (+ \\ \hline 80 & + & 13 & \\ 13 & & & (+ \\ \hline 93 & & & \end{array}$$

With a little bit more practice, the children can simplify the writing even further:

$$\begin{array}{lcrl} & & 59 & \\ & & 34 & (+ \\ (50 + 30) & \Rightarrow & 80 & \\ (9 + 4) & \Rightarrow & 13 & (+ \\ \hline & & 93 & \end{array}$$

(Students need not write down the two lefthand columns consisting of [50 + 30], [9 + 4], and the long right arrows; these only serve as instructional reminders.) The final *coup de grâce,* to be administered only when the children are already secure in all the preceding simpler addition activities, is to point out a *shorthand method* of writing the preceding step: Slip the tens digit "1" of the "13" under 34 to keep track of the addition of the ones digit. So:

$$\begin{array}{r} 59 \\ 34 \\ \underline{{}_1 \quad (+} \\ 93 \end{array}$$

This then is the standard addition algorithm. It should be plain to the children (even if they may not be able to articulate it) that this is an efficient compression of a valuable piece of *mathematical reasoning* into a compact shorthand. They would appreciate this efficiency, let it be noted, only if they have meticulously gone through the laborious process of steps (1) to (3) above. Because young minds are flexible and discerning, the children will learn the algorithm logically without being pressured "from the outside" to "mechanically memorize meaningless facts and skills" while "giving up their own thinking." On the contrary, they will learn how to reason effectively, and the whole experience will stand them in good stead in their later work.

The next step is of course to go back to the original problem of 89 + 34, but the introduction of the hundreds digit in 80 + 30 should now present no real difficulty since the simpler case has been firmly mastered.

It may be useful to elaborate on the idea that the standard algorithm presented above captures a valuable piece of mathematical reasoning that enhances students' understanding of numbers. We can see this more clearly by making explicit the underlying mathematics. The fact that 59 + 34 can be added as in step (1) makes implicit use of the commutative law and associative law of addition:

$59 + 34$	=	$(50 + 9) + (30 + 4)$	
	=	$[(50 + 9) + 30] + 4$	(assoc. law)
	=	$[50 + (9 + 30)] + 4$	(assoc. law)
	=	$[50 + (30 + 9)] + 4$	(comm. law)
	=	$[(50 + 30) + 9] + 4$	(assoc. law)
	=	$(50 + 30) + (9 + 4)$	(assoc. law)

Without entering into the tedious details, one need only point out that both laws are also used in all subsequent arguments. Third-graders should not be saddled with this kind of formalism, of course, but teachers should be aware of it if only to gain the confidence that teaching the standard algorithm does not "encourage children to give up their own thinking." Teachers will also need this knowledge to explain it to their students should the need arise.

Children always respond to reason when it is carefully explained to them. The day will come when teachers are capable of explaining these time-honored algorithms in this logical manner. In the meantime, let us be constructive and concentrate on the needed professional development of teachers rather than spread the destructive theory about the harm these algorithms inflict upon children.

To drive home the point that the standard algorithms embody conceptual understanding, let us conclude with an examination of the multiplication algorithm as taught to, say, fourth-graders. *We assume they are fluent in single-digit multiplications.* Consider the problem of 268×43. A new element now appears in the form of the distributive law. Because this law is so basic and because fourth-graders are sufficiently mature to understand it, the law should be explained to them: For any number *a, b, c:*

$$a(b + c) = ab + ac.$$

Henceforth, we will write $a \times b$ as ab for simplicity. Because multiplication is commutative, this also implies:

$$(b + c)a = ba + ca.$$

This law can be made plausible using rectangular arrays of dots. For example, 5×4 is represented by a five-row and four-column collection of dots.

Similarly 5 x 3 is represented by the dots in:

Hence $(5 \times 4) + (5 \times 3)$ is represented by the dots obtained from putting the two sets of dots side by side:

But this is a rectangular array of dots with 5 rows and (4 + 3) columns, so it represents $5 \times (4 + 3)$, thereby verifying the distributive law in this special case. The general case is entirely similar.

In the following, we shall call attention to the distributive law each time it is used, but will use the commutative laws and associative laws without mention. To compute 268×43, we shall *appeal to the higher order thinking skill of breaking complicated tasks down to simple ones* by breaking it down to two simpler multiplication problems. Because 3 and 4 are the two digits of 43, we first compute 268×3 and 268×4 separately. Because 268 = 200 + 60 + 8 (as usual, students need to be reminded of this fact), the distributive law gives:

$$268 \times 3 = (3 \times 200) + (3 \times 60) + (3 \times 8).$$

Because students know how to multiply single-digit numbers, this equals

$$268 \times 3 = 600 + (180) + (24). \qquad (4)$$

Because the 180 above comes from the tens digit, we can "split off" the 100 from 180 = 100 + 80 and combine it with 600:

(Continued on page 50)

Introduction

WRITING IN this magazine several years ago about the differences between the professional lives of American and Asian teachers, Harold Stevenson and James Stigler made the following observation:

> The first major obstacle to the widespread development and execution of excellent lessons in America is the fact that American teachers are overworked. It is inconceivable that American teachers, by themselves, would be able to organize lively, vivid, coherent lessons under a regimen that requires that they teach hour after hour every day throughout the school year....
>
> The full realization of how little time American teachers have when they are not directly in charge of children became clear to us during a meeting in Beijing. We were discussing the teachers' workday. When we informed the Chinese teachers that American teachers are responsible for their classes all day long, with only an hour or less outside the classroom each day, they looked incredulous. How could any teacher be expected to do a good job when there is not time outside of class to prepare and correct lessons, work with individual children, consult with other teachers, and attend to all of the matters that arise in a typical day at school!

How, indeed? The calculations done by Stephen Swaim—the co-author of the article that follows—show that if a secondary school teacher with a typical workload puts in a 50-hour week, he or she will have approximately 10 minutes to prepare for each class and five minutes *per week* to review the work of each student. An elementary school teacher working 50 hours a week will have 15 minutes for each class preparation and 20 minutes per week to devote to each student's work. That parses out to *four minutes per student per subject* if the teacher is teaching five subjects: math, science, social studies, English literature/reading, and English grammar/writing/vocabulary/spelling, etc.

The first two articles in this issue of *American Educator* discuss the deep level of mathematical knowledge that teachers must have if our students are to really *understand* mathematics. One of the articles compares the math knowledge of American teachers to that of Chinese teachers. It makes the point that while Chinese teachers' education gives them a solid grounding in mathematics, it is only during their tenure as teachers that their deep mathematical knowledge truly develops.

Here is how one Chinese elementary school teacher describes his preparation for a class:

> I always spend more time on preparing a class than on teaching, sometimes three, even four, times the latter. I spend the time in studying the teaching materials: What is it that I am going to teach in this lesson? How should I introduce the topic? What concepts or skills have the students learned that I should draw on? . . .How am I going to pull out that knowledge and make sure my students are aware of it and the relation between the old knowledge and the new topic?...How should I present the topic step-by-step? How will students respond after I raise a certain question? Where should I explain it at length, and where should I leave it to students to learn it by themselves?...What do I expect the advanced students to learn from the lesson? What do I expect the slow students to learn? How can I reach these goals?...

An American elementary school teacher who works a 50-hour week would have about 15 minutes to ponder these issues. And, of course, after the class is taught, there is student work to review. Staying with the example of math, consider the difference between a set of problems that is handed back with a "✓" or an "✗" by each problem and one where the teacher shows the student where he or she has gotten off track. Consider also the motivational difference to a child if a math test is graded with an all-or-nothing score for each problem (much quicker for the teacher to grade) and one where partial credit is given if part of the problem is done correctly (very time-consuming for the teacher, who has to analyze each student's work). The list obviously could go on and on, for math and for every other subject.

The frantic pace that a teacher has to keep in order to do a good job is a frequent topic of conversation among teachers, but it is not widely appreciated by others. Until now, no one has detailed the dimensions of the problem. We owe a debt of gratitude to Marty and Stephen Swaim for doing so.

There are a variety of changes that could be made to give teachers a more realistic workload. All of them at some point bump up against the need to hire more teachers. We do not need to be told that this is a complex issue to address; we know that. How will we attract even greater numbers of qualified people to a profession where 30 percent of new teachers find the conditions and demands of the job such that they leave within the first three years? Capable young people want to go into a top-of-the-line profession. The incentives for attracting and retaining good teachers have to go much deeper than the now-popular "signing bonuses," or as was recently suggested by the governor of Maryland, a reduced home mortgage rate for teachers.

The issue of teacher workload takes us to the center of larger questions about this country's commitment to education. But, then, isn't that precisely where the discussion must go if phrases like "world-class standards" and "every child can learn" are to have any meaning.

—*Editor*

TEACHER TIME

(or, rather, the lack of it)

By Marty Shollenberger Swaim and Stephen C. Swaim

TEACHING IS wonderful, fascinating, and it's never, never dull, one of those professions in which you can really say, "I change lives."*

An American civilization student writes that "when I stepped off the bus into the Ephrata Cloisters, I felt as if I could feel and smell another world, another century." A ninth-grade world history student writes in her journal that "writing in clay with papyrus reed as did the ancient Sumerians was messy, and hard, but interesting and very exciting." Or that "I thought ancient men were the Flintstones, stupid, ugly...and now I know that early men were extremely intelligent and clever to make and use the tools they had and to survive in hard places."

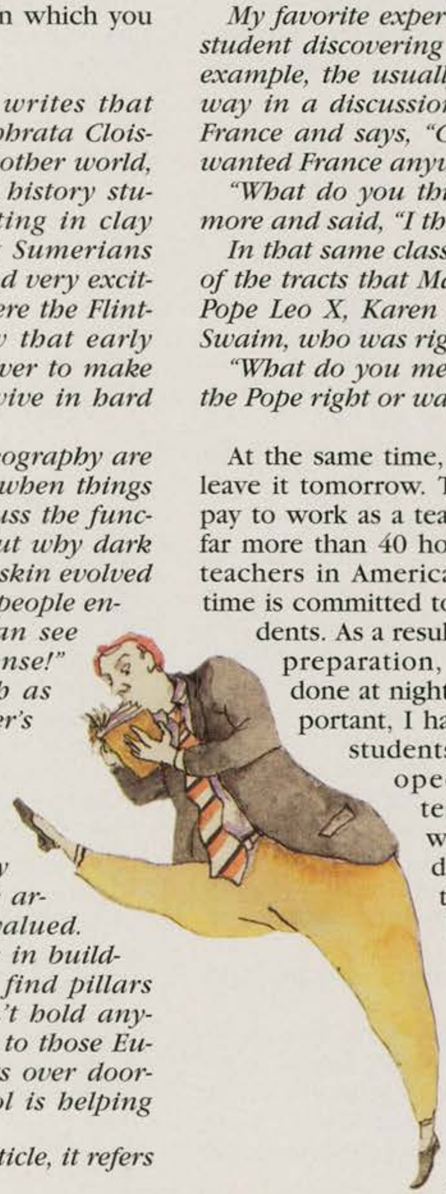
Some lessons in eighth-grade world geography are "light bulb lessons." Kids' eyes light up when things begin to connect. For example, we discuss the function of skin color and the theories about why dark skin evolved near the equator and light skin evolved in the northern forests of Europe where people encountered less ultraviolet rays. You can see students thinking "Oh, that makes sense!" They have important questions, such as "How did I get my Korean grandmother's facial bones and my black granddad's skin color?" The African-American students sit a little straighter when they figure out that the first people in the world were African. In a world history unit on Greece, we study ancient Greek architecture to learn what the Greeks valued. One activity is looking at Greek details in buildings in Arlington [Virginia]. Students find pillars and pediments all over town that don't hold anything up, but are there as a connection to those European and Greek traditions. Pediments over doorways remind us of who we are. School is helping students make sense of the world.

My favorite experiences are those in which I see a student discovering that she or he has a mind. For example, the usually silly ninth-grader pauses midway in a discussion about the English invasion of France and says, "Can you tell me why the English wanted France anyway? Didn't they have enough?"

"What do you think?," I asked. She thought some more and said, "I think they were greedy."

In that same class, in the midst of student analysis of the tracts that Martin Luther wrote to argue with Pope Leo X, Karen says, loud and clear, "Well, Mrs. Swaim, who was right?"

"What do you mean, Karen?," I said. "I mean was the Pope right or was Luther right?"



At the same time, although I love teaching, I could leave it tomorrow. The personal price that I have to pay to work as a teacher is very high. I have to work far more than 40 hours per week because, like other teachers in America, almost all of my official work time is committed to the classroom instruction of students. As a result, most of the necessary planning, preparation, and grading must be regularly done at night or on weekends. And, just as important, I have little or no time for individual students. Statistics show that no developed, industrial country requires teachers to spend as many hours with students in class each week as do American schools. "Despite relatively low pay, teachers in the United States devote more hours to instruction and supervision of students each week and have longer required workweeks than in any other country, including the nations with six-day weeks, such as Japan and Switzerland."[1]

In 1984 when I began to teach high school social studies in Arlington, I was totally over-

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* *When the first person is used in this article, it refers to Marty Swaim.*

whelmed by the amount of work. I came to teaching after five years in which I founded and operated a contract catering business with 18 employees, not a light responsibility. Teaching was, and is, much more work. To do the planning needed for each day and to have a chance of keeping up with grading papers, I worked two to three hours every night. Typically, I worked Sundays, roughly from 10 A.M. until 10 P.M., with breaks for lunch and supper. First, I planned out the next week's lessons for three different subjects (each with classes meeting five times per week), I wrote out teaching materials, and I organized the readings and equipment for the class.[2] I finished grading work handed in the week before. In the first year I taught four classes per day, one class less than full time, an easier load than most first year teachers have.[3]

That first year I did what I needed to survive and, I hoped, do a good job. To get the school work finished, I stopped doing my housework, except laundry and cooking. My family was supportive, and managed the personal consequences of my work. Stephen (who rarely got home from work before 6 p.m.) did the dishes and helped with cleaning, and we shopped for food together. Our two daughters at home did their own cleaning and laundry. I did not visit our daughter in Florida, and rarely had time to see our son in college at Virginia Tech.

I thought putting in 60 hours per week was the result of inexperience. But when I looked around, I realized that most of my fellow teachers worked the same hours. They came in at 6 A.M. and left at 4 P.M., worked through lunch, and assumed that when they assigned a test or paper they would spend evenings and all day Sunday grading it. I began to see that public school teaching was basically a 60-70 hour a week job advertised and paid for as if it were a "9-5" professional job.[4] Sometimes I got very depressed about the consequences for my personal life; I could not travel to Pittsburgh to see my mother-in-law when she was ill. We had fewer people over for dinner, and we did fewer things with our children because one day of each weekend was always obligated to school.

As I recognized that this level of intensity came with the job of teaching, I tried to find less labor-intensive ways to get students involved in learning, such as pairing students to read, discuss, and edit each other's work. Student editing develops student responsibility, and does change initial demands on the teacher. Eventually, however, I have to read student writing. The methods that might really lighten my load are, in my view, not good for students if used regularly: multiple-choice tests, fewer writing assignments, no required rewriting, reading assignments with simpler vocabulary requiring less preparation and follow-up, and using fill-in worksheets instead of writing responses to reading.

The problem I had in finding time to plan and mark assignments and meet with students is not, of course, unique to social studies. In addition to the daily homework and class work products, quizzes and tests, English teachers assign books to read and report on, and papers to write. A math teacher assigns proofs and word problems that must be read and graded, and science teachers assign lab reports.

Some observers believe teachers are adequately compensated for long hours by having a winter break, a spring break, and 9 to 10 weeks in the summer. However, the total break time actually is less than the overtime hours spent during the year. Furthermore, for me and for many teachers, the summer time without students is rarely time spent primarily on personal matters. As soon as school is dismissed, there is a week of filing materials and later in the summer, a week of planning for next year. Most teachers, most summers must take professional work to keep up in their field and to meet recertification requirements. Teachers are employees who actually work 11 months and get paid for 10. In addition, many colleagues must work in the summer in order to meet living expenses.

It is true that many people with professional jobs work as many hours as teachers and don't get as much time without their clients. However, these persons for the most part are lawyers, doctors, owners of small businesses, corporate executives, or others who generally get paid (or have the prospect of getting paid if they succeed) far more than teachers can ever be paid. Often these professionals do not have to work long days for their entire working years, and/or they can retire very early.

My description of the toll that teaching takes is obvi-

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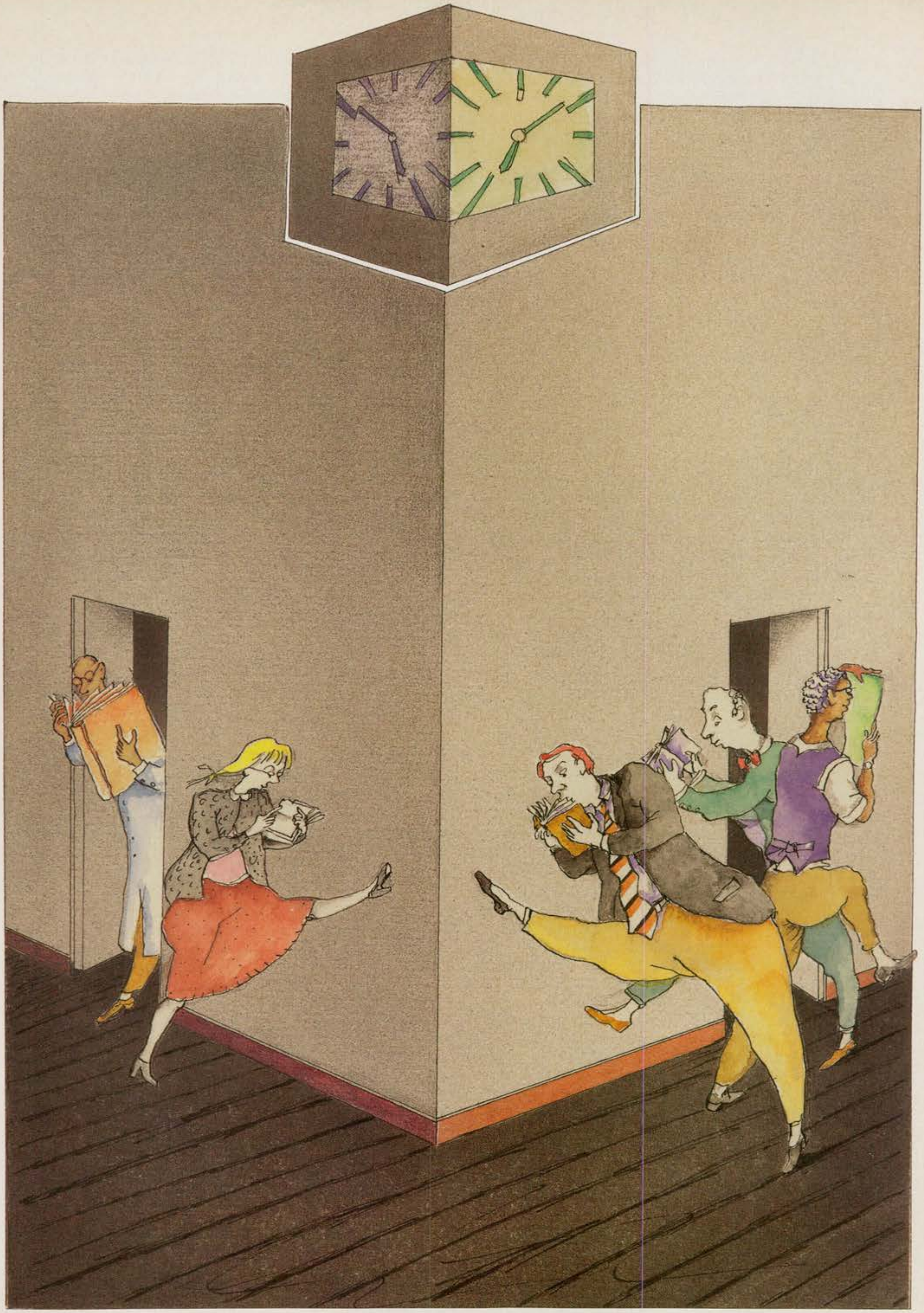
[1] F. Howard Nelson and Timothy O'Brien, *How U.S. Teachers Measure Up Internationally, a Comparative Study of Teacher Pay, Training, and Conditions of Service* (Washington D.C., American Federation of Teachers, 1993), p. 75.

[2] A very small amount of the material for any of my classes (world history and American history) was provided. My first classroom had no materials, not even dictionaries and atlases. I borrowed them from other classes. (This school system has one of the highest per-pupil expenditures in the state of Virginia.) I had texts for each student and a list of some audiovisual materials. A doctor might begin his career with a library and equipment, or a lawyer might buy a library with his practice. But teachers build up similar resources over a long time on their own. The Arlington Public Schools provides one small professional library for about 1,000 teachers, and a rotating collection of audiovisual materials. My high school library had some professional teaching materials. But, of course, to use all of these scattered but possible sources took time. Time was what I did not have.

[3] I had completed student teaching but, at the most, student teaching gave me one week of experience in a subject. I also got four-fifths of the salary, and no benefits.

[4] A substantial portion of this time is working longer than the "school day" as stated in the teaching contract. In Arlington, teachers are required to be present in school for 7.5 hours per day, or 37.5 hours per week. A 60-hour workweek results from working an extra 1.5 hours at school, Monday through Thursday; two hours each evening, Monday through Thursday; and a full 8.5 hour day on Sunday. Adding an additional 1.5 hours each weekday evening and four more hours on the weekend, as often occurs, brings the workweek to 70 hours.

ILLUSTRATED BY YURI VASCHENKO



ously highly personal. But if you sit in on any teacher lunchroom conversation you will find that frequent topics of conversation are time, the lack of time, the lack of a personal life, the difficulties of having one. As a teacher who returned to teaching when my youngest child was in second grade, I do not know how teachers can work and raise infants. Those teachers must never sleep.

My first year in middle school, I taught across the hall from two first-year teachers. By then I was a six-year veteran. "Do you have a life?" was their regular question for me, because they did not. I have known other first- and second-year teachers, excellent teachers, whose beginning experiences were marked with periods of tears and near collapse because the time and emotional demands of teaching were so great. Recently, a second-year teacher, a second-career person coming from a demanding line of work, asked me when the workload would level off. And I explained what has been my experience, that by my seventh year, with preparations in four different subjects under my belt, the workload began to make me less anxious. I met this teacher's husband at a winter staff party, and he wanted to know if maybe by the third year of his wife's teaching, sex could again be a part of their marriage. I said "Talk to my husband. Perhaps a schedule for time together is what you need to do."

It is important to itemize the demands on my time, and that of other teachers, not to complain, but because until a workable remedy is found to this chronic overload, our teachers and our schools are destined to fall far short of the goals we have set for them. Students will continue to pay a price for the fact that their teachers do not have enough time for each of them.

If you are a parent, think about how much one-on-one time or time in a small group your child actually has each day with a teacher. Think about how much time a teacher has to give thoughtful attention to that project your child worked on for a month.

A friend said to me that he knows teachers who do not spend 60 hours per week on their work. So do I. But in good schools, these people are the exception. It is amazing how many teachers work 60 hours each week or more during many weeks of the year. But it is unrealistic to expect most teachers to have to work such long hours in order to do their jobs well. National surveys show that most teachers work considerably more than the hours stated in their contract. The average number of hours worked is usually reported to be around 45 to 50.[5] For school quality, however, the important point is not the amount of time that the average teacher reports working, but the amount of time required to do a good job of teaching. The teaching workload should be designed so that a teacher can do an excellent job working a reasonable number of hours a week.

Why Teachers Have So Little Time To Spend on Each Child

A few simple calculations show that teachers who spend time planning for each class period and paying attention to each student's work have no choice but to work about 60 hours per week or more. Most of the time that teachers are required to be in school is spent teaching. Based on my experience, with teaching five classes, lunch, and breaks to use the facilities, in a required secondary school day of 7.5 hours, there is at most about an hour and a half per day that is not completely taken up with required duties. This time is usually split—20 minutes before school, 20 minutes after school, and about 45 minutes during the day. Most of the time not spent in teaching is needed for copying tests or other materials for upcoming classes; getting or returning library books; filling out forms regarding attendance or special education students; checking with counselors regarding problems a student may be having; planning with other teachers about shared activities or conferring about a student both teachers teach; making arrangements for a field trip; or trying to return parents' phone calls using an office phone (since teachers do not have phones in their classrooms, an incredibly inefficient way of saving money). These tasks are important and need doing, but it is a rare day when there is even a half hour of uninterrupted time during the school day for planning and marking papers. In addition, on most days, after-school time is spent in required meetings one or two afternoons per week and working with a student or two who come after school for help.[6]

But let's optimistically assume that teachers are able to use 45 minutes per day of required school time for planning or marking papers, which adds up to almost four hours during the week. Even using these four hours in school (which teachers rarely have unencumbered), the following table shows that teachers of aca-

[5] For example, public school secondary teachers in urban, suburban, and rural areas told U.S. Office of Education researchers that they worked an average of 46.9 hours per week on school-related work, considering work done in school and after school hours. (*Schools and Staffing in The United States: A Statistical Profile, 1993-1994,* National Center for Education Statistics, U.S. Department of Education [Washington, D.C.: GPO, 1996], p. 74.) The 46.9 hours per week are divided as follows: 1) required to be at school 33 hours; (2) time spent in activities with students outside of school hours, 5.3 hours; time spent in activities outside of school hours without students, 8.4 hours. A National Education Association survey reports that in 1996 the average secondary school teacher spent 52 hours per week on all teaching duties. (U.S. Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 1977* [Washington, D.C.: GPO, 1977] p. 79.] Public elementary school teachers in the same Office of Education survey reported that they worked an average of 44.2 hours per week, divided as follows: (1) required to be at school 33 hours; (2) time spent in activities with students outside of school hours, 2.1 hours; time spent in activities outside of school hours without students, 9.1 hours. The NEA Survey reports that in 1996 the average public elementary school teacher spent 47 hours per week on all teaching duties.

[6] According to a survey conducted by the U.S. Office of Education, the average secondary school teacher spent 5.3 hours per week with students outside of contract-time hours. (See U.S. Department of Education, Office of Educational Research and Improvement *Schools and Staffing in the United States: A Statistical Profile, 1993-1994* [Washington, D.C.: GPO, July 1996] p. 74.)

demic subjects must work about 60 hours per week to be able to spend just 12 minutes planning for each class and nine minutes per week reviewing each student's work, still not enough time to give thoughtful comments and feedback.

Table 1

SECONDARY SCHOOL TEACHERS: RELATIONSHIP BETWEEN (1) HOURS WORKED PER WEEK AND (2) TIME AVAILABLE FOR PLANNING LESSONS AND REVIEWING STUDENT WORK*

Total hours worked per week**	Hours per week for planning and marking papers	Illustrative combination of time to plan for each class and to spend each week reviewing each student's work	
		Planning per class preparation	*Reviewing work of each student*
45 hours	9	6 minutes	3 minutes
50 hours	14	10 minutes	5 minutes
60 hours	24	12 minutes	9 minutes
70 hours	34	15 minutes	13 minutes

**The table assumes teachers (1) are contracted to spend 35 hours in school each week, (2) spend an additional five hours per week after school meeting with students and parents or in required meetings, (3) are able to use about four hours per week of contract time for planning and marking papers, (4) teach five classes per day, and (5) teach 125 students per day. Amounts shown are rounded to nearest whole number.*

***Hours worked at school and at home.*

Source: Calculations by Stephen Swaim

Similar time pressures are experienced by elementary school teachers although the work is not the same. They have to plan four, five, or six different subjects and mark papers in each of those subjects for an average of 24 students. Assuming that elementary teachers have 30 minutes per day in which they can plan or mark papers (time that most elementary school teachers do not get) they, too, must work about 60 hours per week if they are to have adequate time to plan for their classes (which includes assembling and preparing all the materials to be used in the classes) and to have one-half hour per week to review and comment on each student's work in multiple subjects.

If students are to learn how to write and think well, assignments such as essays, research papers, or written exams should be given frequently. However, it takes time to read and correct such work, time that is hard to find even in a 60-hour workweek. In my history or geography classes, I have students assist each other by discussing their first and second written drafts among themselves in small groups and I meet with many students to edit papers in class. But I must read all the papers at least once, usually twice. If I spend just 10 minutes per paper, not really much time if I am to make thoughtful comments to help the student, this translates into nearly 21 hours of time to mark the papers of 125 students. In many other jurisdictions, secondary teachers are responsible for 150 students, another 25 sets of papers.

Some assignments that I give, such as writing an autobiography or interviewing another student and writing his or her history, take 20 minutes each to grade, even using a grading guide prepared ahead of time. Furthermore, to teach students to write, their papers should be revised and graded again—add another 15 to 20 hours. When grading writing on weekends, I get to the point where I am grateful for the students who do not complete the writing assignment; their bad habits help me to survive.

Planning also takes time. Planning is the teacher's art of taking the text, other materials, and the knowledge in one's head and setting up the class so that students are engaged and learning. To prepare for further education, students must not only learn basic facts, but they must have a chance to use these facts and concepts in writing, oral presentations, and other experiences. And almost all students will do better if a variety of approaches are used in class. Whatever a teacher's teaching style, primarily lecture or primarily hands-on experiences, thoughtful preparation takes a great deal of time.

The workload problem takes a different form for elementary teachers than it does for me as a middle-school teacher, but the time problem is, if anything, worse. Although elementary school teachers do not have one set of papers for 125 students, they often have papers for reading, writing, spelling, English, science, math, and social studies from 24 (or more) students. Elementary teachers have just as much to grade and actually more materials to prepare. Teachers for kindergarten may not give letter grades, but they comment on hundreds of work products weekly, tran-

Table 2

PUBLIC ELEMENTARY SCHOOL TEACHERS: RELATIONSHIP BETWEEN (1) HOURS WORKED PER WEEK AND (2) TIME AVAILABLE FOR PLANNING LESSONS AND REVIEWING STUDENT WORK*

Total hours worked per week**	Hours per week for planning and marking papers	Illustrative combination of time to plan for each class and to spend each week reviewing each student's work	
		Planning per class preparation	*Reviewing work of each student*
45 hours	9	10 minutes	12 minutes
50 hours	14	15 minutes	20 minutes
60 hours	24	30 minutes	29 minutes
70 hours	34	40 minutes	45 minutes

**The table assumes teachers (1) are contracted to spend 35 hours in school each week, (2) spend an additional four hours per week after school meeting with students and parents or in required meetings, (3) are able to use about three hours per week of contract time for planning and marking papers, (4) teach five subjects per day, and (5) teach 24 students per day. Amounts shown are rounded to nearest whole number.*

***Hours worked at school and at home.*

Source: Calculations by Stephen Swaim

scribe student writing and reading, record student work, and spend a great deal of time in conversation with parents. They have to plan 10 times as many activities for each hour of teaching, since, generally speaking, a kindergartner's attention span is one-tenth as long as that of an older child.

If a teacher spends "only" 45 or 50 hours a week on school work, what is not getting done? If it takes a teacher 15 or 20 hours outside of school to grade essays from an assignment, you can see that teachers may decide to assign less essay writing. If 10 hours of preparation time on the weekend is required to write out the materials for a new, student-directed unit, teachers will plan fewer of those kinds of units than would be the case if more planning could be done during a teacher's workday.

What about conversations with students? How much time can a teacher spend with a child, one on one? For most students, very little. If I wanted to spend 10 minutes a month talking to each of my middle school students privately—a modest amount—I would have to find about 20 hours at lunchtime or after school. Of course, that does not happen. It is extremely frustrating to teach students in a large class who have special academic interests or a problem with which they need help and have no way to give them the time they need.

Many teachers, driven by conscience and living in personal circumstances that allow them the time, give the writing and homework assignments and the time to individual students that good education demands. One of our children had an unmarried public school high school math teacher who always returned graded tests the next day. It isn't hard, though, to see why many teachers can't do that. Some have children to raise, some need a good night's sleep, some spend time with spouses and friends, some coach Little League, some need to relax or hit the softball field, some are active in church or community service projects. The pressures are to find ways to do less planning and assign less student work that requires individual grading, just in order to survive. These pressures naturally lead teachers to use multiple-choice tests, assign fewer book reports, and fewer writing assignments. Over all, that equates to less education for each child. Until workloads are adjusted to permit teachers to devote individual attention to their students, and to do more planning and grading in the workplace rather than at home on nights and weekends, efforts at school reform are destined to fall short.

Lowering teacher workload, both the number of students in class and the number of classes a teacher teaches, to obtain higher academic quality has been market tested in this country. That is what people pay for who send their children to private, non-sectarian preparatory schools. In every such school we know of, teachers have substantially lower workloads than in public schools. According to the U.S. Department of Education, the pupil/teacher ratio in public schools is 80 percent higher than in non-sectarian private schools. Ratios are 17.6 teachers to 1 student for public schools and 9.8 to 1 for non-sectarian private schools.[7] These private school teachers teach fewer classes each day, and class sizes are lower. For example, in a college preparatory school that one of our children attended, teachers taught four academic classes a day, often in the same subject, in a day with eight or nine periods. This gave the teachers about three hours a day at school for planning, marking papers, and meeting with students even after fulfilling responsibilities for study hall monitoring and student activities. In all, the teachers in that school were usually responsible for about 50 to 60 students—less than half the number for which teachers in regular public secondary schools are responsible—and they never had more than 72 students. Private school students have as long a school day as those students in public school; the private schools simply hire more teachers.

The case for a substantial reduction in teacher workload is also supported by comparisons with other industrialized countries.

One of the first insights I had about the connection between teacher workload and academic standards came from conversations with Fulbright exchange teachers from France who worked at my high school. I discovered that if I taught an academic subject in their high schools, I would meet students in class 16 to 18 hours a week or less, not 25 as I was doing. Their class sizes were about the same as ours, or less. Their class schedule directly increased the time available to them to meet with individual students, plan, and grade.

How U.S. Teachers Measure Up Internationally: A Comparative Study of Teacher Pay, Training, and Conditions of Service compares teacher workloads in the United States with those in other countries.[8] The study gathered data on 19 economically advanced countries from a variety of sources, including the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the Organization for Economic Cooperation and Development (OECD) publications, embassies in this country, and government or teacher union officials in foreign countries. Data in this study for the average number of instructional hours per week and the average class size, show:[9]

- U.S. primary teachers spend more time with students than teachers in any other nation studied. The study found U.S. primary school teachers spend over 30 hours per week in instruction. Japanese primary teachers spend 20 hours in front of students, and German teachers 21 hours.

(Continued on page 50)

[7] The ratios for private non-sectarian schools are calculated by co-author Stephen Swaim from enrollment and teacher information available on pp. 70, 71 of the U.S. Department of Education's *Digest of Education Statistics*, 1997 (Washington, D.C.: GPO, 1997). Public school ratios are calculated from data on pp. 58, 59 of the same document.

[8] F. Howard Nelson and Timothy O'Brien, *How U.S. Teachers Measure Up Internationally: A Comparative Study of Teacher Pay, Training, and Conditions of Service*, (Washington, D.C.: American Federation of Teachers, 1993).

[9] Ibid, p. 37, Table II-3, "Instructional and Required Work Time for Teachers."

DIFFERENT STROKES FOR DIFFERENT FOLKS?

A Critique of Learning Styles

BY STEVEN A. STAHL

I WORK WITH a lot of different schools and listen to a lot of teachers talk. Nowhere have I seen a greater conflict between "craft knowledge" or what teachers know (or at least think they know) and "academic knowledge" or what researchers know (or at least think they know) than in the area of learning styles. Over the years, my experience has told me to trust teachers; it has also taught me that teachers' craft knowledge is generally on target. I don't mean to say that teachers are always right, but they have learned a great deal from their thousands of observations of children learning in classrooms. So, when teachers talk about the need to take into account children's learning styles when teaching, and researchers roll their eyes at the sound of the term "learning styles," there is more to it than meets the eye.

The whole notion seems fairly intuitive. People are different. Certainly different people might learn differently from each other. It makes sense. Consider the following from the Web site of the National Reading Styles Institute, a major proponent of the application of learning styles to the teaching of reading:

> We all have personal styles that influence the way we work, play, and make decisions. Some people are very analytical, and they think in a logical, sequential way. Some students are visual or auditory learners; they learn best by seeing or hearing. These stu-

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dents are likely to conform well to traditional methods of study.

> Some people (we call them "global learners") need an idea of the whole picture before they can understand it, while "analytic learners" proceed more easily from the parts to the whole. Global learners also tend to learn best when they can touch what they are learning or move around while they learn. We call these styles of learning "tactile" and "kinesthetic." In a strictly traditional classroom, these students are often a problem for the teacher. She has trouble keeping them still or quiet. They seem unable to learn to read.
> (http://www.nrsi.com/about.html)

This all seems reasonable, but it isn't.

Research and Learning Styles

The reason researchers roll their eyes at learning styles is the utter failure to find that assessing children's learning styles and matching to instructional methods has any effect on their learning. The area with the most research has been the global and analytic styles referred to in the NRSI blurb above. Over the past 30 years, the names of these styles have changed—from "visual" to "global" and from "auditory" to "analytic"—but the research results have not changed.

In 1978, Tarver and Dawson reviewed 15 studies that matched visual learners to sight word approaches and auditory learners to phonics. Thirteen of the studies failed to find an effect, and the two that found the effect used unusual methodology. They concluded:

> Modality preference has not been demonstrated to interact significantly with the method of teaching reading.[1]

One year later, Arter and Jenkins reviewed 14 studies (some of these are overlapping), all of which failed to find that matching children to reading methods by preferred modalities did any good. They concluded:

> [The assumption that one can improve instruction by matching materials to children's modality strengths] appears to lack even minimal empirical support.[2]

Kampwirth and Bates, in 1980, found 24 studies that looked at this issue. Again, they concluded:

> Matching children's modality strengths to reading materials has not been found to be effective.[3]

In 1987, Kavale and Forness reviewed 39 studies, using a meta-analysis technique that would be more sensitive to these effects. They found that matching children by reading styles had nearly no effect on achievement. They concluded:

> Although the presumption of matching instructional strategies to individual modality preferences has great intuitive appeal, little empirical support for this proposition was found.... Neither modality testing nor modality teaching were shown to be [effective].[4]

A fifth review, in 1992, by Snider found difficulties in reliably assessing learning styles and a lack of convincing research that such assessment leads to improvement in reading.

> Recognition of individuals' strengths and weaknesses is good practice; using this information, however, to categorize children and prescribe methods can be detrimental to low-performing students. Although the idea of reading style is superficially appealing, critical examination should cause educators to be skeptical of this current educational fad.[5]

These five research reviews, all published in well-regarded journals, found the same thing: One cannot reliably measure children's reading styles and even if one could, matching children to reading programs by learning styles does not improve their learning. In other words, it is difficult to accurately identify children who are "global" and "analytic." So-called global children do not do better in whole language programs than they would in more phonics-based programs. And so-called analytic children do not do better in phonics programs than they do in whole language programs. In short, time after time, this notion of reading styles does not work.

This is an area that has been well researched. Many other approaches to matching teaching approaches to learning styles have not been well researched, if at all. I could not find studies in refereed journals, for example, documenting whether the use of Howard Gardner's Multiple Intelligences Model[6] improved instruction. This does not mean, of course, that the use of the model does not improve achievement, only that I could not find studies validating its use. The same is true of other learning style models.

One cannot prove a negative. Even if all of these studies failed to find that matching children by learning styles helps them read better, it is always possible that another study or another measure or another something will find that matching children to their preferred learning modality will produce results. But in the meantime, we have other things that we ***know*** will improve children's reading achievement. We should look elsewhere for solutions to reading problems.

Yet, the notion of reading styles (or learning styles) lingers on. This is true not only in my talks with teachers, but also in the literature that teachers read. The most recent issue of *Educational Leadership* included, as part of a themed issue on innovations, several articles on learning styles. *Phi Delta Kappan* also regularly contains articles on learning styles, as do other publications intended for teachers.

Research into Learning Styles

Among others, Marie Carbo claims that her learning styles work is based on research. [I discuss Carbo because she publishes extensively on her model and is very prominent on the workshop circuit. In the references for this article, I cite a few examples of her numerous writings on the topic.[7]] But given the overwhelmingly negative findings in the published research, I wondered what she was citing, and about a decade ago, I thought it would be interesting to take a look. Reviewing her articles, I found that out of 17 studies she had cited, only one was published.[8] Fifteen were doctoral dissertations and 13 of these came out of one university—St. John's University in New York, Carbo's alma mater. None of these had been in a peer-refereed journal. When I looked closely at the dissertations and other materials, I found that 13 of the 17 studies that supposedly support her claim had to do with learning styles based on something other than modality. In 1997, I found 11 additional citations. None of these was published, eight were dissertations, and six of these came from St. John's. In short, the research cited would not cause anyone to change his or her mind about learning styles.

What Do People Mean by Learning Styles?

Modality refers to one of the main avenues of sensation such as vision and hearing. I have only talked about modality-based reading styles because these are both the best researched and the most heavily promoted. The National Reading Styles Institute claims that it has worked with "over 150,000 teachers," and its advertisements seem to be everywhere. Furthermore, these notions of "visual" and "auditory" learners or "global" and "analytic" learners have been around for a long time and have found their way into a number of different programs, not just the NRSI programs.

There are other ways of looking at learning styles. People have proposed that children vary not only in perceptual styles, but on a host of different dimensions. To name a few, people have suggested that children are either two-dimensional/three-dimensional, simultaneous/sequential, connecting/compartmentalizing, inventing/reproducing, reflective/impulsive, field dependent/field independent, and so on.

Some of these are *learning preferences,* or how an individual chooses to work. These might include whether a person prefers to work in silence or with music playing, in bright light or dim light, with a partner or alone, in a warm room or a cool room, etc.

Some of these are *cognitive styles,* such as whether a person tends to reflect before making a choice or makes it impulsively, or whether a person tends to focus on details or sees the big picture.

Some of these are *personality types,* such as whether a person is introverted or extroverted.

Some of these are *aptitudes,* like many of Howard Gardner's multiple intelligences. Gardner suggests that people vary along at least seven different dimensions—*linguistic* or the ability to use language, *logico-mathematical* or the ability to use reasoning especially in mathematics, *spatial* or the ability to use images or pictures, *bodily-kinesthetic* or the ability to control movement, *musical, interpersonal* or the ability to work with people, and *intrapersonal* or the thinking done inside oneself. The last two are more like personality types, rather than aptitudes or even learning styles. The others are Gardner's attempt to expand the notion of what we think is intelligent behavior to people who are skilled in music, or dance, or even in interpersonal relations. In contrast to the traditional vision of learning styles as either/or categories (either a person is visual or he or she is auditory), multiple intelligences are put forth by Gardner as separate abilities. A child may be strong in a few of these areas, or none of these areas.

What is a teacher to do with all this? If there are children who prefer to work with music, then the teacher might either provide Walkmans for those who prefer music or play music openly and provide earplugs for those who don't. If there are children who prefer to work in bright light, the teacher might seat those children over by the window. Children who like to snack while reading can be allowed to eat during class (healthy foods, of course). It would be easy to see how accommodating all of these preferences in a class could lead to chaos. How would a teacher lecture, give assignments, or even call to order a class in which a sizable proportion of the students was wearing earplugs? Or how does one regulate the temperature so part of the room is warm and part cool?

Others have used learning styles theory as a way of making sure that all the needs of diverse learners are being met. Marguerite Radenich used Gardner's model to examine literature study guides.[9] Her ideal was one that incorporated all of these ways of knowing into an integrated whole to be used to study adolescent literature. Thus, Gardner's model was used here to create more multidimensional instruction. This is very different from using these different styles to segregate children into groups where they would receive fairly one-dimensional instruction.

Thoughtful educators have tried to make this work, and perhaps it is workable, but trying to meet all of the preferences of a group of children would seem to take energy that would be better spent on other things. This is especially true since no one has proven that it works.

Learning Styles and Fortune Telling

Why does the notion of "learning styles" have such enduring popularity—despite the lack of supporting evidence? I believe that this phenomenon has a lot in common with fortune telling.

You go to see a fortune teller at a circus. She looks you over and makes some quick judgments—how young or old you are, how nicely you are dressed, whether you appear anxious or sad or lonely—and based on these judgments, tells your fortune. The fortune she tells may be full of simple and ambiguous statements—"you will be successful at your next venture," "you will be lucky at love," or may be more complex—"you are successful at home, but someone is jealous; make sure you watch yourself." Either way, the statements are specific enough so that they sound predictive, but ambiguous enough that they could apply to a number of situations.

When we read the statements on a Learning Style Inventory, they sound enough like us that we have a flash of recognition. These inventories typically consist of a series of forced choices, such as these from Marie Carbo's *Reading Style Inventory, Intermediate,* 1995.[10]

A) I always like to be told exactly how I should do my reading work.
B) Sometimes I like to be told exactly how I should do my reading work.
C) I like to decide how to do my reading work by myself.

Or

A) I like to read in the morning.
B) I don't like to read in the morning.

A) I like to read after lunch.
B) I don't like to read after lunch.

A) I like to read at night.
B) I don't like to read at night.

Or

A) I read best where it's quiet with no music playing.

B) I read best where there is music playing.

C) I read about the same where it's quiet or where there is music playing.

Since all of us have some preferences (my experience is that adults have clear preferences about music during reading, especially), these items tend to ring true. Like the fortunes told by the fortune teller, these statements at first light seem specific enough to capture real distinctions among people. But the problem with choices like these is that people tend to make the same choices. Nearly everybody would prefer a demonstration in science class to an uninterrupted lecture. This does not mean that such individuals have a visual style, but that good science teaching involves demonstrations. Similarly, nearly everybody would agree that one learns more about playing tennis from playing than from watching someone else play. Again, this does not mean that people are tactile/kinesthetic, but that this is how one learns to play sports. Many of these "learning styles" are not really choices, since common sense would suggest that there would not be much variance among people. In the class sample provided with the Reading Style Inventory above, for example, 96 percent of the fifth-graders assessed preferred quiet to working while other people were talking, 88 percent preferred quiet to music, 79 percent picked at least two times of day when they preferred to work, 71 percent had no preference about temperature, and so on. Virtually all of the questions had one answer preferred by a majority of the students.

The questions are just specific enough to sound like they mean something, but vague enough to allow different interpretations. For example, does "music" refer to Mozart or Rap? Obviously, one's choices would be different for different types of music. A more serious question would arise over the "teacher direction" item. Doesn't the amount of teacher direction needed depend on the difficulty of the assignment? There are some assignments that are self-evident and do not need much teacher direction, but when work gets complex, students need more direction. This is not a matter of preference.

The other major problem with these inventories is that there are no questions about a child's reading ability. So children with reading problems are given the same measure as children who are doing well in reading. This has two effects. First, there is a bias on some items for children with different abilities. Consider these two items, also from the Carbo inventory:

A) It's easy for me to remember rules about sounding out words.

B) It's hard for me to remember rules about sounding out words.

Or

A) When I write words, I sometimes mix up the letters.

B) When I write words, I almost never mix up the letters.

Children with reading problems are more likely to answer that they do not remember phonics rules and that they sometimes mix up the letters. According to the learning styles research reports, such children are likely to be considered as having a global (or visual) preference.[11] Actually, this may not be a preference at all, but a reflection of the child's current level of reading ability. The potential for harm occurs when children with reading problems are classified as "global" (visual) learners and thereby miss out on important instruction in decoding, or are classified as "analytic" (auditory) learners and miss out on opportunities to practice reading in connected text.

Not including information about reading ability also leads to some strange prescriptions. Adults attending learning styles workshops often get prescriptions for beginning reading instruction methods, such as the language experience approach or phonics/linguistic approaches, certainly not needed by competent readers. And for children, too, some of the approaches may be inappropriate. The language experience approach, for example, is best suited for children at the emergent literacy stage, when they need to learn about basic print concepts, one-to-one matching, letter identification, and so on.[12] For a second-grader, or even a newly literate adult, language experience may be appropriate (if they still have not mastered basic print concepts) or highly inappropriate (if they are already reading fluently). It depends on the readers' skill, not their learning styles.

Reliability

If you are to use a test, even an inventory like the one cited above, it should be reliable. If a test is reliable, that means you are going to get the same (or close to the same) results every time you administer it. If a test is 100 percent reliable (or has a reliability coefficient of 1.0), then a person will score exactly the same on Thursday as on Tuesday. Perfection is tough to come by, so we generally want a reliability coefficient to be .90 or higher.[13] If a test is not reliable, or trustworthy, then it is difficult to believe the results. This is a problem, not only with inventories, but with any measure that asks subjects to report about themselves.

Reliabilities of these measures are relatively low. The self-reported reliabilities of Carbo's Reading Style Inventory and Dunn and Dunn's Learning Style Inventories are moderate, especially for a measure of this kind—in the neighborhood of the .60s and the .70s. Similar reliabilities are reported for the Myers-Briggs Inventory, another learning styles assessment.[14] These are lower than one would want for a diagnostic measure. And, these scores are inflated, since for many items there is generally one answer that nearly everybody chooses. This would tend to make the reliabilities higher.

The vagueness in the items may tend to make the reliabilities low. Again, how a child interprets each item will influence how it is answered, as with the "teacher direction" and "music" examples discussed earlier.

Test-retest reliabilities are particularly important for a measure of learning styles. These moderate reliabilities could be interpreted in two ways. The test itself may not be a reliable measure of what it is supposed to measure—that is, a person has a stable learning style, but the test is not getting at it. If the test is not reliable, then the information it gives is not trustworthy.

The other possibility is that learning styles may change, from month to month, or even week to week. This is also problematic. If we are talking about matching a person to a situation using this instrument, this is a relatively long-term (semester or academic year) matching. If a person's style changes, then one either must measure learning styles frequently, or allow for more flexible assignments.

How Reading Develops

The Learning Style model assumes that different children need different approaches to learn to read. Children are different. They come to us with different personalities, preferences, ways of doing things. However, the research so far shows that this has little to do with how successful they will be as readers and writers. Children also come to us with different amounts of exposure to written text, with different skills and abilities, with different exposure to oral language. The research shows that these differences *are* important.

Rather than different methods being appropriate for different children, we ought to think about different methods being appropriate for children at different stages in their development. Children differ in their phonemic abilities, in their ability to recognize words automatically, in their ability to comprehend and learn from text, and in their motivation and appreciation of literature.[15] Different methods are appropriate for different goals. For example, approaches that involve the children in reading books of their own choice are important to develop motivated readers.[16] But whole language approaches, which rely largely on children to choose the materials they read, tend not to be as effective as more teacher-directed approaches for developing children's word recognition or comprehension.[17]

A language experience approach may be appropriate to help a kindergarten child learn basic print concepts. The child may learn some words using visual cues, such as might be taught through a whole word method. With some degree of phonological awareness, the child is ready to learn letters and sounds, as through a phonic approach. Learning about letters and sounds, in combination with practice with increasingly challenging texts, will develop children's ability to use phonetic cues in reading, and to cross-check using context. With additional practice in wide reading, children will develop fluent and automatic word recognition. None of this has anything to do with learning styles; it has to do with the children's current abilities and the demands of the task they have to master next.

What Do Teachers Get out of Learning Styles Workshops?

I have interviewed a number of teachers who have attended learning styles workshops. These were meetings of 200 to 300 teachers and principals, who paid \$129 or so to attend a one-day workshop or up to \$500 to attend a longer conference. They have found them to be pleasant experiences, with professional presenters. The teachers also feel that they learned something from the workshops. After I pressed them, what it seemed that they learned is a wide variety of reading methods, a respect for individual differences among children, and a sense of possibilities of how to teach reading. This is no small thing. However, the same information, and much more, can be gotten from a graduate class in the teaching of reading.

These teachers have another thing in common—after one year, they had all stopped trying to match children by learning styles. □

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ORGANIZING.COM

New Unions for the New Economy

BY DAVID KUSNET

IN THE new economy, where processing information is as important as bending metal, do workers believe that organizing unions can help them make their jobs better?

To answer that question, you have to talk to people in places as different as Endicott, N.Y., and Redmond, Wash.

A gritty factory town in the Hudson Valley, Endicott is the birthplace of IBM, the nation's leading manufacturer of computers.

A fast-growing suburb of Seattle, Redmond is the headquarters of Microsoft, the leading creator of the software that allows computers to perform tasks from word-processing to financial forecasting.

Working with a major national union, workers in both communities recently have begun to organize. They've already started to reverse IBM's cuts in veteran employees' pensions and to reshape Microsoft's treatment of its large number of temporary workers. And they're offering new models for a labor movement seeking new ways to relate to workers in the new economy.

While the "new economy" has almost as many definitions as observers, most agree that its hallmarks include global competition, advanced technology, the erosion of stable jobs with secure benefits in large corporations such as the old IBM, and the need for workers to learn new skills as they struggle to make their way in a churning job market.

So far, this "new economy" is almost entirely nonunion. While union membership is increasing in government, in education, and in several fast-growing industries, such as health care and hotels, unions have yet to find a foothold in high-technology occupations.

David Kusnet writes frequently on labor and workplace issues. He was chief speechwriter for President Clinton from 1992 through 1994 and is a visiting fellow at the Economic Policy Institute.

And, while the Labor Department projects that the fastest job growth is taking place among professionals and technicians, few of these workers are joining unions, except in the public sector.

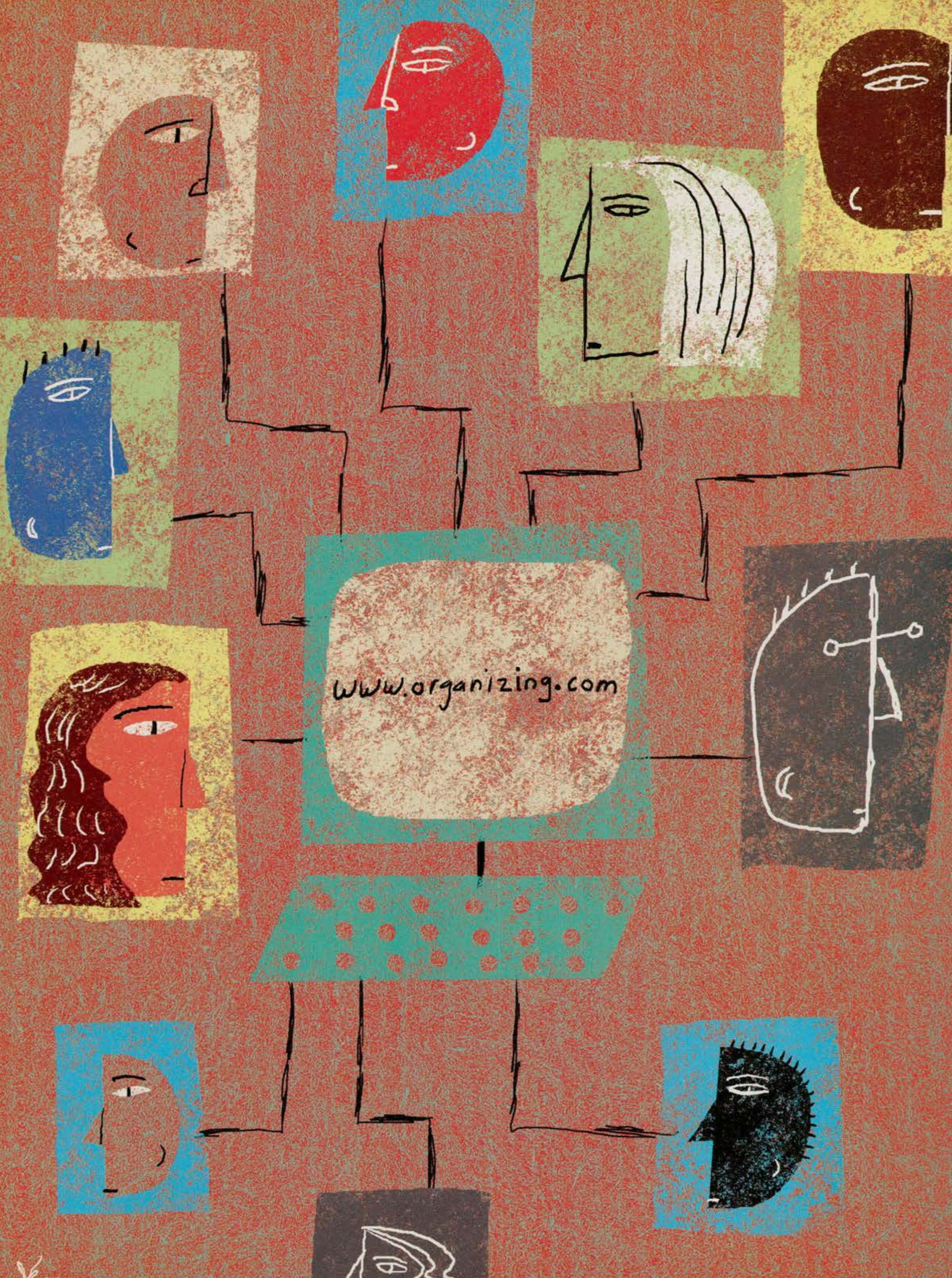
Much of this situation results from fierce employer opposition and federal labor laws that make organizing difficult and are often laxly enforced as well. But public opinion surveys show there is also a gap between what many workers, particularly those in the "new economy," perceive unions as offering and the ways in which these workers themselves want to make their jobs better. While traditional unions are sometimes seen as imposing rigidities on workplaces, "new economy" workers, in particular, are likely to want assistance in advancing their careers as they change jobs; they want portable health and pension benefits, flexible hours that allow them to balance work and family, and they want cooperative relationships with managers that allow them a voice in decision-making.

Lately, there has been a lively debate among labor organizers, sympathetic academics, and other analysts about how unions can play a larger and more useful role in this emerging economy.

Some say unions should look beyond their traditional role of helping workers improve their pay, benefits, and conditions by bargaining and enforcing contracts with their employers. Instead, in a strategy some call "back to the future," unions would take on some of the tasks once assumed by workers' guilds and still performed by craft unions and professional organizations. These efforts would include providing education, training, and professional certification; offering workers pension and health care benefits that they can take with them from job to job; and helping workers improve the quality of their products and services. Such organizations, some say, would have a less adversarial relationship with employers than most existing unions.

To be sure, many unions in every sector of the econ-

ILLUSTRATED BY JAMES YANG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omy already are doing many of these things. But, taken together, these new roles and responsibilities constitute a vision of a new unionism for the new economy.

But how does this vision compare with reality? Looking at some of the flagship industries of the "new economy"—computers, software, and electronic commerce—what problems are workers experiencing, what solutions are they seeking, and what forms of organization are they developing?

At well-known companies such as IBM, Microsoft and Amazon.com, workers are facing difficulties with roots in the old economy as well as the new—low pay, poor working conditions, and cuts in pension benefits, as well the problems plaguing temporary workers and the long hours endemic to the new breed of high-technology companies.

In response to these problems, workers in communities like Endicott, Redmond, and others with high concentrations of high-tech workers are beginning to build organizations that advocate employees' concerns even without formal collective bargaining rights, using tactics from legislative action to media campaigns. They are becoming respected sources of information and training. And, in all these efforts, they're making innovative use of the Internet.

But, largely because most non-union employers treat independent employee organizations of any kind as enemies, these new employee groups are not yet poised to be partners with management, helping them hire skilled workers and hear employees' views about improving productivity and quality.

At opposite ends of the continent, Endicott and Redmond represent very different stages in the high-tech industry's evolution. And they are giving rise to varying forms of employee organizations.

Union-building at "Big Blue"

In Endicott, more than 80 years ago, IBM was founded as a manufacturer of cash registers, adding machines, and other business equipment. Over the years, under the leadership of its legendary founder, Thomas Watson, IBM became the nation's leading producer of computers, starting with the huge "mainframes" that became essential to major corporations, government agencies, and educational and health care institutions in the years after World War II.

Watson was known for two watchwords: "Think," which emphasized IBM's early leadership in information technology, and "Respect for the individual," which underscored IBM's familial, almost paternalistic corporate culture. Under Watson and his son, Thomas Jr., IBM resisted unionization but offered generous pay and benefits and guaranteed job security to its employees, from programmers to production workers. For decades, the IBM personnel manual boasted:

> In nearly 40 years, no person employed on a regular basis by IBM has lost as much as one hour of working time because of a layoff. When recessions come or there is a major product shift, some companies handle the workforce imbalances that result by letting people go. IBM hasn't done that, hopes never to have to.... It's hardly a surprise that one of the main reasons people like to work for IBM is the company's all-out effort to maintain full employment.

But, by the early 1990s, that personnel manual read like an artifact from an earlier era. Facing declining demand for mainframes, unable to establish a secure beachhead in the growing market for smaller computers, and losing ground in the software sector as well, the giant corporation that had been dubbed as "Big Blue" was running in the red. For the first time in its history, IBM resorted to a massive downsizing, wiping out 60,000 jobs through layoffs and early retirements. And in 1993, also for the first time, it looked outside its own ranks for a new chief executive officer to lead its last-ditch effort at recovery, turning to Louis Gerstner Jr., who had made his name at American Express and RJR Nabisco.

By streamlining operations, modernizing marketing, and emphasizing client service as well as computer production, Gerstner helped return IBM to profitability. But the company's continued efforts to cut the work force and curtail wage increases angered many employees, especially in view of Gerstner's own compensation package, which last year totaled $60 million in salary, benefits, and stock options.

This May, when IBM announced a new pension plan widely viewed as victimizing midcareer employees, it triggered protests from workers already uneasy after years of widespread layoffs and meager pay increases. In communities with IBM offices and factories, from Endicott, Fishkill, and Poughkeepsie, N.Y., to Burlington, Vt.; Raleigh, N.C.; Austin, Texas; and San Jose and Los Angeles, Calif., hundreds of workers attended protest meetings that generated interest in union organizing. Meanwhile, angry workers shared information and ideas through Web sites such as www.ibmunion.com and www.cashpensions.com.

By August, some of the most union-minded workers had reached out to the Communications Workers of America. Together with CWA, these employees began building the Alliance@IBM, an organizing committee that is speaking out on issues such as the pension plan while laying the groundwork for an eventual election to win union representation in collective bargaining.

In mid-September, when IBM partially backed down

New Economy Information Service

The idea for this article came from a forum on organizing in the "new economy" sponsored by the New Economy Information Service (NEIS). The full transcript of the forum is available from the NEIS Web site at www.newecon.org. At the Web site, search under "labor-organizing."

The New Economy Information Service is a network for sharing information and for discussing and analyzing the effects of rapid economic change on work life, families, communities, and the wider world. It recently released a new study, entitled "Dollars and Democracy: Developing Democracies' Declining Share of U.S. Trade and Investment Dollars."

Smith also expresses the logic that is leading many IBM workers to organize a union: 'You can't take on the world's largest computer company on your own.'

from its proposal, allowing 35,000 more employees to keep their existing pension benefits, the move was seen as a response to the employees' protests. Thus, Sen. James Jeffords (R-Vt.), whose committee is investigating the pension issue, declared: "He [Gerstner] recognized he had a problem, obviously, from the employees' reaction, and he listened to his employees."

The "employees' reaction" was exploding into anger, just a few weeks earlier, when I visited an organizing committee meeting at the Alliance@IBM's new office in Endicott.

Seated around the conference-room table was a cross section of IBM workers, from a tool and model maker to a zone analyzer. They discussed the proposed pension shift—not yet modified by management—from a traditional defined benefits plan, where workers receive a predictable monthly check upon retirement based on years of service, to a cash benefits plan, where the company began setting up individual retirement accounts for each of its 140,000 employees in the United States.

The workers agreed they would stand to lose more than 25 percent of their benefits under the new plan. Some said it was designed to save IBM money as well as make the company more attractive to younger workers who would not spend their careers there and would want to take their pension money with them.

To most of the workers at the meeting—men and women in their 40s and 50s with 20 years or more of service to IBM—the issue was moral as well as material, with wide-ranging concerns that reach well beyond the pension plan. Did IBM honor the contributions of loyal employees who had willingly sacrificed during the difficult years of the early '90s? Some thought IBM was becoming more like Microsoft, a free-form company where employees are seen as disposable parts, not dependable partners. A few remembered the letter IBM sent to employees, explaining the pension changes, offering an ironic counterpoint to the language of the old personnel manual:

> The fact that significantly fewer people are staying with one company their full careers means that, more and more, people are looking for opportunities to contribute and be rewarded sooner in their careers.

"I wonder whether this is the company I went to work for," says Patricia Johnson, a circuit designer with 22 years at IBM. "My father worked for 44 years here in Endicott. He was always talking about how good the company was, and I wanted to work there. We made sacrifices. We were doing it for the company because they had done well by us. Now we wonder whether top management appreciates what we have done."

Turning to another area where IBM is cutting back—medical benefits for retirees—Robert Smith, who has worked for 22 years in equipment maintenance says: "People who worked under T.J. Watson were told they would have medical benefits for life. We were told something, we worked for years to get it, and now they're going to take it away. That is wrong."

In addition to retirement take-aways, workers saw a change in atmosphere at IBM. Richard Roscoe, an equipment maintenance worker, explains: "I started in about 1980. I thought IBM was the most wonderful place I had ever seen. The technology was the most advanced. Manufacturing a mainframe was like coming on to a scene from Star Trek."

Over the years, workers found IBM's corporate culture becoming less friendly, with the fear of layoffs, small and infrequent pay raises, and more pressures on the job—"a decade of torture," as Roscoe puts it. At the end of it all, they felt unappreciated. "Trust has been broken," Smith asserts, to approving nods from his co-workers.

Smith also expresses the logic that is leading many IBM workers to organize a union: "You can't take on the world's largest computer company on your own."

As the meeting continued, committee members and CWA organizer Jeff Latcher sketched out organizing plans—a mix of traditional union tactics and information-age innovations.

With support from CWA, the organizing committees at Endicott and other IBM outposts would become the Alliance@IBM—a national employee advocacy group. East Coast members would board buses to Washington, D.C., to attend U.S. Senate and House hearings on the changes in the pension plan.

Meanwhile, the Alliance would set up a Web site of its own—www.allianceibm.org. And, while most employees at Endicott have home computers, the organizing committee members discussed bringing an online computer to the new union office, so that workers could visit Web sites about IBM issues.

Second-class in Seattle

By building an organization capable of challenging corporate management, these IBM workers are following in the footsteps of Microsoft employees who last year founded a similar group—the Washington Alliance of Technical Workers or WashTech.

Most of these workers are longterm temporary employees—"perma-temps," as many angrily but accurately call themselves. They are nominally employed by temporary agencies, which pay their wages. Thus, they fall through the gaps in federal labor law, which makes it almost impossible for workers in such situations to win the right to form a union and bargain with their employer.

Thus, WashTech currently functions less as a traditional union than as a source of information and an advocate on issues for employees at Microsoft and another fast-growing Seattle-based company, the online bookstore Amazon.com, as well other high-tech workers throughout the state.

For these workers, it wasn't one issue but a constellation of concerns that caused them to create an organization of their own last year.

Of Microsoft's more than 20,000 employees, some 6,000 are temporary and contract workers who perform professional tasks—testing software, writing manuals and other materials such as Microsoft's *Encarta* encyclopedia, developing CD-ROMs, and designing Web pages.

Required to wear yellow badges at Microsoft's seemingly casual, campus-like headquarters in Redmond, the temporaries are at the bottom of the corporate caste system—below the regular employees who wear blue badges and workers for established vendors, such as the shuttle bus company, who wear brown badges.

Compared to regular employees, the temporaries receive an inferior economic package—no stock options, no pay on sick days, and a less comprehensive health plan. Although many of these workers are young, single, and childless, these conditions are especially trying for workers who have, or want to have, children and families.

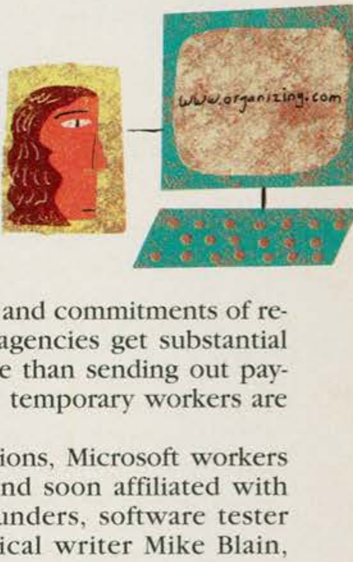
Almost as galling are the indignities of second-class status in a company that prides itself on its friendly and informal environment. While they can enjoy the free drinks Microsoft offers its employees, temporary workers cannot use the company's athletic fields or attend the company's annual picnic. And the "perma-temps" have come to be called "a-dashes" because their @microsoft.com e-mail accounts are all marked with an "a-" before their names.

The stigmatizing letter "a" stands for the employment agencies that are the temporary workers' nominal employers although they were hired and supervised by Microsoft. After being selected for their jobs, temporary workers are assigned to one of 15 employment agencies, which then provide their paychecks. As Lisa Lewis, a longterm perma-temp, told a Washington state Senate committee hearing this year:

> In the last two years, I have worked in the same group, with the same agency, on a contract that renewed every three months. When Microsoft hired me, they said I have to "join" an agency.

The arrangement benefits everyone but the employees: Microsoft avoids the costs and commitments of retaining regular workers. The agencies get substantial fees without doing much more than sending out paychecks and W2 forms. But the temporary workers are trapped in an economic limbo.

Required to wear yellow badges at Microsoft's seemingly casual, campus-like headquarters in Redmond, the temporaries are at the bottom of the corporate caste system.



In response to these conditions, Microsoft workers founded WashTech in 1998 and soon affiliated with CWA. Two of the group's founders, software tester Marcus Courtney, and technical writer Mike Blain, now work for WashTech full time.

"What prompted me to start questioning the system was the whole scam," Blain recalls. "If you have a team of 20 writers or testers, they might nominally work for five agencies or more. We're working at Microsoft, using Microsoft equipment, but ostensibly the staffing companies are providing our paychecks. They don't add any value—it's more like money laundering."

Similarly, Courtney remembers: "I was really hired by Microsoft. I sent my resume in. I was interviewed by a Microsoft manager. And then they sent me to an agency."

For Courtney, the job brought important responsibilities—and constant humiliations. He helped test Microsoft's major product—Windows 98. But, he says, "All of a sudden, I'd be walking down the hall, I'd see none of my blue-badge co-workers around, I'd ask what had happened to them, and someone would say that they were at a meeting about the product without us yellow-badges."

After both workers reached out to Seattle's King County Central Labor Council, its organizing director, Jonathan Rosenblum, introduced them to each other. Together with like-minded colleagues, they founded WashTech.

Appropriately for an organization of information-industry workers, the group sees itself as a source of what Blain calls "information about Microsoft that you can't get anywhere else." Through its Web site (www.Washtech.org) and a newsletter that it e-mails to subscribers, WashTech not only offers news about company policies but surveys its readers about developments at their work sites.

A former journalist himself, Blain excitedly describes WashTech's efforts, using language that owes as much to his background as a reporter as to his new role as an organizer:

> We get internal company documents ahead of time and notify people of pending policy changes. Last July, Microsoft implemented a new policy that said if you were on an assignment for 12 months or longer as a temporary employee, you have to leave for a month.
>
> They called it a break in service—in fact, it was a forced layoff. It's a shell-game designed to make workers look like short-term contractors when they really are long-term employees. It's designed to get around the lawsuit that defined the perma-temps as regular employees.
>
> We found out about it before it happened. We posted the story on our Web site. A lot of the staffing agencies didn't even know about it. We broke that story, and it got picked up by the *Seattle Times.*

Many of WashTech's priorities emerged from a survey of Microsoft employees conducted through the Internet. More than 500 workers responded, and they expressed these concerns:

- A majority of temporary workers have been at Microsoft for at least a year.
- A third have worked at Microsoft for two years or more.
- Sixty percent would prefer to have permanent, full-time jobs.
- Ninety percent said they were concerned about full disclosure of staffing agency fees.
- And almost two-thirds of Microsoft temporary employees do not believe that their agencies best represent their interests.

Acting on these issues, WashTech has promoted "agency choice," so that employees can choose which agency they work through within their job category. In a partial victory for WashTech, Microsoft recently announced a new policy allowing workers some choices and encouraging agencies to offer a "baseline package" of medical coverage and other benefits. Now, technical writers will be able to choose among five approved agencies, but software testers can still "choose" only one agency.

In another effort, WashTech and the Washington State AFL-CIO Labor Council are supporting a bill that would create a state legislative study of temporary workers' concerns, including the role of employment agencies. WashTech has mobilized Microsoft temporary workers to testify before the Legislature about their problems on the job.

In addition to advancing their concerns, WashTech offers high-tech workers a sense of community that is often lacking in their lives. "People want to be part of something," Courtney explains. "One thing that strikes you in high tech, even though this work force is the most wired in the world, is that there is a real sense of isolation and a longing for community."

WashTech offers a virtual community—and an actual one as well. About 2,000 workers have given the group their home e-mail addresses, so that they can receive WashTech's online newsletter. More than 200 have joined WashTech as formal members, paying regular monthly dues. "E-mails are no substitute for one-on-one contact," Courtney says. "We're constantly having one-on-one meetings, building meetings, membership meetings."

These activities are also making WashTech attractive for employees of another major Seattle-area company, the online bookstore Amazon.com. Amazon's more than 400 customer service representatives must be college graduates, and most are in their 20s. But they are paid only $10 or $11 an hour, in addition to stock options that vest completely after five years of service.

While Amazon doesn't use perma-temps, employees express other frustrations: low pay; no clear career paths; overwork and overcrowded conditions; and inept management by supervisors who are almost as young as the workers they direct.

In a telephone interview, an Amazon worker (and WashTech member) who refused to be identified, even by his first name, told this story:

> In my department, basically all you do all day is answer e-mails from customers about books. You have a quota you have to meet for how many e-mail messages you answer. If you meet that quota, that's what the supervisors really care about.
>
> Until a short while ago, there were about 400 to 500 people packed into one building. We were all using the same two bathrooms—one for men, one for women.
>
> There were no fire exits. There was poor ventilation. We worked two people per cubicle. It was like working in someone's basement.
>
> This isn't the job most people expected. We thought our knowledge of books would be more important. In the job interview, they tell you, "We're so non-corporate. You can wear casual clothes. People dye their hair and pierce parts of their bodies. It's one big happy family."
>
> The truth is, it's very corporate. It's impossible to look at your job any other way than the manager tells you. The attitude is, "You're either one of us, or you're against us."

As WashTech continues to grow, its activists are exploring how it can serve high-tech workers without collective bargaining.

"Our organizing is really centered around trying to build a membership-based organization in the absence of contracts—an effective advocacy group like the Sierra Club or the National Rifle Association," says

(Continued on page 46)

Why Read?

Letters to Your Students

By Jim Burke

Like many high school English teachers, Jim Burke frequently encountered students who "claimed to 'hate' reading, who found it a chore, a curse." Such sentiments, he writes, "are what I wake to each day....They form a challenge to my profession, demanding that I somehow explain why books matter..."

It was "with such students in mind" that Burke decided to write a letter to the editor of the San Francisco Chronicle, *inviting that paper's readers to write to his students "about your experiences with books, perhaps telling them what role books and literature have played in your life."*

He received more than 400 letters in response: "They kept coming day after day, and so we began reading as many as we could in my class. Soon letters began coming from other newspapers, other regions of the country; I realized people had sent my letter on to other publications, extended the invitation to other communities.

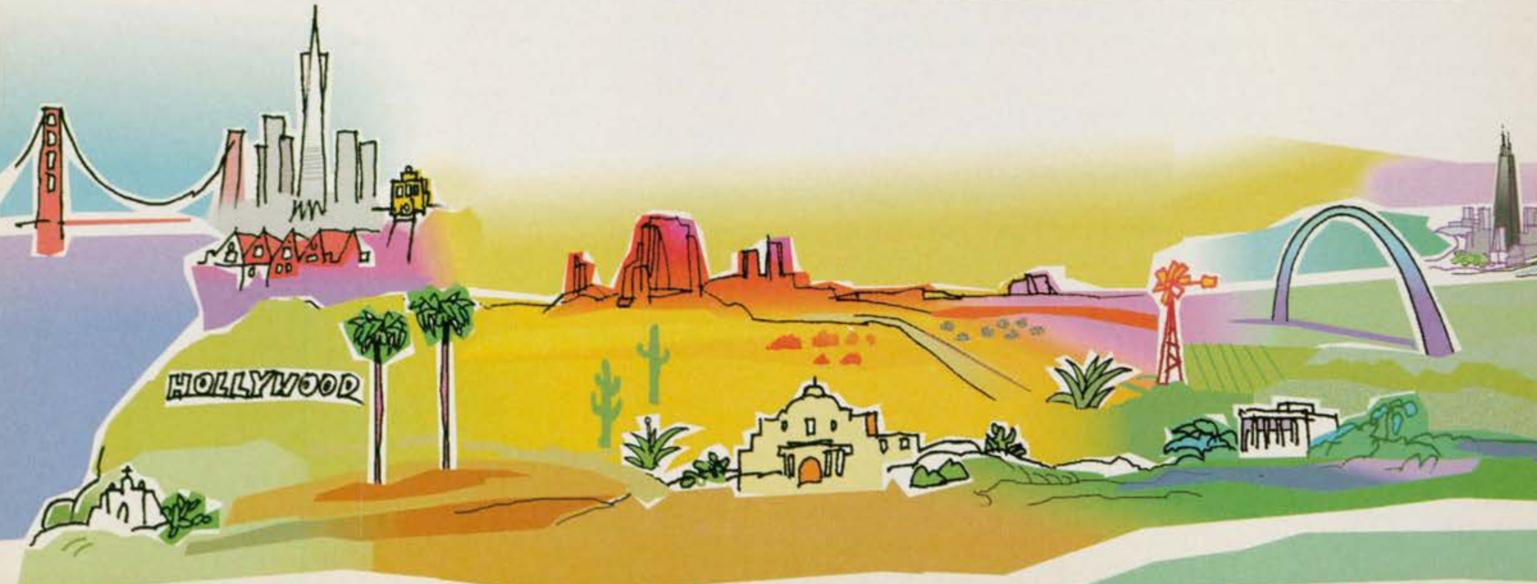
"My students, mostly sophomores that year, were

To the *San Francisco Chronicle*
Dear Editor:
In an era of decreasing commitment to literacy—how else to explain the failure of the state, for example, to adequately fund the libraries?—it is no surprise that most students, too, are bypassing books.

Instead they look elsewhere for information, for entertainment, for experiences. I would like to invite you to write to my high school students about your experiences with books, perhaps telling them what role books and literature have played in your life.

I would be just as interested in hearing from the 6-year-old about her favorite book as the 60-year-old whose life was changed by the reading of a book. Send your letters to me at Burlingame High School. Thank you, and keep reading.

Sincerely,
Jim Burke



visibly affected by this attention.... [The] letters have lived in my classroom, each kept in its own plastic sleeve, for these past six years; on free reading days, students often take down the binders and read them, turning to other students to share something, or wrinkling their brow in confusion or disagreement. For the letters present to us not just erudite scholars, but soldiers and students, felons and lawyers, teenagers and 8-year-olds, kindergartners and cattle ranchers."

From the letters he received, Jim Burke selected 50 and published them in a heartening little book entitled I Hear America Reading: Why We Read~ What We Read. We have reprinted some of those letters here, for you and your students to read. And we add this thought: How about writing a letter to your own local newspaper, inviting people in your community to write to your students about what reading has meant in their lives.

—Editor

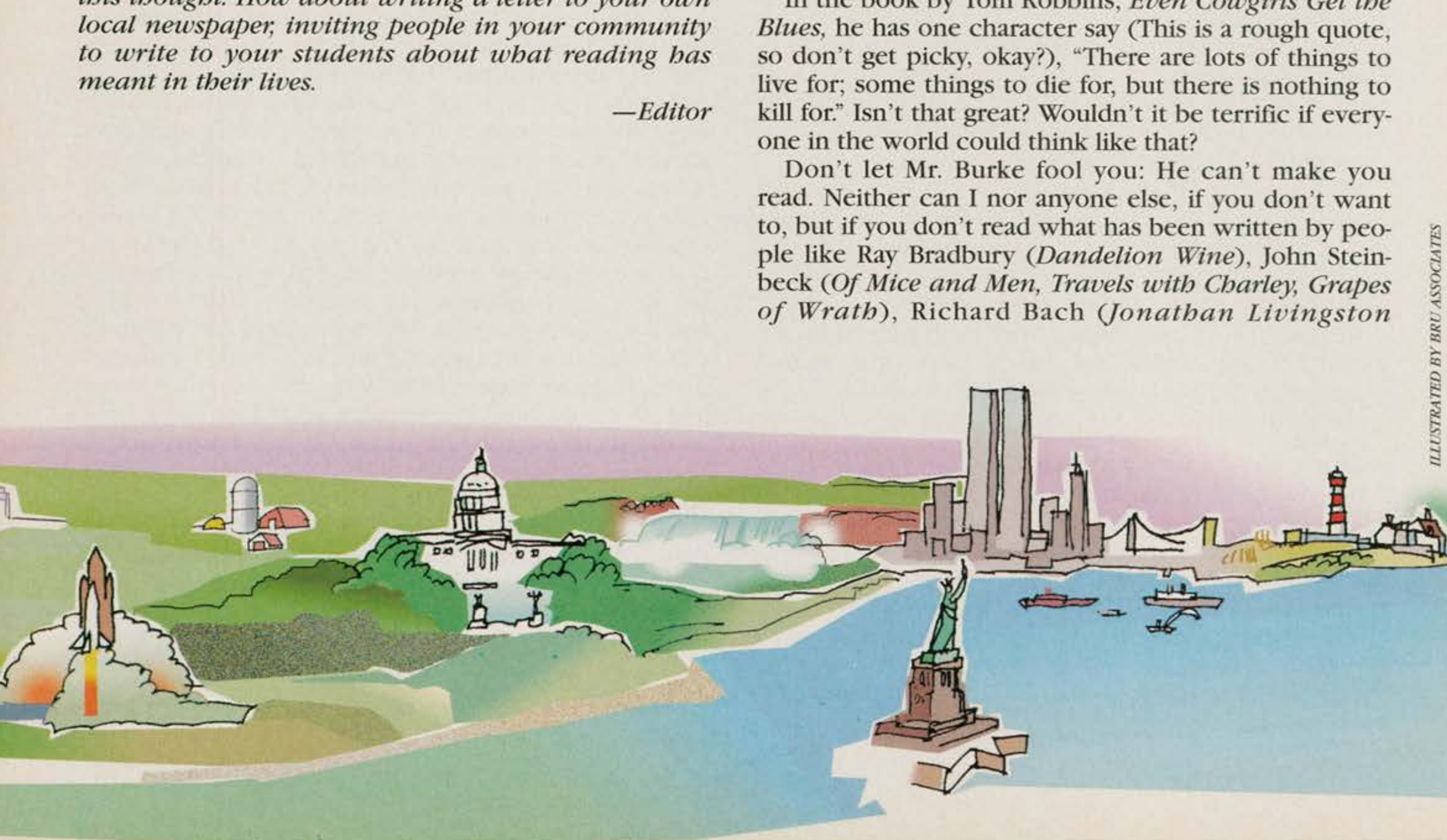
To Whom It May Concern—

That means whoever is awake if Mr. Burke is reading this to you. Don't let me keep you awake, go back to sleep, because this is a C.O.F. writing this letter. What's that? Oh, a C.O.F.? That stands for Crusty Old Fellow.

Let's get down to why I decided to write this letter. I was born in 1931 so I qualify as a 60-year-old. The rest of the qualification was, "...whose life was changed by the reading of a book." Sorry, but my life has not been changed by a single book, not even the Bible which has some damn fine stories. However, my life has been changed by hundreds, perhaps even a thousand books, because each book has a unique idea, one tantalizing line, one shocking proposal, one beautiful thought. Some books have even more than one great thought!

In the book by Tom Robbins, *Even Cowgirls Get the Blues,* he has one character say (This is a rough quote, so don't get picky, okay?), "There are lots of things to live for; some things to die for, but there is nothing to kill for." Isn't that great? Wouldn't it be terrific if everyone in the world could think like that?

Don't let Mr. Burke fool you: He can't make you read. Neither can I nor anyone else, if you don't want to, but if you don't read what has been written by people like Ray Bradbury (*Dandelion Wine*), John Steinbeck (*Of Mice and Men, Travels with Charley, Grapes of Wrath*), Richard Bach (*Jonathan Livingston*



ILLUSTRATED BY BRU ASSOCIATES

Seagull), Kahlil Gibran (*The Prophet*), Henry David Thoreau (*Walden*), Shel Silverstein (*The Light in the Attic* and *Where the Sidewalk Ends*), *The Collected Works of Robert Frost*, Jack London (*The Call of the Wild* and *The Sea Wolf*), the list goes on and on and you will not find those books that you really like. However, it is like I said, no one can make you read, all I can do is feel a deep, deep sorrow for you if you do not do this for yourself.

End of lecture.

PERRY J. RABLIN

P.S. Good luck to all of you, and you too, Mr. Burke.

Dear Mr. Burke:

What role have books and literature played in the life of the Sandstrom family (parents Don and Joanne, sons Donald and Erik)? Writings of John Muir and Colin Fletcher sent us into the Sierra for a 40-day, 240-mile back-packing trip (the John Muir Trail plus) when Donald and Erik were eight and six. *National Geographic*, Melville, Stevenson, Conrad, Bligh, and Cook infested us with an itch to sail the world. Since we couldn't afford to buy a boat, we had to read plans and construction manuals so we could build one. *Anduril*, the 40-foot trimaran we built (named after the sword of Aragon in Tolkien's *Lord of the Rings* trilogy, one of the "icons" of our family), has taken us on two circumnavigations.

The first trip, begun when Donald and Erik were 13 and 11, took us five years. Except for four months in Cyprus, the boys didn't attend school for five years—but we read about 800 books (from Darwin to Louis L'Amour). Donald had to take the GED in Rhodes, his SATs in Cyprus and Spain. He was accepted at UC Berkeley and graduated with a degree in civil engineering. Erik majored in English, graduated from California State University at Long Beach and now teaches English in Lodi.

When we returned from that first circumnavigation, Don couldn't find a job, so he went to the library and read books about building houses (different from building boats) and designed and built (with help from the rest of us) a home for us in Oakland.

Having read much about the Great Barrier Reef, Don, Erik, and I took a "quickie" 16-month circumnavigation to see it. That trip I at least kept track of what I read during the year (I had to fly back after 12 months to get back to work); the list is enclosed.

Reading, of course, inspired writing. I've written numerous articles about our travels for various sailing magazines. When book publishers wanted a book quite different from the one I wanted to write, we formed our own publishing firm, Earendil Press (name taken from Tolkien), and published *There and Back Again*, the story of our first circumnavigation (title is the subtitle of Tolkien's *The Hobbit*).

We wouldn't have done *any* of these things if we hadn't read books. We were inspired and empowered to do them *because* we read books. Other activities we can't/won't be able to do we *can* experience through reading books. Readers aren't limited to one life at one place and time in history. Past, present, future, and worlds that never were are open to readers. Through reading books, psychology majors (Don) and English majors (me) can learn to do things they never learned in school.

If you think your class(es) would be interested, we'd be happy to visit and talk about books/show slides of our trips that relate to books (Darwin's voyage to the Galapagos; Robinson Crusoe Island; the *Bounty* mutiny and Pitcairn Island, etc.).

Yours truly,
JOANNE SANDSTROM
Managing Editor
Institute of East Asian Studies

Dear Mr. Burke:

Your letter struck a spark in the mind and heart of a former teacher. First to my own life—books have brought the wealth of the universe, a realization of the intellectual achievements, the spiritual insights, the aesthetic pleasure, the ingenuity in all fields that our ancestors attained and passed on to us. Without the treasury stored up in libraries, we would be in the Stone Age.

In my classes I used to repeat an account of a woman whose identity I have unfortunately forgotten. She had been arrested for political reasons in Europe before World War II and subjected to solitary confinement for four years. On her release, her friends were amazed at her serenity and the clarity of her mind. When asked to account for this and to what she attributed her ability to have maintained her mental equilibrium, she said that she had no explanation but that she did know how she had passed her days. All her life, she explained, she had been a great reader and had traveled a great deal. Some days she would recall some book she had read and in her mind would go through the content of the book, live in its ambiance and work out her own reaction to it. Other days she would recall a particular place she had visited and relive the experience, imagining the sights and sounds, smells and feelings stored up in her memory. A mind filled with things outside herself had enabled her to people her loneliness and surmount her isolation.

Books can bring the whole world into our lives.

Sincerely,
SISTER CHRISTINA MARIA WEBER
Teacher

Jim Burke teaches English at Burlingame High School in California. He is founder and moderator of CATENet, an electronic roundtable designed to promote discussion among English teachers throughout the nation. This article is an excerpt from his book I Hear America Reading: Why We Read~What We Read *(Heinemann, 1999, © Jim Burke). Reprinted with permission. To order, call toll free 800/793-2154; or visit the Heinemann Web site at www.heinemann.com.*

Dear Mr. Burke:
Your students might reflect on what has motivated and enriched my 67-year-old life: books are man's best friend. Take me for an example. By the time I was 25 years old, I had lost a brother in World War II, a father in a fishing accident when I was four, a mother by heart attack, a cherished maiden aunt only 37 years old, and grandparents on both sides before I was 6.

How else could I have survived without books, all kinds, history, poetry, novels, and the Bible.

Enclosed is a book for you and your students.

Cordially,
DR. FRANK L. KEEGAN
Philosopher/historian

Do you know what Newton did? What made him famous? Neither did I until two years ago. But I'd studied (and received three degrees in) engineering and knew a great deal of math and physics. A book I borrowed from a library where I'd been a professor for almost 25 years then, told me on my first working visit back to my Ph.D. alma mater, UC Berkeley.

After reading bits of it, I bought my own copy and read every word.

ALLEN KLINGER
Professor of engineering

Dear Students:
I grew up on the streets of Brooklyn, N.Y. I went to a Catholic grammar school where I didn't do well. I was also raised in a family of abuse. Alcohol was the big problem. I started drinking young and never really got much done. Alcohol keeps you in a trance. My life changed very much by going back to school and reading books. Books have taken the place of alcohol. I now read about a book a week.

The most important thing I learn from a book is that we are all human beings. We must learn to love unconditionally. Everyone has shortcomings. That's what makes us human. Please don't make fun of people's looks and how they feel. Learn to get in touch with how you feel. It's OK to get angry, cry, and to disagree with anyone. You must have your "feelings."

We are all "different," and we are all capable of much Love.

KEVIN BURNS
Real Estate agent

Mr. Burke:
I'm a helicopter test pilot and flight instructor for the U.S. Army at Los Alamitos, Calif. I have over 7,000 hours of helicopter flight time, and I am currently the only female test pilot in the AH-1P Cobra helicopter. I am also the only female test pilot in the country in the OH-6A and UH-1M helicopters.

Books have *always* been important to me. I remember Nancy Drew as one of my early favorites. I've enjoyed so many books over the years, but the one that stands out for me is *The Search for Amelia Earhart* by Fred Goerner. I was in high school when I came across it.

I had always wanted to get into aviation and be a pilot, but the doors were closed to women in the '70s in the field of aviation. However, I remember reading about Amelia Earhart, her struggle and her around-the-world flight in 1937.

I could understand her frustrations and the excitement of her goals. Because of people like Amelia Earhart who dared to reach out, I believed I could accomplish my dream. And I did just that. Eight years after graduating from high school, I became California's first woman aviator in the U.S. Army Reserves. Today, I continue with my dream by flying seven different types of helicopters.

Books have always been a part of my life. I have my own library in my home (mostly aviation and biographies) and my own encyclopedia set (something I had always wanted to own). I read every night before I go to sleep. Some of my favorite authors are: Dean Koontz, Tom Clancy, Clive Cussler, Dale Brown, Stephen Coontz, Scott Carpenter, Arthur C. Clarke, Ray Bradbury, Danielle Steel, and Larry McMurtry.

KEEP IN THOSE BOOKS—IT'S AN ADVENTURE!
Be Safe.

GERI BOWERS
Helicopter pilot

Dear Mr. Burke,
When I think about what reading means to me, two important places come to mind: the small neighborhood library down the street from my house, and my cozy little pink bedroom, which has looked the same for more than eight years. These two places have provided the atmosphere in which I can think and feel, and discover so much about the world.

Some of my first memories are of my parents propping me up on my bed next to them and reading me amazing stories about everything from magic fairies to field mice falling asleep in their soup. Soon my favorite bedtime plea became, "Just one more," or "Read it again!" And eventually I was old enough for Pajama Story Time at the neighborhood library down the street.

A little after dinner time, my sister and I would march down the street in our pajamas, sometimes holding our favorite stuffed animal, for a story in the Lions Den (the children's room of the library). I vaguely remember my first trip to this special gathering. I was so excited after all those years of seeing my sister indulge in this summer-evening event without me, I couldn't believe it was finally my turn, too. It was all that I had hoped for and more. The stories were fantastic. Soon enough I began to take my own after-school trips to the Lions Den to check out my three books for the week.

When we finally returned from the library (it usually took at least a half-hour to narrow down my choices), I would rush up to my room to set them out in the order they would be read each night. Looking back, I am amazed at how much even these children's books made me feel.

I was so happy for Arthur and D.W. (after reading almost every single book in the Arthur series by Marc Brown) when their parents brought home their new baby sister. I remember telling my grandma, "I wish I could reach into the book and hold her. She's so cute." And I remember being scared for Mitzi every time I read *Tell Me a Mitzi*, when she would take a taxi with her little brother, just the two of them, in the early morning hours on a New York City day.

Even though I don't attend Pajama Story Time anymore, and rarely even check out a book from the "library down the street," I still read stories in my little pink room before I sleep. Though the readings have changed and the stories have matured in difficulty and length, many of their themes and morals are drastically similar. And even those which are not really stories at all, they still make me feel and think, just on different levels, or about different things.

Sincerely,
LINDSAY ROSENTHAL
High school student

Hello, Mr. Burke...and students:
Shall try not to set your literacy teachings back too far...and punctuation rules and stuff like that there...but I've been running a cattle ranch for 40 years and one does get a bit rusty around the edges.

Oh, I read a lot...don't get me wrong...but I read for relaxation now, for mind "unwinding" at the end of the day and no longer to acquire knowledge that I'm durn sure I'll never put to use. Or even to read to broaden my knowledge of places I've never been to or are likely to see. Bein' 69 does that to many a person...not every person but a lot of 'em....

Y'see...a livestock operation, a cattle ranch, is sort of a demanding thing. There's always a fence to look after...maybe fix...what with thirty miles of it around and criss-crossing the place. Some of the wood posts have been in since it was built some 70 years ago. Dry out here...and the posts are cedar...but they're beginning to give way, finally. And there's hay to put up and then one moves the durn stuff to the feeding corrals and pretty soon it is winter and you gotta feed every day and then spring and calving time and then summer comes around again and it's time to hay, etc., etc., etc.... Just a small operation...what you would probably term a mom and pop operation...for we had sheep up until 40 years ago and it was too much hassle what with sheepherders and hired help at lambing time and a sheep being the most exasperating, dumbest thing ever put on this green—sometimes, even out here—earth.

But as a kid, growing up in the country...until high school the country schools had seven to maybe fifteen kids in all the seven or eight grades, one teacher for all...well, if one was ever to learn what it was like on the "outside" you had to read a book. When you get around a team and wagon or horseback, your horizons are kinda limited...especially in the winter time. Summer school...eight months of the year, stay home December, January, February, March. Come time I was of school age, my mother, brother, and I came down from the sheep ranch which was just seven miles south of the Canadian border and took over a country store and post office. Half mile walk to school. That one year. Next year, they consolidated three rural schools—the homesteaders were pulling out in bunches as it was in the Depression years of the '30s so they didn't have as many students to teach. Two mile walk—each way—when a car didn't come along but part of the time, we had a saddle horse to ride. Healthy...and tiring, didn't need a whole lot of parental urging to go to bed at night....

Had a small community lending library in one corner of the store and I guess I read every book in it. And magazines, we subscribed to a few, and there was a lot of swapping of those old paper-pulp westerns and detective magazines among the neighbors year around. And there were two other sources of reading material...there being three different mail routes from rural towns that met at Genevieve, the store-post office and in those days the farmers all milked some cows and sold cream to the creameries. The mail carriers took it down to the railroad in five-gallon cans and it was shipped along and the cans came back via carrier also. They had been washed out and all, but to soak up the moisture and keep them from rusting inside, the creameries would, after drying them, toss in a couple of paper-pulp magazines to help soak up the last moisture. Boy, when I discovered this, I had it made!! If, that is, the people weren't waiting there for their cans when the mail came. One had to be a fast reader because if I didn't chuck two magazines in the can when I removed the originals, there would be the dickens to pay. Not only might cans rust, the other folks looked forward to getting a couple free magazines also. The other source of reading material...the drug stores in town sold the magazines, nickel, dime, sometimes two bits, and those they could not sell, they could return for a refund and all they had to do was tear the front covers off and send them in. So you could buy a bundle of assorted reading material...comic book or two, lots of detective stories, some westerns, some real literary magazines, some movie mags, whole bunch of stuff for two bits. Dad had one or two sheepherders up north to keep supplied with reading material...sheepherders having lots of spare time on the better days...and I got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LOCAL NUMBER

to pick through the bundles when he came from town.

No electricity out that far. Poor radio reception and radios required batteries that were always running down so that was not much of a means of getting the word. So it was mostly reading. Folks got it made...in that way...these days.

Reading won't ever go out of style. Books won't. As yet, there is no way to turn a TV program back a page or two to view again if you don't quite "get it." Video is something else...if you have unlimited numbers of cassettes around, if you got all the time to search through them, you can do quite well. On the current status of it, what it looks like today.... But what about how it was, what about the history of this place, that place, this development, this industry? Here you can do best with books, with encyclopedias. Way better...by far the best way. One with any amount of natural curiosity about how things come about, evolved...you have to turn to the printed page. The ability to do so easily means a lot. It means a whole hell of a lot when your turn comes to go out looking for employment. Yeah, sure...you can call up any amount of information by punching the proper computer keys. But presently, you still have to be able to read it. Maybe now, maybe soon, they'll have computers that talk to you and tell you what you want to know. But the printed page, my friends, is a long ways from becoming obsolete. Learn how to get familiar with them and their contents....

Now me, new knowledge I don't really need much at sixty-nine. Got the cows, got the ranch, the kids got through college in good shape, I figure just to kind of ride it out the remaining years. And I imagine I can. But for you...with much of life yet ahead of you, a job, then a career, perhaps commitments that won't allow you to travel, to see the world, with the natural curiosity of youth, books will fill in where TV and videos kind of hit around the edges.

Had it to do all over again, I'd maybe do it about the same and even wind up here. Country living, boarding out for the high school years, armed combat in World War II, four years of college, an honors graduate (changed from engineering to agriculture in the process)...well, I had my options and one of the reasons I had 'em was because I was mighty familiar with the printed page and the words on it. Could have taught, could have gone into agricultural research, gone with banks or the government agencies as an ag rep man, there was opportunity. I won't say it all started with the Genevieve Community Lending Library or those milk-can pulp magazines or the variety of literary offerings in the two-bit sheepherder bundles. But everything has gotta start someplace...we all know that.

Good Luck,
JOHN H. BARTON
Cattle rancher

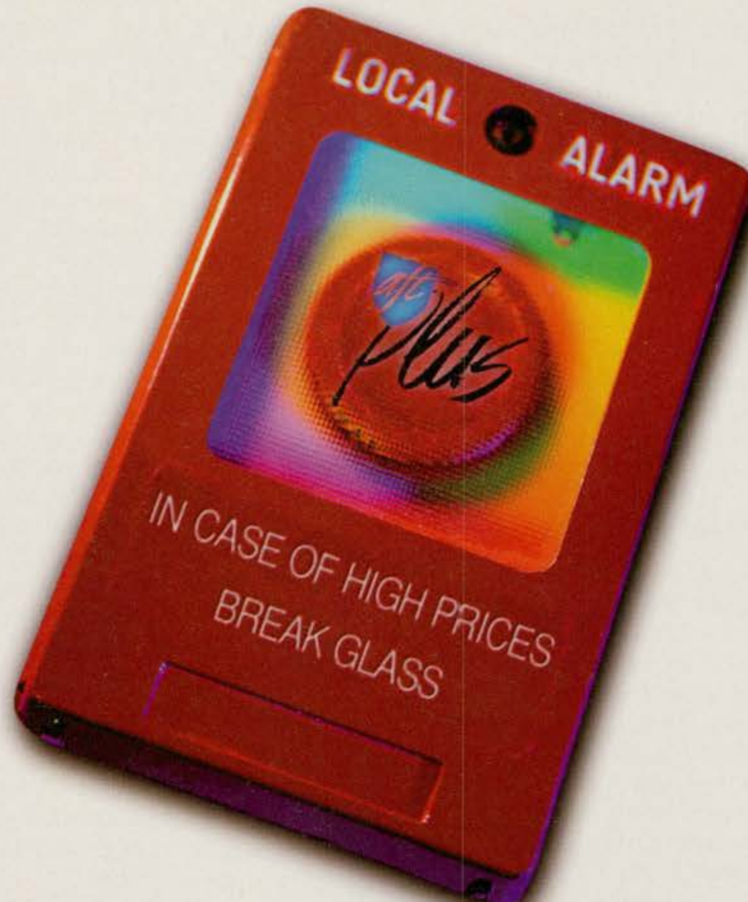
Dear Mr. Burke and Students:

My name is Jimmy White, I'm 29 years old and a psychiatric case manager for a nonprofit agency that provides mental health services for the mentally disabled. I'm writing to you because I want to let you know how important books and reading are to me. When I was a child, my family was extremely poor and as a result we had to move from town to town so my parents could find work. By the time I was 13, I had lived in 22 different places! This constant moving meant that I was always "The new kid on the block" and therefore always felt ostracized. I never felt like I belonged anywhere. Forming friendships was difficult, especially when the threat of moving so often loomed over my head; it's hard to get close to someone when you know that you will probably leave them.

Given these circumstances, it's no wonder I hated my world and thus began reading. Reading offered me a healthy escape into other worlds. I say "a healthy escape" because we all know how many other forms of escape there are that are unhealthy: drugs, for example. Anyway, I found that through books I could enter other times, existences, realities, etc. I could become the hero or the hero's companion. Some of my favorite books then were books by Edgar Rice Burroughs. He's most famous for creating Tarzan, but he also wrote some fantastic science fiction series that are quick and easy to read. Other favorites of mine were *A Separate Peace* by John Knowles, *The Collector* by John Fowles, *Salem's Lot* by Stephen King (I couldn't sleep for two weeks after reading this one!), *The Hobbit* [and *Lord of the Rings*] trilogy by Tolkien, *Watership Down* by [Richard] Adams, *1984* and *Animal Farm* by George Orwell, *A Tale of Two Cities* by Charles Dickens, *Robinson Crusoe* by Daniel Defoe, *Slaughterhouse Five* by Kurt Vonnegut Jr. and *The Little House on the Prairie* series by Laura Ingalls Wilder.

These books were an important part of my growing up, and I'll cherish the memories I have of staying up well past my bedtime because I couldn't put the book down on various occasions. Today reading is one of my favorite pastimes. I started keeping a book diary in 1990, and each year I try to read more books than the previous year. Let me make a suggestion: If your world is scary or lonely or confusing or overwhelming, don't try suicide or drugs, try a book instead. It's a much more rewarding, enriching, wonderful experience than those self-destructive ways (and believe me, I'm speaking from personal experience!) I hope this doesn't sound preachy because it's coming from the heart. I sincerely wish the best for each of you.

Yours truly,
JIMMY WHITE
Psychiatric case manager


LOCAL ALARM
IN CASE OF HIGH PRICES
BREAK GLASS

(Continued from page 37)

Blain. And Courtney adds, "We also want to help people build careers in this industry."

Thus, WashTech offers courses on computer skills, software writing languages, and other subjects for Seattle-area high-tech workers. While Microsoft doesn't provide training for temporary workers, and private courses often cost $600 or more for 10 hours of training, WashTech offers classes for members for only $75.

Looking to the future, Blain suggests that WashTech, the King County Labor Council and the CWA co-sponsor a computer lab and high-tech training for union members and other interested people throughout the Seattle area.

"The potential for using training as a recruiting tool is incredible, and the need for training and retraining just to keep up with new technologies is enormous," he says. "We've got to think big."

New Unions for the New Economy?

These efforts at IBM and Microsoft depart from traditional union organizing, which CWA Executive Vice President Larry Cohen describes as "focusing from the beginning on winning an election to get recognition."

WashTech and Alliance@IBM show that workers can build organizations that advance their interests, even before they win the right to bargain with their employers. And they illustrate how workers' organizations can offer other benefits as well—information about corporate policies, training for new skills, and even a sense of community that is absent in the workplace itself.

What of the other paths sketched out by some of the more visionary advocates of "new unions for the new economy"?

Some of the most influential and sophisticated recommendations for new forms of unionism come from Stephen A. Herzenberg, John R. Alic, and Howard Wial, who worked together at the Congressional Office of Technology Assessment and are now affiliated with the Keystone Research Center, a Pennsylvania think tank. In their recent book, *New Rules for a New Economy: Employment and Opportunity in a Postindustrial America* (Twentieth Century Fund/Cornell University Press, 1998), and in other writings, the authors argue that the new economy requires a new model of unionism.

With workers moving from project to project, job to job, and employer to employer, the authors suggest that unions should organize workers on the basis of their occupation, not the company where they work. Thus, there might be national organizations for computer programmers, software testers, or technical writers. This recommendation recalls the old-time workers' guilds, as well as today's craft unions, which were founded a century ago—thus, the phrase "back to the future" unionism.

According to these authors, the new economy's emphasis on workers' skills and adaptability to change creates two problems that these occupation-based unions could seek to solve. As companies continue to eliminate employees' jobs, and as workers change jobs frequently within their careers, "Firms have no incentive to train workers who may soon be 'downsized' or quit." And, with workers no longer relying on large corporations for lifetime guarantees of job security, health coverage, and retirement benefits, portable benefits are also important.

By assuming the functions of yesterday's guilds and today's craft unions, the authors argue, more unions could fill the needs of employers and employees in the new economy. Such unions would conduct education and training, set skill requirements for jobs, certify trained and capable workers, and become the leading advocates for high-quality work in the occupations they represent. They would help employers find skilled workers—and skilled workers find new or better jobs. And, by performing functions that benefit employees and employers alike, these "new unions" would be better able to cooperate with management in improving the quality of goods and services.

Similar views are offered by the leader of the innovative AFL-CIO Labor Council in another center of high-tech, California's Silicon Valley.

"The next generation of employee organizations may look very much like a page from the past," said Amy Dean, executive officer of the South Bay Labor Council. "In the first industrial revolution, we were a craft-based society. In the second, we became an industrial-based society. We are now in our third industrial revolution, and, in many respects, we are turning back to a craft-based society. The original labor organizations were craft based and regional in scope. So we might take a page from history in terms of the way we organize employee groups."

In fact, many unions already are doing much of what these writers recommend. The building trades unions, for instance, provide apprenticeships and journey-level training, certify workers' skills, negotiate multi-employer contracts, and provide portable pensions, health coverage, and other benefits that workers can carry with them from job to job. With assistance from the AFL-CIO, several national unions, among them the AFT and CWA, offer "associate memberships" to workers who are not covered by union contracts; these members receive information about issues of importance to their jobs, as well as such benefits as health coverage, credit cards, and legal insurance.

Meanwhile, professional and public service unions, such as the AFT, have long been voices for higher standards in education, health care, and other endeavors. Increasingly, there is an exchange of ideas among different unions from different sectors of the economy about how to respond to changing workplaces and workforces. For instance, the CWA's Cohen says: "Our dialogue over the years with [AFT Organizing Director] Phil Kugler, and AFT's efforts to build organizations prior to collective bargaining in cities like Dallas, have provided much of the inspiration for our high-tech organizations."

Meanwhile, in Silicon Valley, the South Bay Labor Council is reaching out to the industry's temporary workers.

In 1996, a think tank founded by the Labor Council—Working Partnerships USA—conducted a study which found that a quarter of the Valley's more than 800,000 workers are contingent employees—and that 32,000 were hired through employment agencies.

In an effort to help these workers obtain and share information about their work situations, the Labor Council launched a page on its Web site which offers materials about temporary employees' legal rights and job placement and training opportunities, as well as a forum for discussing their own experiences on their jobs.

This year, Working Partnerships founded an advocacy group for temporary employees, Working Partnerships Membership Organization, which began accepting dues-paying members in January.

And, together with community groups, Working Partnerships also created a nonprofit employment agency, Working Partnerships Staffing Services, to help temporary employees find jobs. Working with a local community college, the agency offers free classes to prepare workers for new and better jobs, including computer skills and word processing.

Currently focusing on clerical workers but planning to expand into other occupations, Working Partnerships Staffing Services pays temporary workers $10 per hour—$2 more than for-profit agencies in the area. The agency is also negotiating with health-care providers for a group rate and hopes eventually to offer "portable" benefits, training, and job certification that workers can take with them from job to job.

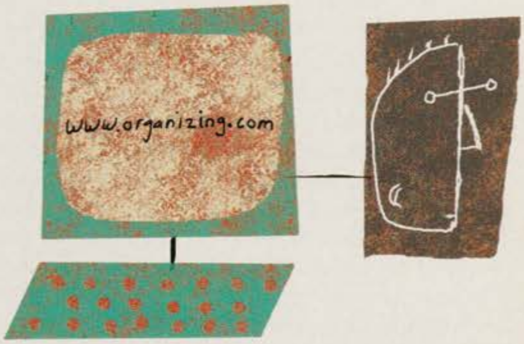
Explaining the thinking behind these initiatives, the Labor Council's Amy Dean says: "We have to acknowledge that people work differently these days. Our goal is to transform employment practices by marrying a placement agency to an advocacy strategy that, in time, will raise the wage floor, allow access to benefits, and affect overall hiring practices."

But are such innovations likely to lead to entirely new forms of unionism, discarding the traditional emphases on improving pay, benefits, and working conditions through collective bargaining and challenging unfair management policies with tactics of all kinds?

At a forum sponsored by the New Economy Information Service, a research group based in Washington, D.C., that question was posed to three union organizers who have worked with professional employees, workers in high tech, and workers in industries without large and stable employers. In different ways, each favored innovative efforts, tempered by the understanding that, as long as most employers resist any efforts by their employees to build organizations of their own, it will be difficult for unions to emphasize their roles as sources of skilled labor and advocates for quality.

Such efforts are easiest in the public sector—from the schools to the local, state, and federal governments—where employers generally accept the existence of unions. In his presentation to the group, AFT organizing director Phil Kugler stressed the union's evolving role as a source of information and advocacy on the full range of educational issues, from curricula to discipline. These services are valuable not only to AFT members who are covered by union contracts but also to a growing number of "associate members" in communities where educators do not have collective bargaining rights.

WashTech and Alliance@IBM show that workers can build organizations that advance their interests, even before they win the right to bargain with their employers.



Issue-oriented advocacy is increasingly important for other groups of professionals as well. For instance, psychologists who work with health maintenance organizations (HMOs) are experiencing second-guessing in decision-making, as well as reductions in reimbursements and even arbitrary cut-offs in treating patients. To help address these issues, the New York State Psychological Association has forged a working relationship with the AFT.

"This is happening in professional associations as the pressures build—the economics, the quality that's being sacrificed, the loss of autonomy in the role of setting standards," Kugler said. "This is not the traditional route [to union organizing]. But we're stepping into territory that's somewhat new and thinking outside the box."

But, particularly in the private sector where most employers fiercely resist unions, there is the question of whether employers will appreciate the value of unions as partners in recruiting and training skilled workers and enlisting employees' support in improving productivity and quality.

At the forum, Jeff Hermanson, who has organized for UNITE and the Carpenters union explained:

> People talk about offering skilled labor to the employers and persuading the employers that this is of such great value that they will accept unionization. Well, I'm afraid that we have to do more than offer the carrot to employers because I've tried it many times. I always try to go nicely to the employer and say, you know, the majority of your workers would like to be represented by the union. We'd love to sit down with you and work out a way that could be to our benefit, a non-adversarial relationship. I've even taken to putting those terms in my letter of demand to employers—mutually beneficial, non-adversarial relationship.
>
> And you know, I can't remember when that's ever been accepted.

But he also told the story of the Carpenters' efforts to organize the cabinet workers in Las Vegas who "provide all of the fancy architectural woodwork for the casinos and hotels." These workers received low pay and no benefits and often worked in "sweatshop" conditions. Many are recent immigrants.

Hermanson said the Carpenters are using an array of tactics to help these workers organize:

> We used our industry leverage—the fact that our members were installing the cabinets—to pressure the employers from the top. We used the industry-wide approach to assure employers that they weren't the only ones being organized. Most importantly, we did bottom-up organizing and agitation in the shops.

The union also tried a tactic from the "back to the future" play-book, establishing a new apprenticeship program for cabinet workers, helping them learn new skills to improve the quality of their work. Hermanson explained that, together with the union's other efforts, the prospect that, "if an employer accepts the union, he will have access to some pretty darn good carpenters and well-trained cabinet makers," is contributing to the success of the organizing drive. The union has already organized 10 shops that provide 90 percent of the cabinet work for the casinos. Now, the union is reaching out to workers at other cabinet shops in the Las Vegas area.

Learning from their successes and their setbacks, these innovative but experienced organizers urge an approach that might be called not "back to the future" but "back to basics": building organizations, addressing issues, providing services, seeking collective bargaining when possible, and winning battles in other arenas when necessary.

"If you strip away what unions are really about, they're about building organizations," the CWA's Larry Cohen, who directs the union's organizing programs, declared in an interview. "At their soul, they're not just about contracts and representation elections, important as those are. Unions are organizations of working people."

Through these organizations, Cohen believes, workers can wage campaigns on issues of importance to them, such as the IBM pension cutbacks or Microsoft's treatment of its temporary employees. Through tactics such as demonstrations, media coverage, and meetings with public officials, these employee organizations can gain support and eventually even prevail. Meanwhile, the organization should also be a source of information about employee issues and of services employees need, such as training for high-tech workers. All this can build a growing, active, and effective employee organization—as well as support for winning a representation election, bargaining a contract, and establishing a union.

Indeed, Cohen challenges the view that highly skilled employees or high-technology industries have no interest in unions or collective bargaining, declaring: "The main barrier to extending collective bargaining is not so much the character of the work force as the resistance of the employer." He notes that, over the past two years, more than 5,000 workers in the wireless telephone industry have organized and joined CWA. Most work for companies where CWA already represents other workers and negotiated "neutrality" agreements under which management does not interfere with workers' organizing efforts.

But the management of many newer, non-union companies, such as Microsoft and Amazon.com, oppose any attempt by employees to build an organization of their own. While this clashes with the companies' images of gentle informality, Cohen explains:

> There is a line in a song by The Who that says, "Meet the new boss, same as the old boss." In a similar vein, we might say, "Meet the new economy, same as the old economy," because the bosses' attitudes about worker organization are, if anything, more harsh today. They are not gentler, they are not based on cooperation. They're based on the sense that control is primary.

Still, particularly in public sector, educational, and health care institutions, there is the opportunity for employee organizations to raise issues of the quality of the work they do and the integrity of their profession. By raising issues about how well their workplace is performing—whether it is a company, a school, a hospital, or a government agency—employee organizations can achieve what the AFT's Kugler calls an "engagement" with the employer. And, eventually constructive criticism may lead to a cooperative relationship with some employers, as they come to understand that the union gives voice to employees' aspirations to do their best work.

So will new efforts at organizing eventually result in more teamwork between employees and employers in the new economy? Will unions new and old help provide improved training, portable health coverage and retirement benefits, and a better match-up between skilled workers and the employers who need them?

In large measure, it all depends on what workers are doing and how their employers respond in companies like IBM, Microsoft, and Amazon.com—and in places as different as Endicott, N.Y., and Redmond, Wash. □

(Continued from page 13)

ics or mathematics and one other subject. This allowed them to specialize in ways that few of our elementary school teachers can. Quite a few regularly changed the level at which they taught. They might go through a cycle of three grades, then repeat the same cycle, or change and teach a different age group. This allows them to see the development of mathematics from the perspective of a teacher, something too few of our elementary school teachers are able to do.

Recently, the Learning First Alliance—an organization composed of many of the major national education organizations—recommended that beginning in the fifth grade, every student should be taught by a mathematics specialist.[6] This is a hopeful development, and for many teachers it would mean unburdening themselves from something they now find difficult and unpleasant.

There is more we can do. Our teachers need good textbooks. They need much better teachers' manuals. As noted before, our college math courses for future teachers at all levels need to be improved. And just ask any teacher who has sat through mindless "workshops" whether our in-service "professional development" isn't long overdue for major overhaul.

Teachers also need *time* to prepare their lessons and further their study of mathematics. Recall Ma's comments that it is *during* their teaching careers that Chinese teachers perfect their knowledge of mathematics. Listen to this Shanghai teacher describe his class preparation:

> I always spend more time on preparing a class than on teaching, sometimes three, even four, times the latter. I spend the time in studying the teaching materials: What is it that I am going to teach in this lesson? How should I introduce the topic? What concepts or skills have the students learned that I should draw on? Is it a key piece on which other pieces of knowledge will build, or is it built on other knowledge? If it is a key piece of knowledge, how can I teach it so students can grasp it solidly enough to support their later learning? If it is not a key piece, what is the concept or the procedure it is built on? How am I going to pull out that knowledge and make sure my students are aware of it and the relation between the old knowledge and the new topic? What kind of review will my students need? How should I present the topic step-by-step? How will students respond after I raise a certain question? Where should I explain it at length, and where should I leave it to students to learn it by themselves? What are the topics that the students will learn which are built directly or indirectly on this topic? How can my lesson set a basis for their learning of the next topic, and for related topics that they will learn in their future? What do I expect the advanced students to learn from the lesson? What do I expect the slow students to learn? How can I reach these goals? etc. In a word, one thing is to study whom you are teaching, the other thing is to study the knowledge you are teaching. If you can interweave the two things together nicely, you will succeed. We think about these two things over and over in studying teaching materials. Believe me, it seems to be simple when I talk about it, but when you really do it, it is very complicated, subtle, and takes a lot of time. It is easy to be an elementary school teacher, but it is difficult to be a good elementary school teacher. (p. 135)

LIPING MA'S book provides a start to what I hope will be a continuing study of fundamental mathematics and the connections between different parts of it. We need many more commentaries on the teaching of mathematics like those contained in Ma's book. We also need more detailed lesson plans, as are frequently provided in Japan.[7] There are a few places where one can read comments by U.S. teachers or by mathematics education researchers. However, these comments almost all deal with the initial steps of an idea, which typically means using pictures or manipulatives to try to get across the basic concept. Almost never is there elaboration of what should be done *next*, to help develop a deeper view of the subject, which will be necessary for later work.

And elementary school mathematics *is* much deeper, more profound, than almost everyone has thought it to be. As Ma comments, toward the end of her book:

> In the United States, it is widely accepted that elementary mathematics is "basic," superficial, and commonly understood. The data in this book explode this myth. Elementary mathematics is not superficial at all, and any one who teaches it has to study it hard in order to understand it in a comprehensive way. (p. 146)

But, she concludes:

> The factors that support Chinese teachers' development of their mathematical knowledge are not present in the United States. Even worse, conditions in the United States militate against the development of elementary teachers' mathematical knowledge.... (p.xxv)

This must change. We cannot continue to abandon teachers at every critical stage of their development and then send them into the classroom with a mandate to "teach for understanding." This is dishonest and irresponsible. As things stand now, we are asking teachers to do the impossible. They and the students they teach deserve better. □

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Teacher Time

(Continued from page 26)

- U.S. high school teachers spend more hours (22.9) in instruction each week than those in any of the other countries examined except for the high end of the range for England. Japanese high school teachers spend 20 hours per week teaching, German teachers spend 18, and French and Spanish teachers, 15-18. In 12 of the 19 countries, secondary school teachers teach 20 hours or fewer.
- The U.S. falls in about the middle in class size.

European countries with lower teacher instructional time do not reduce the amount of time students spend in school or in academic classes. Students there just meet more teachers than American students do, and can take more subjects per week because not every class meets every day.

In interpreting this information, remember that the data represent national averages, so that within each country some schools may vary considerably from the figures shown here. Also, this information says nothing about the composition of the student body (diversity based on ethnic or economic group, language differences, students with disabilities, etc); the structure of the educational system (determining admission to certain types of schools by tests, use of private tutors to supplement school instruction, etc.); what a teacher is expected to do (lecture, mark homework assignments, provide varied types of learning experiences, etc.); or quality of instruction. In Japan, where teachers have larger class sizes than in the United States, families do not rely on the regular teacher for all instruction. Japanese families typically hire tutors to make sure their children pass exams, and students study with those tutors after their regular school day. Furthermore, Asian cultural norms are more supportive of education than American norms. Japanese teachers can expect the families of their students to be involved in their school work and to carefully monitor their children's progress. These practices are not reflected in the school statistics.

The teacher workload that we find in private schools in the United States and in public schools in Europe works to educate students to a high level of quality. Why not plan such workloads for teachers in American public schools? Teaching is a wonderful job, endlessly fascinating, challenging, good for the mind and the soul. It is probably the most important job in this society in the 21st century, after the job of being a parent. But it is completely unrealistic to expect to create high quality, American "educate-everybody" schools on the basis of a workload that requires a 60-hour workweek. □

Bogus Dichotomy

(Continued from page 19)

$$268 \times 3 = (600 + 100) + (80) + (24). \qquad (5)$$

Similarly, 24 = 20 + 4, and we can combine the 20 with the 80 in the tens digit:

$$268 \times 3 = (600 + 100) + (80 + 20) + 4. \qquad (6)$$

But now the (80 + 20) in the tens digit is equal to 100, and we can again combine it with the (600 + 100) in the hundreds digit. Thus

$$268 \times 3 = (600 + 100 + 100) + 0 + 4 = 800 + 0 + 4 = 804.$$

A few more experiences with working from left to right would tell us that we are likely to waste a little time by so doing because of the frequent need to backtrack to fix a certain digit as in step (6). (There it was the tens digit.) Thus *from experience,* we learn *to work from right to left in order to save time.* This is the reason to work from right to left, but let students find out for themselves by working through several such problems. Therefore, we now redo the above, from right to left, as follows. Start with step (4) again, 24 = 20 + 4, so

$$268 \times 3 = 600 + (180) + (20 + 4) = 600 + (180 + 20) + 4. \qquad (7)$$

Next, 180 + 20 = 200, which can be combined with 600:

$$268 \times 3 = (600 + 200) + 0 + 4 = 800 + 0 + 4 = 804. \qquad (8)$$

The numbers that were carried from the ones digit to the tens digit in step (7) and from the tens digit to the hundreds digit in step (8) can be recorded by a shorthand method, and this is the standard algorithm for the multiplication of any number by a single-digit number:

$$\begin{array}{r} 268 \\ 3 \\ \underline{{\scriptstyle 2\,2} \qquad (\times} \\ 804 \end{array}$$

In exactly, the same way, we see that 268 x 4 = 1,072 via the standard algorithm:

$$\begin{array}{r} 268 \\ 4 \\ \underline{{\scriptstyle 2\,3} \qquad (\times} \\ 1{,}072 \end{array}$$

Incidentally, this implies that:

$$268 \times 40 = 10{,}720. \qquad (9)$$

Now we put the pieces together using the distributive law:

$$268 \times 43 = 268 \times (40 + 3) = (268 \times 40) + (268 \times 3).$$

Using steps (8) and (9), we obtain:

$$268 \times 43 = 10{,}720 + 804 = 11{,}524.$$

In retrospect, we see that the single-digit approach to this two-digit multiplication problem (that of multiplying by 43) results from *heeding the call of the indispensable mathematical principle to always break down a complicated problem into simple compo-*

nents. The *correct* way to think about multidigit multiplication is therefore to regard it as nothing more than a sequence of single-digit multiplications. Let children learn this fundamental fact from day one.

Now to convert the preceding to algorithmic form, it is traditional to use the commutative law of addition to rewrite it as:

$268 \times 43 = 804 + 10{,}720 = 11{,}524$

so that we have:

$$\begin{array}{rl} 268 & \\ 43 & (\times \\ \hline 804 & \\ 10720 & (+ \\ \hline 11524 & \end{array} \qquad (10)$$

A final touch-up: We see from step (9) that the "0" at the end of 10,720 comes from the "0" of 40, and is the result of 268 being multiplied by the tens digit (4 in this case). Thus this "0" can be taken for granted and will therefore be omitted in the next-to-bottom row of step (10). This accounts for the apparent shift of digits in the next-to-bottom row of the *standard multiplication algorithm:*

$$\begin{array}{rl} 268 & \\ 43 & (\times \\ \hline 804 & \\ 1072 & (+ \\ \hline 11524 & \end{array} \qquad (11)$$

Several observations readily come to mind at this point. The foremost pertains to the clear demonstration of the unity of skills and understanding in this derivation. For example, fluency with single-digit multiplication allows us to take for granted 268×40 and 268×3 and focus instead on the mathematical ideas leading up to step (10). Another observation is to underscore yet again the central role played by the distributive law, while noting (of course) that the commutative law and associative law also have been used implicitly. For example, in going from step (4) to step (5), we have used the associative law of addition because: $600 + 180 = 600 + (100 + 80) = (600 + 100) + 80$. A third observation is that this derivation is nothing if not about place value. The passage from (10) to (11), for example, explains in terms of place value why the digits of the middle two rows have that particular vertical alignment. In what way then does learning the standard algorithms "unteach" place value?

Finally, we call attention to the breathtaking simplicity of the multiplication algorithm itself despite the tediousness of its derivation. The conceptual understanding hidden in the algorithm is the kind that students eventually need in order to prepare for algebra. In short, this algorithm is a shining example of elementary mathematics at its finest and is fully deserving to be learned by every student. If there is any so-called harmful effect in learning the algorithms, it could only be because they are not taught properly. In Chapter 2 of her pathbreaking book, *Knowing and Teaching Elementary Mathematics,*[8] Liping Ma gives a more refined discussion of why rote learning might take place in the context of multidigit multiplication: It does so when the teacher does not possess a deep enough understanding of the underlying mathematics to explain it well. The problem of rote learning then lies with inadequate professional development and not with the algorithm. This is exactly the kind of scholarship we need in order to assist our teachers and to move mathematics education forward.

We have given several examples to show that deep understanding of mathematics ultimately lies within the skills. It remains to make a passing comment on the idea of skipping the standard algorithms by asking children to invent their own algorithms instead. The justification is that inventing algorithms promotes conceptual understanding. What is left unsaid is that when a child makes up an algorithm, the act raises two immediate concerns: One is whether the algorithm is correct, and the other is whether it is applicable under all circumstances. In short: correctness and generality. In a class of, say, 30 students, asking the teacher to carefully check 30 new algorithms periodically is a Herculean task. More likely than not, some incorrect algorithms would slip through, and these children would come out of this encounter with mathematics with no understanding at all. Such a potentially harmful effect should have been brought into the open in the advocacy of invented algorithms, but it seems not to have been done. As far as generality is concerned, this aspect of the standard algorithms—the fact that they are applicable under *all* circumstances—seems also to have been neglected in educational discussions. For example, although there are shortcuts to compute special products such as 97 × 103 faster than the standard algorithm, these shortcuts would be of no help at all in a different setting. With each invented algorithm, then, the responsibility of checking its generality again falls on the teacher. Are those who are telling teachers to encourage invented algorithms in their classrooms aware of this heavy burden?

As Euclid told King Ptolemy in the fourth century, B.C., there is no royal road to geometry. Neither is there a royal road to conceptual understanding. Let us teach our children mathematics the honest way by teaching both skills and understanding. ☐

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Lost Futures

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