Scenarios from Ms. Nolan's Algebra Classes

It is 12:55 p.m. on the Friday afternoon before Thanksgiving and Mrs. Nolan's algebra students enter class laughing and teasing each other. One girl calls to another to "shut the door, it's cold out there." Their teacher is ready to begin checking homework as the bell rings. Fifteen students settle in and turn their attention to the transparency containing five problems. A note on the board says *write an addition equation for each of the following situations*. Ms. Nolan circulates to check their homework papers, reminding students to stop talking and begin working. There is absolute silence in the room at 1:01 as students work the assigned problems and she returns marked papers to certain students. At 1:05 Mrs. Nolan directs students to "put your name on your paper and pass it to the front, please." Despite protests from three students to "wait, I'm not finished," she repeats "finished or not, put your name on it and pass the paper to the front." She reminds them of an upcoming quiz next class (Tuesday) and refers them to the planner sheet that informs them of upcoming topics, homework assignments, and assessments. Ms. Nolan begins to call on students to orally respond to the five problems. Terri-Ann correctly answers the first question. B.J. is asked to simplify -18 + 2 + (-4). When he incorrectly says "20," Ms. Nolan asks the class for the rule for adding numbers with different signs.

> I assign homework daily (Q46) and provide specific feedback to students after seeing their written work. (Q5)

> “I feel I have to account for every minute. I do not want any time wasted. If the children get into the habit of having [unused time] in each class, then they start to lose interest. Also, I personally don’t like to waste any time.”

One girl says "subtract."

"So, B.J.?" prompts Ms. Nolan.

"Subtract."

"What do you get here?" she asks again.

B.J. says "sixteen."

"Positive or negative sixteen? Which sign do you keep?" Mrs. Nolan continues to prompt him. Another student suggests "the larger number." Ms. Nolan says "right," and models the solution using a number line to illustrate location and value of each number in the expression.

Jimmy responds to the next similar problem with the correct answer. Ms. Nolan asks Jeff to *write a formula for t in terms of e* to represent a problem involving several cuts in a board *t feet* long. He correctly responds "*t = 6 + e.*" His classmates are quiet and attentive. Several students are absent and Ms. Nolan asks others to move to the front of the rows. She

rearranges them in closer proximity to her and to the board and overhead projector.

At 1:15 they begin to check results of their homework. Students respond orally as the teacher calls them by name. The assigned problems require students to simplify a variety of expressions using multiplication and addition of rational numbers and monomials. The focus is on paying attention to positive and negative signs as well as application of rules for multiplying monomials with like and unlike variables. Ms. Nolan engages several students with each problem, redirecting questions to others before validating any response. She insists on the use of accurate terminology when students explain the property or process they used to simplify the expression. "Please give me specific wording that tells us how to simplify" a problem such as (-2.142)-(34.34). Students respond "to change subtraction to addition, add the opposite." Ms. Nolan seems pleased with their ability to communicate accurately. She reminds them that they "are algebra students." The tone is serious but supportive and indicates they will get no credit for less-than-quality work.

My lesson demonstrates that learning algebra means learning a specific set of rules. (Q39)

At 1:35 Ms. Nolan moves from taking oral responses to basic skills review problems to solving equations. She calls on students to go to the board to show their work. "Right or wrong, go to the board and put your problem on the board." She writes the number of each problem on the board and, beside the number, the name of a student. Kia, Jeremiah, Charlotte, Kareem, Rita, Megan, and Ronnie each go to the board. By 1:42 they have finished working. Before they begin to discuss the problems, Ms. Nolan holds up her hand, counting the steps to consider in solving equations.

Nolan: "First step..."

Choral response from class: "Find what's added to the variable."

N: "Second..."

C: "Take its opposite."

N: "Third..."

C: "Add to both sides."

N: "Fourth..."

C: "Simplify."

N: "Don't try throwing [new] rules in there! Follow your steps. Consider w + 0 = -22. What property is this?"

C: "Commutative?"

N: "No."

C: "Associative?"

N: "No."

Rita: "The identity property."

N: "Good. Learn the properties. [Consider] -10+10 = 0. What property?"

C: "Associative."

N: "No. When in doubt, look it up."

A girl glances in her notes and says "the property of opposites."

Mrs. Nolan turns to the first equation, *y-6 = -10*. "What kind of problem is this? Addition or multiplication?" Students say "It's subtraction." She reminds them, "Solve a problem we know. Let's make an addition problem." She rewrites the equation as y + -6 = -10 and calls on Jeff to explain the solution. He solves by adding six to each member and applying the properties of opposites and identity. She smiles at the correct response and says "Please make every problem something we know how to work. Make every problem an addition or multiplication equation. Keep your rule. You can't go wrong."

It is 1:55 and Ms. Nolan works with Aimee to solve -6d = -42 and then moves to rework #11. At 2:04 she asks students why they have a problem solving the equation *7 - p = 2*.

"We can't subtract."

Ms. Nolan nods and rewrites the equation as *7 +(-p) = 2*. "Please copy this problem on a separate sheet of paper. These are notes for today (sections 3-5 and 3-10.)" She models the solution by adding -7 to each member, transforming the equation to 0 + (-p) = -5 and then applying the identity to produce -p = -5. "-p is not the same as p; keep going! Go until the variable p is all you have left." She continues modeling by rewriting the equation as -1(p)=-5. "How do we solve this?" she asks.

I require students to take notes daily. (Q33)

"Take the reciprocal, then multiply by it," says one boy.

She multiplies both members by -1 to complete the solution p = 5.

"We follow our rules. We can't go wrong. No short cuts. On the quiz, you'll be saying '*Is this a short cut? Where's my short cut? Do I use it now?*' And you'll get nervous. And I'll get a blank paper or a paper with all kinds of stuff on it." She smiles as she warns them and then she moves on to explain the new material.

"Consider the equation ax + b = c" Ms. Nolan says as she writes the equation on the board. Beneath that form she writes 2x+4=14 saying "What's x? Think of this analogy. Multiplication puts it [x] in the box. Addition wraps it up.

So when I give you a present, what do you do first?" She illustrates the equation on the board to match her analogy. "So you first unwrap [the addition] and then unbox [the multiplication.]" She models the inverse processing by first using addition of opposites and the identity property to produce *2x = 10*.

box *wrap*

2 $\boxed{x}$ + 4 = 14

"Jimmy, what do you notice now?"

"The number beside the x is 2."

Ms. Nolan continues, "Say what you mean. You're an algebra student now. Don't say *the number beside the x*, say *the number multiplying x is 2."* Her next step shows multiplication of both members by $\frac{1}{2}$, producing 1x = 5 or x = 5. "There's your present."

Aimee asks "How'd you get 1x?"

"The reciprocal of 2 is $\frac{1}{2}$ and $\frac{1}{2} * \frac{2}{1} = \frac{2}{2} = 1$

It is 2:14 and Ms. Nolan glances at Jimmy's paper. "Why didn't you copy the problem, sir?"

"I know how to do it."

"Copy the problem now, sir." Ms. Nolan moves about the room, checking the notes that students have written. She writes a problem on the board and says "Mr. Whitt wants to do the whole problem on the board." She hands him the chalk and he goes to the board and works the problem correctly. At 2:22 she informs the class "This is my gift to you." She writes the equation $\frac{2}{5}x + -10 = 30$. "When you get it, raise your hand. I'll come to you. Be neat." It is clear that she plans to reward correct solutions with a daily grade. The daily grade will be the solution to the equation. That "100" is Ms. Nolan's "gift" to them for their work.

James finishes first and, after examining his work, she marks a check on his paper and records his points in her gradebook. Megan is next, followed by Ronnie and Kia. All are correct. Ms. Nolan tells Aimee she has a problem with the reciprocal, so Aimee goes back and makes a change. When Ms. Nolan checks again, Aimee is correct. Jenny makes an error copying the problem. When Nolan rechecks she smiles at Jenny and says "Yes, ma'am!" Charlotte, Jeremiah, and Terri-Ann earn check marks. Rita makes two tries with errors but on the third try meets with Ms. Nolan's

> "They've learned that, when I ask them to do a problem at their desk, I will check them. They have to do the work. Students will even tell others 'work the problem; put something down on paper.' At first they went home and told Mom 'she doesn't teach.' They are coming around. They are doing the work."

approval. Jeff has an error in multiplication that he quickly corrects. Helen finishes correctly. At 2:27 B.J. and Jimmy are still working. When they ask to use a calculator, Ms. Nolan says "Get used to using your head, not the machine!" At 2:32 Jimmy seems irritated because Ms. Nolan will not tell him what to do. She is nearby for support, but encourages him to make his best effort. The rest of the class begins working on the homework assignment that appears on the planning sheet for chapter three. At 2:35 a voice on the intercom proclaims announcements and students listen quietly as they finish the problem they are working and begin to gather their things so that they may leave as soon as the bell sounds.

It is one week before Christmas and the same third-block algebra class is assembling. Ms. Nolan's plan for the lesson appears on the board.

> *Take out paper and pencil.*
> *Clear your desk.*
> *We will review for test (Friday).*
> *No computer lab today.*

Twenty-one students are present and attentive as Ms. Nolan explains that "interim grades did not appear on the reports" so she writes their algebra grades on the report sheets (if the student has brought the interim report to class) or on a sheet of paper (if they have not.) Ms. Nolan then distributes a page of fourteen problems intended as a review of chapter three. As she distributes the pages, she says "you should treat this like a test. Don't sit and wait for me to go over these problems. Most of you have good interim grades. To keep those grades, you need to get a good grade on Friday's test. Please take this seriously." There are a few grumbles but students begin working and all are working quietly at 1:07. At 1:17, Rita leaves for the restroom. Two boys are signaling each other across the room and Ms. Nolan gives them a disapproving glance. They continue to work as do others in the class. At 1:20 she moves to the overhead projector in front of the room. Two students have put their heads down. "Raise your hand if you are still working." Six hands go up. Ten students appear to be finished and are sitting quietly. Ms. Nolan circulates to look at their work. She moves from one to another, speaking quietly to students about this review work or, occasionally, about work upon which the interim grade was based. At 1:27, four students

> "I always do the same thing. I'm at the board, at the overhead projector, walking around, asking individual questions, leading a discussion, leaving students alone to figure something out on their own. I think I'm predictable. My students are not."

are still working, including Rita who has returned from the restroom. Ms. Nolan is ready to begin a whole-group check and calls their attention with the announcement "If I wrote *'missing work'* on your interim, be sure to check the posted list and get your work in by Friday or it will be a zero. Let's begin reviewing. Lionel, how about #1?"

Lionel correctly simplifies by combining like terms in an expression. Ms. Nolan writes the problem on the board and talks to the students about it. "Why is 3y + -8y equal to -5y?" James explains that "we take the sign of the higher number."

"That's correct. Use the sign of the greater number. And may I add -5y + 15?"

Lionel says, "yes, it's 10y."

"No. Why not?" Ms. Nolan calls on one girl.

"Because they are unlike terms."

"Let's take the next problem. What property do we see here? It starts with a D."

A student calls out "deficiency."

"No," says Nolan. "What is it?"

Charlotte says "Distributive" at the same time that Rita does.

Ms. Nolan adds "Let's remember how to treat something like this." She writes 4(3x+8)+6. "Remember what we learned about this?" pointing to +6. "It's a tag-along number. Do not distribute to this number."

When she asks for a response to the next problem, $\frac{2n}{5}+\frac{n}{3}$, no one is correct. At this point, Ms. Nolan begins to illustrate two operations with fractions, multiplication and addition. She leads students in their recollection of the process used to multiply $\frac{1}{2}*\frac{5}{6}$ to produce $\frac{5}{12}$. Then she asks what they recall about addition using the same two fractions. As a group they reconstruct the process of determining a common denominator (6) and rewriting to produce $\frac{3}{6}+\frac{5}{6}=\frac{8}{6}=1\frac{2}{6}=1\frac{1}{3}$.

Rita says "This isn't how Mr. Wilson taught me to do fractions."

"I expect it is," says Ms. Nolan. "Mr. Wilson speaks well of you. Now, let's use this information to rework the problem at your desk. I'll check your work." She begins to circulate to monitor their progress. "Please do not share your answers."

At 1:43 Ms. Nolan asks Lionel to put his problem on the board. Rita interrupts "Let me! Let me!" Lionel goes to the board and writes the following.

$$\frac{2n}{5} + \frac{n}{3}$$

$$\frac{6n}{15} + \frac{5n}{15}$$

$$\frac{11n^2}{15}$$

I use an "error analysis and reteaching" approach when teaching algebra. (Q12)

Rita calls out, "That's wrong. Let me!"

Ms. Nolan tells Lionel "Let's look at this." She reviews the correct first two steps. "Now," pointing to the last line, "what should this be? If we were adding 6 apples plus 5 apples what would we get?"

Lionel responds "apples."

"Right. Not apples squared. Class, write this on your paper.

$a + a = 2a$ and $a * a = a^2$
When you add, do not add exponents.
When you multiply, you may then add exponents.

A girl asks Ms. Nolan a question about the least common denominator and changing fractions to like denominators. They have a one-to-one discussion and then Ms. Nolan turns to Jeremiah. "How do you multiply fractions? Wake up and tell us." He correctly multiplies fractions in the next problem and then Megan answers the following question correctly. They demonstrate using correct procedures in order to answer multiple choice problems and Ms. Nolan reminds them "Don't guess on multiple choice items. You have enough knowledge to simplify and choose."

Ms. Nolan moves to the next problem. Students must solve an equation. "What kind of equation, Natalie?"

My algebra lesson provides for active student participation. (Q43)

"An addition equation."

"And what do we do to solve it?"

"Add the opposite."

"How do we find the opposite of a number, Lionel?"

"Multiply the number by -1."

"Natalie, multiply 6.8 by -1."

"It's -6.8"

"So what do you add to both sides, Jimmy?"

"-6.8"

Ms. Nolan sends Ashley, Megan, Rita, and Charlotte to the board to solve the next three equations and one inequality respectively. It is 1:55 and she circulates among the seated students as the other four work at the board. At 2:05, they begin to check the board work together.

"Problem #7 *(8n+ 28 = 76)* is a combination. When I have a combination, I consider addition first." Students nod agreement. "This gives us 8n = 48. How do we decide whether to multiply by $\frac{1}{8}$ *or* $\frac{1}{48}$ Jeff?"

"Use the reciprocal of the number with the variable."

"What is the product of a number and its reciprocal, Jenny?"

"One."

"Megan, let's check the solution to #9 by [substitution and] using the distributive property." Megan checks her work, resulting in a true statement, -125=-125. "You could also check using the order of operations. Recall *please excuse my dear algebra student*? Now let's look at Rita's problem #10. First, she did not copy the problem." Ms. Nolan writes the problem as all students watch her. "Class, what kind of statement is this *(108 + -36n < 72)*?"

"Inequality" is the choral response.

"When do you reverse the sign of an inequality?"

Jimmy says "when you add."

Ms. Nolan frowns.

Jimmy changes his answer. "No. When you multiply."

"Multiply by what?"

"By a variable?" he asks.

"Help him, Aimee. You had trouble remembering this at first."

"When you multiply by a negative number."

"That's right. Good," responds Ms. Nolan.

"What is the reciprocal of -36?"

Someone calls out "$\frac{1}{36}$."

"No. How do you find it? Natalie?"

"I don't know." Another student says "flip it."

Ms. Nolan probes. "Is the reciprocal of -36 going to be $\frac{1}{36}$ *or* $\frac{-1}{36}$?

The class response appears to choose the positive value.

"Why? Do you get 1 when you multiply a negative number by a positive reciprocal? What is the reciprocal of a negative number going to be, Natalie?"

"Huh?"

"Huh?" repeats Ms. Nolan.

Natalie says "It will be the same."

"So what is the reciprocal of -36?"

Natalie says "-36."

Ms. Nolan says "No!" and turns to Lionel who quickly says "$\frac{-1}{36}$."

"Correct! Write this down."

$$\frac{-a}{b} = \frac{a}{-b} = \frac{-a}{b} \quad \text{but} \quad \frac{a}{b} = \frac{-a}{-b}$$

"Toby will do the next problem on the overhead." The time is 2:25 and students begin to mumble. "Do not be rude or we will spend tomorrow afternoon [after school] talking about this." Toby graphs several points on a coordinate plane and Ms. Nolan circulates to monitor student work. "If it doesn't say to make a line graph, bar graph, or scatter plot, you may choose. Kia made a bar graph. Remember your project [to design a survey and then use a spreadsheet program to graph the results] is due Friday by 2:40 [the end of class.] I will stay as late as you need tomorrow to help you get your project printed. If you wait until Friday, find someone else or another lab to print your work. Poor planning on your part does not equal an emergency on my part. I will not print on Friday. To receive credit, your project must be printed out in a hard copy format." Ms. Nolan writes the following reminder on the board.

> I incorporate computer-based activities for students (Q32) and assign independent projects occasionally. (Q49)

<u>You need:</u>
1. Your 3 survey questions
2. Your survey sheet
3. Your tally sheet
4. A bar graph for each question

It is 2:36 and students begin to stand. Ms. Nolan tells Jimmy and Aimee to "have a seat." She repeats that directive to Jeremiah. The late announcements remind students what to do in case school is canceled due to pending snow. The voice on the intercom concludes the message as the bell sounds. Students grab their jackets, books, and backpacks and hurry to catch the bus or to meet their friends for a ride home. They are chattering loudly about their plans for the remainder of the day and tomorrow, if it should snow overnight.

> "I didn't do cooperative grouping at the beginning of the year until I got a feel for the students and their ability to work in groups. Our students have not been groomed to interact socially. Later, I put them in groups. Unless we are having a test, the desks may stay in groups. I can move around them."

It is early February and twenty students are entering Ms. Nolan's algebra class at 12:55. The class still contains many of the same

students, but has been reconfigured to include students from other classes who were passing algebra at the end of the first semester. The students from Ms. Nolan's first semester class who were failing have been rescheduled to another class. All students arrive before the tardy bell rings. They are talking to their friends and taking seats in groups of three or four. Ms. Nolan notes to the observer that "these are all students with good knowledge. Some of them won't volunteer unless they are asked, but they are learning [my] new expectations." Ms. Nolan asks the class to take out their homework. They had been asked to write equations to fit a problem situation, then solve the problem using a table of values and a graph. Several students indicate that they had trouble with the homework assignment and did not see a "match" to the classwork. Ms. Nolan circulates to check their work. One student asks to stay after school for help today. Nolan writes six names on the board for Monday's after-school help session. At 1:05 Ms. Nolan speaks to the group.

"We are checking the costs of printing at two companies. Best Company charges $.02 per copy plus a monthly charge of $70. Acme charges $200 plus $.01 per copy. What should x be?"

A girl suggests "x is the number of copies."

Ms. Nolan writes on the overhead *x = number of copies.* "So what is the cost for each company? Do we know the basic cost?"

Rita answers, "Yes, Best is $70 and Acme is $200."

"Should y be an unknown in this problem?"

The class responds in unison, "no."

"What is y? What is this problem about?" prods Ms. Nolan.

"The cost of printing services," answers a boy near the window.

"So let's write a sentence or expression to describe our problem." She writes *cost of printing service = monthly charge plus* _____. "Think... what else is part of the cost?"

Several students respond at the same time, "cost for each copy."

Ms. Nolan fills the blank with *cost for each copy*. "I think you have it! So y (the cost of print service) equals what? You know that x is what we hope to find (the number of copies) and y is what the problem situation is about in general (the total cost of printing services.) Let's write an equation for Best Company costs."

A girl says "y = $70 plus" and a boy interrupts to add "2x." Another girl disagrees and suggests ".02x instead of 2x."

Ms. Nolan asks why she thinks it should be .02 x.

"If $70 is written as a whole number, then 2x says $2 per copy. Two cents would be .02x."

"That's correct!" compliments Ms. Nolan. "Who can express the printing costs for Acme?"

A boy suggests "y = $200 + .01x."

"That's right." Mrs. Nolan goes to the overhead and writes the following two equations on the transparency.

y_A = $200 + .01x

y_B = $70 + .02x

"And what is our question, Jeff?"

Jeff reads from his algebra book, "When will the costs be the same?"

"Right. How do we find that answer?"

Another student suggests "Put the values into a table."

"And what do you find?" asks Ms. Nolan.

"13,000 copies."

The table in the book suggests some values for x (from 10000 to 15000 in increments of 1000.)

James suggests "Set those two expressions as equal. If the cost is the same, isn't it true that $y_A = y_B$?"

Other students, somewhat hesitantly say "yes."

"Yes," says Ms. Nolan. "So $200+.01x = $70+.02x." She writes the equation as she speaks. "Let's solve. Remember the rules. Variables left, constants right (for consistency.) Sarah, the first move is what? Keith, please write this down."

"I don't use this rule. I use what Mrs. King taught me."

"You're not in Mrs. King's class. You should follow our rule or you may go back to…"

Keith remarks "Whatever..."

"Please step outside." Keith and Ms. Nolan speak briefly in the hallway and she returns to the room. She continues to use students to assist her with solving the equation. They transform the equation to state -.01x=-130. "What do we do now?"

"Divide by .01," says one boy.

"No" says another.

"Yes" says a third.

"No, why not?" says Ms. Nolan. There is no answer. "If you divide by .01, you would get -x and there would be another

"I spend my time trying to break habits. As I look into other classes, I may see desks facing the board and students sitting, some asleep, some taking notes, but passively learning. I want students to become more independent. When I give them something to do where they read, punch in something on the calculator, look at an illustration or graph, and come up with their own idea, they haven't had that experience. Their confidence is low. Some of student engagement is reluctance to do when they are not comfortable with the task."

step to end with x. Let's divide. Use a calculator if you wish. What do you get?"

"13,000."

"That's good. I think we expected that."

"How do we get a graph?" asks a girl.

"Did you make a table?" asks Ms. Nolan.

Several students say "yes," and others nod.

Ms. Nolan uses a transparency and fills in the values for the printing costs at both companies using the suggested values from 10,000 to 15,000 copies. "[To graph] we need ordered pairs. What are they? Allen, give me Acme."

He responds with "(10000, 300), (11000, 310)..." and so on.

"Sarah, the ones for Best."

She calls out "(10000, 270), (11000,290)..."

Allen asks "Should we start the graph at 10000?"

Ms. Nolan shakes her head. "No. Suppose I said to tell me the cost of 9000 copies."

Allen smiles "You'd be out of luck!"

"Right!" Ms. Nolan smiles too. "So, let's start with zero copies." She begins to label the axes using the horizontal axis to represent x, the number of copies from 0 to 15000. As she is setting up the y axis to represent total printing costs, Allen volunteers to plot the graph for Acme. He plots the graph correctly. "Good," says Nolan. Dave volunteers to graph the line for Best and he does so correctly. Ms. Nolan asks him to extend the line he has plotted. Students use the model to make corrections on their own graphs and Ms. Nolan circulates to check their progress.

It is 1:40 and Rita leaves to go to the restroom. Ms. Nolan offers suggestions to three students and then assigns the class to "Work #19, page 341 in your group. Please work together. Afterward, you will be on your own with a similar problem." Ms. Nolan checks on Keith in the hallway.

She returns and watches the groups working and talking. Rita's group asks for help and she goes to them, staying to answer questions for several minutes. At 1:53 she gives graph paper to another group and pauses to sit briefly with them as they discuss their problem. At 1:55 another group asks for help and she assists for a few minutes, returning to the first group at 1:59. All groups are engaged and on task. Ms. Nolan continues to circulate and monitor. At 2:05 she distributes calculators and rulers to each group. "Let's wrap this up by 2:10." Ms. Nolan goes to her computer to enter data into a table as the groups continue working. At 2:10, Ms. Nolan calls James to get

a copy of the next assignment for his group. "Your group can begin with problem #1."

At 2:14, Ms. Nolan calls for attention as she moves to the overhead with a transparency showing the solution to problem #19. (Students were to set up and solve an equation, graph two lines to show the same solution, and also use a table of values to demonstrate the third method for solving the problem.) She begins by saying "I've used a spreadsheet to enter data into a table and make a graph. It looks neat. This problem involves salary. There is a base salary, which could be the minimum wage or $5.50 per hour. Then there is the commission which is that part of the total sales rung under the salesgirl's name. When does it pay her more to work for *Sun* instead of *Today's Outerwear*?"

Jeff replies "At $20,000."

"Right. If she will be selling more than $20,000 in sales, she should work for *Sun*. If she expects to sell $12,000 in one month, where should she work, Sarah?"

No answer.

"Clarissa?"

"At *Today's Outerwear*."

It is 2:20 and Ms. Nolan suggests they use the calculators on their desks. "Exactly how much pay would she get if she sold $12,000 in merchandise? At *Today's,* Jenny?"

"$1950," Jenny says.

"And at *Sun*?"

Charlotte seems hesitant. Ms. Nolan probes. "Give me *Today's* equation Charlotte."

"y = $750 + .10x"

"And the *Sun* equation?"

"y = $400 + .12x"

Ms. Nolan shows a completed table of values on a transparency. "We used the table of values to see which job pays better. Suppose we didn't have the table. We need to read a graph. How do we do that?"

Jeff explains that "you find where the lines meet. Read the graph by looking down at the scale."

Ms. Nolan asks "on the x-axis?"

"Yes, right."

"Let's see if we can solve. What is our equation?"

Jeff asks Ms. Nolan, "Wouldn't it be an inequality?"

"Wow! You're right." As she says that, Ms. Nolan write on the board. Y_S ____ Y_T "What symbol do I need if I want to know when the pay from *Sun* is greater than from *Today's Outerwear*?"

Jeff suggests "use greater than."

"Right." Ms. Nolan fills in the blank with ">" as directed. She then writes the complete inequality.

$400+0.12x > $750 + 0.10x

Students assist her with the steps in solving the inequality to produce x > $17,500. She asks them "Why doesn't this agree with our answer from the table ($20,000)?"

"The table is in units of 5000s," answers Dave.

"Exactly! At $20,000 in sales, *Sun* is paying more." Ms. Nolan points to the graph. "But here, exactly, in our inequality we see that any amount after she sells $17,500 will pay better at *Sun*. I postponed the quiz so you could work some more on these [types of problems.] Here's a page with five problems. Everybody is going to work every problem. Write an equation. Make a table. Make a graph."

James interrupts. "Can I use a computer?"

"Sure. But be assured, on the quiz, no computer is allowed." Ms. Nolan then assigns one problem to each group to present to the class at the next meeting. "But remember, you should work them all!"

"I like 100 minutes because it lets me do a lot of different things. Some lecture, lots of individual questions, time to work in groups and [let students talk to each other], some things with technology, some investigations, also some time to start homework. What I don't like is the alternate schedule because students procrastinate."

Rita begins to collect rulers. It is 2:35 and Jeff asks, "Is this homework?" Ms. Nolan nods. The afternoon announcements interrupt the assignment. Students mumble and Ms. Nolan asks for quiet during the announcements. When they end, she reviews the directions for each group presentation. "For your problem, write an equation, show a table, and make a graph. Use at least five values in your table. Put your work on one sheet of paper. Provide a visual aid to give to your classmates when you present the problem. Exchange your phone number with your group members in the next few minutes so that you can prepare to make your group presentations the next time we meet. If you will bring me your group product, the one-page visual for your classmates, I will have them copied before class." As Ms. Nolan finishes her directions, the bell rings. Students gather their things and quickly write phone numbers or make plans to meet before the next class so that they will be prepared. In a matter of minutes, the room is empty and quiet.

Teacher Background

Ms. Nolan is a second-year teacher who has taught algebra both years. Last year she taught algebra in a short (forty-four minute) daily schedule and now she is teaching in the hundred-minute alternate-day block schedule. She indicates that she had no advance training or preparation before she started teaching in the alternate-day block schedule. "None whatsoever! One experience in college did train me to motivate students to study, take notes and ask questions in class. I was a mentor who met with other students once or twice each week to discuss any anxiety, go over their homework, and answer their questions." Nolan sees this mentoring experience as good preparation for listening and responding to students in algebra.

Distinctive Features of the Case

Development of Good Learning Habits Among Students

Ms. Nolan is a teacher who gives much energy to her job. It is obvious to an observer that she cares about her students yet is unwilling to allow them to make excuses for less-than-acceptable effort. "I spend my time trying to break habits," she says. "My students will discuss issues and answer questions because at the beginning of the year I would say 'I already know how to do this, so *you* talk to *me*. . .' Eventually someone would volunteer or I would call on them randomly." The level of student engagement in her class is high, but she is aware of situations when students have been less engaged. This generally results in her immediate attention to the issue and students returning to task. Ms. Nolan admits that "sometimes students are reluctant to engage when they are not comfortable with the task. Other times, it's apathy. The 'I-don't-care-to-figure-it-out. You-tell-me-or-I-won't-know' situation." She reflects on other impediments to student learning in the block and admits "sometimes students just get tired. In some ways, they have a short attention span. They can sit down with a Nintendo game for hours. But handling that pencil isn't the same as handling the joystick." In spite of these issues, Nolan attempts to model good habits of inquiry for her students. "I would most like to change student attitudes toward learning. I would change them from seeing me as a know-it-all to seeing me as a facilitator."

Use of projects

One of the aspects of the block schedule that Nolan likes most is the opportunity to investigate and discuss a problem in the same period. "I can include an application in class so that

students see the connection between application and theory. I can spend a couple of days in the computer lab and students actually do a project with technology. We did a survey and the students made their graphs on the computer. We are going to use the computer to graph lines and to draw conclusions from looking at a series of graphed lines. We will also do a project involving scatterplots and finding the line-of-best-fit." Some projects are individual tasks; others involve cooperation among several students.

Role of the parent in student success

Ms. Nolan notes that parent support is important to student success (regardless of the type of schedule.) She would like more parent support for students to stay after school for academic help. In one case, a parent refused to allow her student to stay after school for algebra help because he did not have transportation. Ms. Nolan offered to take the student home, but the parent declined. Later, she saw the same student staying after school for extra curricular activities. "Some parents are not requiring the students to take advantage of the time they have." On the other hand, she has received positive support from parents. "I had a student studying slope whose parent called me to say he measured the slope of the car windshield and wrote an equation. He could actually explain what he was doing and his parents were tickled pink."

Individual Perspective

According to Ms. Nolan, "Teaching in the block is hard work and requires preparation if the teacher wants to use all of the time" available. However, she prefers teaching algebra in a longer period. "There may be changes we need." Nolan suggests a daily schedule such as the 4x4 model rather than the alternate-day schedule. "We should make the changes we need in order to make the most of this block of time. We've got to be willing to stick it out. We don't stay with it. As soon as we get used to one thing, we change."

Advice to Algebra Teachers Beginning a Block Assignment

Rather than offer advice, Ms. Nolan would ask the teacher a series of questions to prompt his or her thinking. She would advise them to think about such things as "Describe your typical student now (homework habits, class participation, parent involvement and support.) Will you have any training opportunities? How about your level of enthusiasm for teaching algebra? Do you like it or was it simply given to you? You can be a phony for 30-40 minutes but you can't pretend for 100 minutes. What activities do you do now? Show and tell?

Questions? Are you comfortable with students on a one-to-one basis? The longer time requires interaction with students. Time is not a limitation if you are prepared, if you are enthusiastic, if you love what you do, if you are prepared for what you do, if you plan what you are going to do, and if you think about it after you plan."

Student Achievement

At the end of the school year, none of Ms. Nolan's students received an A; however, seven of the twenty-one students earned a B or C. Another four received a D and ten students failed (48%.)