Notes for the Teacher

Students play a game in which they find the binomial factors of quadratic expressions. Unlike the activity *Factoring Games Part One—Dynamic Algebra Tiles*, this game does not represent each problem with virtual algebra tiles. Rather, the randomly-generated problems are presented with a minimal of visual imagery to prepare students for a more abstract understanding of factoring.

Objectives:

- Students develop strategies for finding the binomial factors of quadratic expressions with a minimum of visual imagery.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

Common Core State Content Standards: A-APR; A-SSE3a

Grade Range: Grades 8–9

Introduce:

Note: If possible, start with the activity **Factoring Games Part One—Dynamic Algebra Tiles,** in which students use grids of virtual algebra tiles to find binomial factors of trinomials. Part 1 prepares students for the challenges of this second activity in which the algebra tiles are not present and the coefficient of x^2 can be negative.

Open **Factoring Games Part Two--Developing Factoring Fluency.gsp** and distribute the worksheet. Use a projector to show sketch page "Practice." Explain that this page shows a binomial multiplying machine. Ask, "What multiplication problem is represented by this model?" The model shows $(4x + 2)(-2x + 3)$. "What is the product?" Have students work through the problem, finding the partial products: $-8x^2 + 12x - 4x + 6 = -8x^2 + 8x + 6$. Press the *Partial Products* button with the **Arrow** tool to check.

Then demonstrate how to drag the blue pointers side to side and the green pointers up and down to create a new binomial multiplication problem. Create a few new problems for volunteers to solve at the computer.

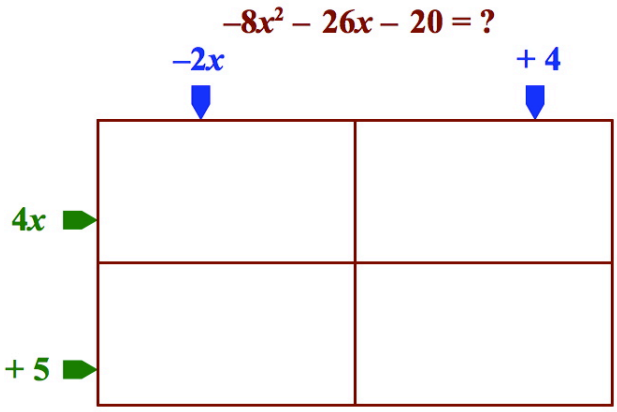
Next, go to sketch page "Game." Explain that students will play a game in which they try to find the two binomial factors of a given quadratic expression. The goal of each game is to earn as many points as possible. Each game has 10 problems, and each problem is initially worth 10 points, for a total of 100 possible points.

Point to the grid. Ask, "What two binomials are being multiplied here?" [$(4x - 5)$ and $(-3x + 4)$]

"Are these the factors of $-8x^2 - 26x - 20$? Explain how you know." Students may state that $(4x - 5)$ and $(-3x + 4)$ are not the factors of $-8x^2 - 26x - 20$ because the first term of the trinomial would be $-12x^2$, not $-8x^2$, since the area of the $4x \cdot -3x$ rectangle is $-12x^2$.

Say, "Let's try different factors. What two factors should we try?" Test students' suggestions or have volunteers come to the computer to find the factors.

Students will eventually conclude that $(4x + 5)(-2x - 4) = -8x^2 - 26x - 20$. Be sure students understand how the area of each rectangle shows the partial products: $-8x^2 - 16x - 10x - 20$, or $-8x^2 - 26x - 20$.



When the class agrees on the factors, they have two choices: If they are certain of their answer, they can press *Next Problem*. They will be taken to the next random problem to solve and receive full credit (initially 10 points) for a correct answer and 0 points for an incorrect answer. If students are uncertain of their answer, they can press *Check Answer*. Doing so will give them the opportunity to retry the problem if they solved it incorrectly, but the value of a correct problem will be reduced by 2 points with each answer check.

Also indicate the *Show Hints* button. The *Show Hints* button shows the partial products. Tell students they can press this button if they need help solving a problem, but they will lose 2 points. Tell students they can press *Next Problem*, *Check Answer*, or *Show Hints* at any point in the game.

Explore:

Assign students to partners and send them in pairs to the computers. Tell students to go to page "Game" and find the two binomial factors of the quadratic shown. Students can play more than one game if time allows.

As you circulate, observe students as they work. Keep track of the trinomials that seem difficult for students to factor. This information can help identify which types of problems students may need additional practice modeling. Make sure students record their scores and their explanations on the worksheet.

Discuss:

Call students together to discuss and summarize what they have learned. Have students share the strategies they used to find the two binomial factors for each quadratic:

- *We first focused on the coefficient of the x^2 term. We found two factors for this coefficient, and then we found two factors of the constant term. We tried different combinations of factors until we got the x term right. For example, to factor $6x^2 - 8x + 2$, we used 2 and 3 as factors of 6. Then we tried –2 and –1 for factors of 2 since the second term was negative. First we tried $(2x - 1)(3x - 2)$, but we got $-7x$ for the second term. Then we tried $(2x - 2)(3x - 1)$ and that worked!*

- *If the coefficient of the x^2 term was positive and the constant term was negative, then we had to find a negative factor and a positive factor.*

- *We knew if the x^2 term and the constant term were positive and the coefficient of x was negative, then we had to find two negative factors of the constant term.*

- *Things got confusing when the x^2 term was negative. We knew the coefficient of x for one factor had to be positive and the coefficient of x for the other factor had to be negative.*

Related Activities:

- *Binomial Multiplication, Part One—Dynamic Algebra Tiles*
- *Binomial Multiplication, Part Two—Dynamic Algebra Tiles*
- *Factoring Games, Part One—Dynamic Algebra Tiles*

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