Lesson: Multiplying Polynomials

Length: 70 minutes

Age/Grade Intended: Algebra II

Academic Standard(s):
Standard 5 Polynomials
Students use the binomial theorem, divide and factor polynomials, and solve polynomial equations.

Indicator(s):
A2.5.3 Factor polynomials completely and solve polynomial equations by factoring.
(Note: We will not exactly be finding factors of polynomials in this lesson. We will work with the factors of a polynomial by multiplying them together. This will help students as they move into factoring during a later lesson. There is no indicator which directly corresponds to simplifying polynomials by multiplication.)

Performance Objectives:
Given the algebra tiles, the students will find the product of two polynomials by calculating the area of a rectangular region with 100% accuracy.

Given a brief background in Punnet squares, the students will use a similar idea to find the product of two polynomials with 85% accuracy.

Using the distributive property, the students will find the product of two polynomials with 90% accuracy.

Using the FOIL method, the students will find the product of two polynomials with 100% accuracy.

Assessment:
I am typically able to get a feel for the way this class responds to the material simply by hearing student reactions and fielding questions during the lecture. They are not shy about getting their thoughts and feelings out in the open. I have also prepared a brief homework assignment on which the students will have ample time to work. Based on my prior experiences with this class, most of them seem to use in-class time in a wise manner. Those who have questions do not hesitate to ask. The brief homework assignment will cover today’s lesson objectives.

Advanced Preparation by the Teacher:
The teacher will need to gather enough algebra tiles so that each student can have their own set. A little research on Punnet squares may also need to take place before the
lesson so that students who have not had biology can relate to its connection with multiplying polynomials. Finally prepare enough examples. Some students will take to this with ease; others will probably be confused. Practice is the best way to master this concept.

**Procedure:**

**Introduction/Motivation:**

Begin by asking for a student volunteer to describe how the algebra tiles were used in the previous lesson to add and subtract polynomials (*Bloom’s Comprehension*). Have a student predict how they might be used to multiply two polynomials (*Bloom’s Analysis*).

**Step-by-Step Plan:**

1. Begin by having the students draw the appropriate grid for multiplying with algebra tiles in their classroom notes. Do this before distributing the actual tiles themselves. Otherwise the students will not listen to what you are saying but rather they will be playing with the algebra tiles.

2. Give the students the following problem: \((x + 3)*(x + 2)\). This will be the problem to which we will continually return in order to verify our ways of multiplying polynomials. As a refresher of yesterday’s experience, ask someone to describe how we model \(x + 3\) using the algebra tiles (*Bloom’s Comprehension*). Model for the students what they should do with the grid they created in Step 1. Place the algebra tile model of \(x + 3\) along the top of the grid, and place the model of \(x + 2\) along the side of the grid. Have the students then draw lines at each break in their model. They will fill in this picture with the appropriate algebra tiles.

3. Ask the students:
   a. What algebraic expression have we just constructed? (*Bloom’s Comprehension*)
   b. Do you believe we have just found the product of \(x + 3\) and \(x + 2\)? How do you know (*Bloom’s Analysis*)?
   c. What shape have we formed with the algebra tiles? How do we find the area of this shape? What are the length and the width? (*Bloom’s Knowledge, Comprehension, Analysis*)

4. Have the students practice using the algebra tiles to multiply the following polynomials (*Bloom’s Application*). When the students finish, have volunteers come up and explain what they did as they model with the algebra tiles at the overhead:
   a. \((2x + 4)*(x + 1)\)
   b. \((x + 3)*(x - 1)\)

5. Introduce the second way to visualize multiplying polynomials by asking for a volunteer to describe the use of Punnet squares in studying genetics in a biology class. Show how they can be used in a similar fashion to multiply polynomials by returning to the example of \((x + 3)*(x + 2)\). Students already have a supposed answer to this multiplication problem. Use the Punnet square approach to verify this answer. You could either have the students practice with the problems they solved using the algebra tiles or with new examples. Again have student
volunteers place their solutions at the board or on the overhead (*Bloom’s Application*)

6. Quickly present the next method of multiplying polynomials. It is related to the distributive property (one which the students have encountered many times in the past). Start with a simple example of the distributive property; this could be one the students are insulted you have asked them to solve because it is too easy. Again present the problem \((x + 2)(x + 3)\). Ask for a student to describe how the distributive property might be used in a similar manner to multiply these two polynomials (*Bloom’s Synthesis*).

7. Finish the lecture with a review of the FOIL method for multiplying polynomials. Return to the example which has run throughout the entire lesson. Multiply the polynomials by demonstrating that we are finding the product of the first, outside, inside, and last terms. Ask students how this method is similar to the Punnet squares method and the distributive property (*Bloom’s Analysis*). Provide the students with a pneumonic device for remembering the FOIL method (a face we can call George).

**Closure:**

Finish the lesson by having students critique the four methods for multiplying polynomials. Lead them to consider questions pertaining to complexity and efficiency (*Bloom’s Evaluation*). The remainder of the period can be used to begin the assignment and prepare for the next day’s quiz.

**Gardner’s Theory of Multiple Intelligences:**

*Logical-Mathematical:* Multiplying polynomials, combining like terms

*Visual-Spatial:* Using algebra tiles to visualize the parts of a polynomial, using Punnet squares as a way to organize the various products one has to find when multiplying polynomials, providing the pneumonic device for remembering the FOIL method

*Verbal-Linguistic:* Providing opportunities to explain how to multiply polynomials using the various methods to the larger class

**Adaptations/Enrichment:**

This lesson is designed for students who may struggle with the thoughts of what it means to multiply polynomials because they are being with four “different” strategies for finding that product. These students can be given a handout which shows an example of each method being used with the same binomials. This may facilitate understanding and increase comprehension when they are asked to try out the methods with different polynomials. Students who seek enrichment can explore how to solve multiplication problems containing polynomials of increasing degree. They can explore connections between these problems and the ones covered throughout class (multiplying binomials). I do not anticipate students in this class, however, seeking any sort of enrichment.

**Self-Reflection:**

- Did I meet my objectives?
- What feedback did I receive from students (whether through direct verbalizations or indirect nonverbal communication)?
- How might I change this lesson in the future?
• The lesson remains pretty lecture-oriented. This class seems to enjoy that so do I need to increase the hands-on features?