# Polynomials

Get More Math has a lot of polynomial problem types. Here is a guide for choosing ones that suit your needs. You may also get some insight into some GMM features and organization.

Finding Problems

There are two main ways to find polynomial problem types. They are listed in the **Problem Bank** and the more selective collection, **GMM Algebra Curriculum**.

To find either source of problems, first select the **A** tab. **Problem Bank** is selected by default. Type 'Polynomial' in the filter, then follow the highlighting:
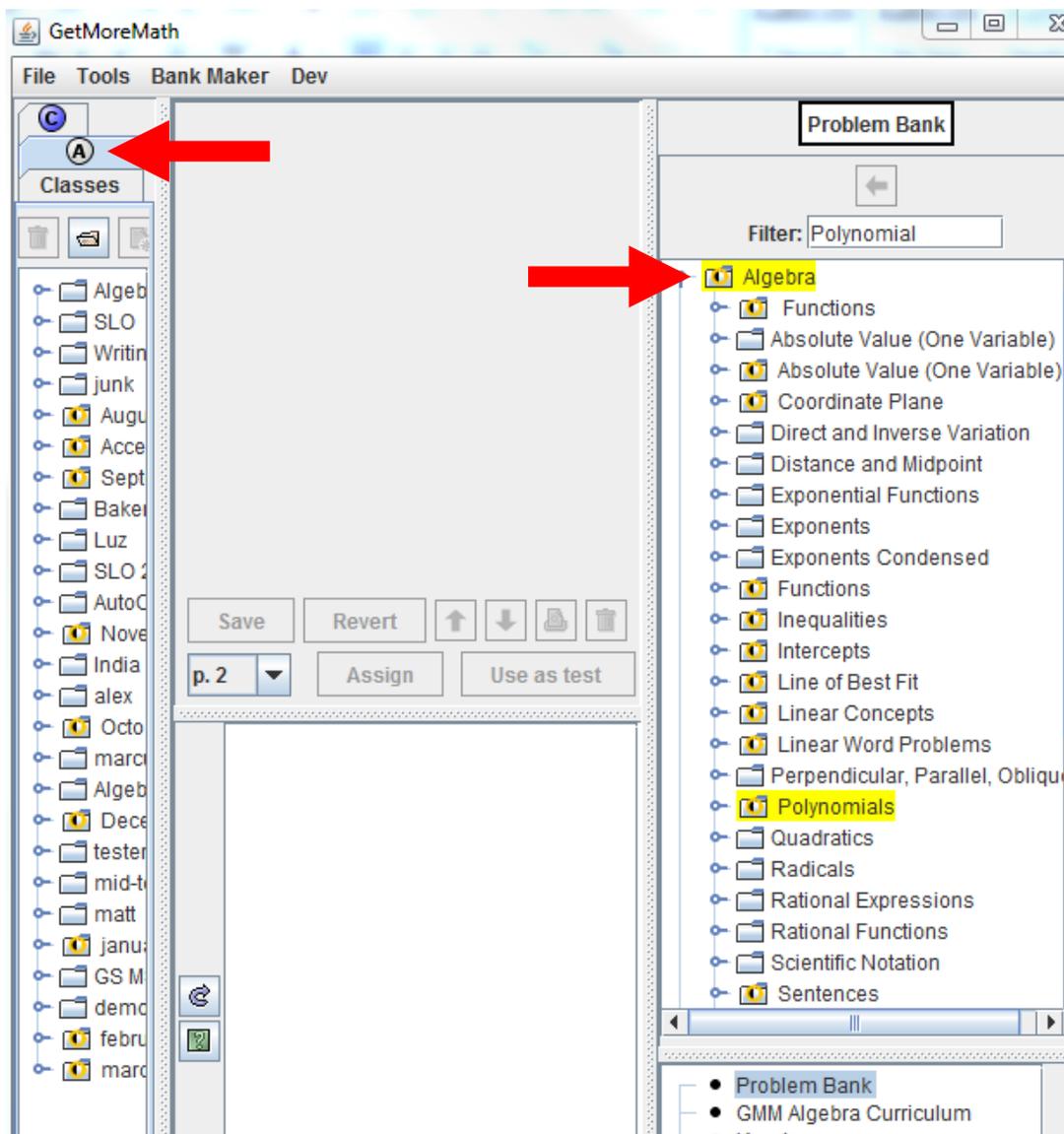
You will find many polynomial skills in **Problem Bank**. Click them to see examples in the bottom middle of the screen.


Our intent is to provide you with choices so you can tailor your GMM use to your curricular needs. However, you should *not* use all of these! That would take up too much screen real estate and also hinder student progress.

You can limit your view to only see the skills we use in our GMM classes. With the **A** tab still selected, in the bottom right corner click on **GMM Algebra Curriculum**. Click on the tiny handle next to the Polynomials unit, then you can see each 'lesson' we teach. Open a lesson to access the GMM skills for that lesson, as well as the PowerPoint we use for it.

Entering Polynomial Answers

You can use the mouse to click on the power icon when you need to enter a power:

However, you can save a lot of time with hot keys. Use ctrl-p to enter a power, then the right arrow to move back down out of the power.

Polynomial Vocabulary

Our first lesson covers polynomial vocabulary skills. They are listed in the lesson named "Polynomial Basic Concepts." We usually make an assignment with the skills shown below. Note that we set the **Points to finish** at 20.
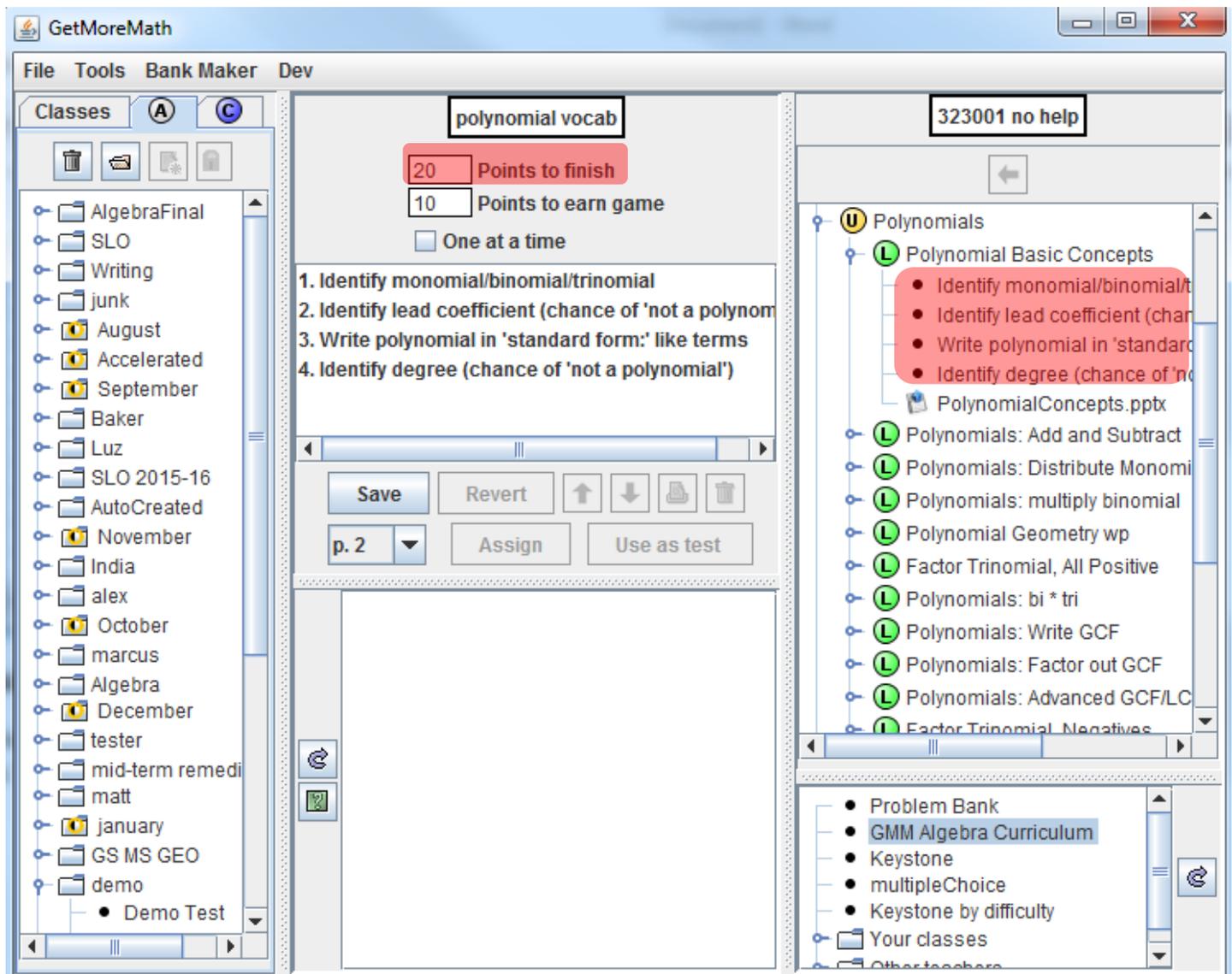
Also note that when we **assign** this assignment to a class, we do NOT add to Priorities (see below). While we care enough about these concepts to ensure a basic early understanding via a one-time assignment, we do not rate them as long-term 'Priorities.' We will use polynomial vocabulary in class discussions from this point forward: that should be enough ongoing review.
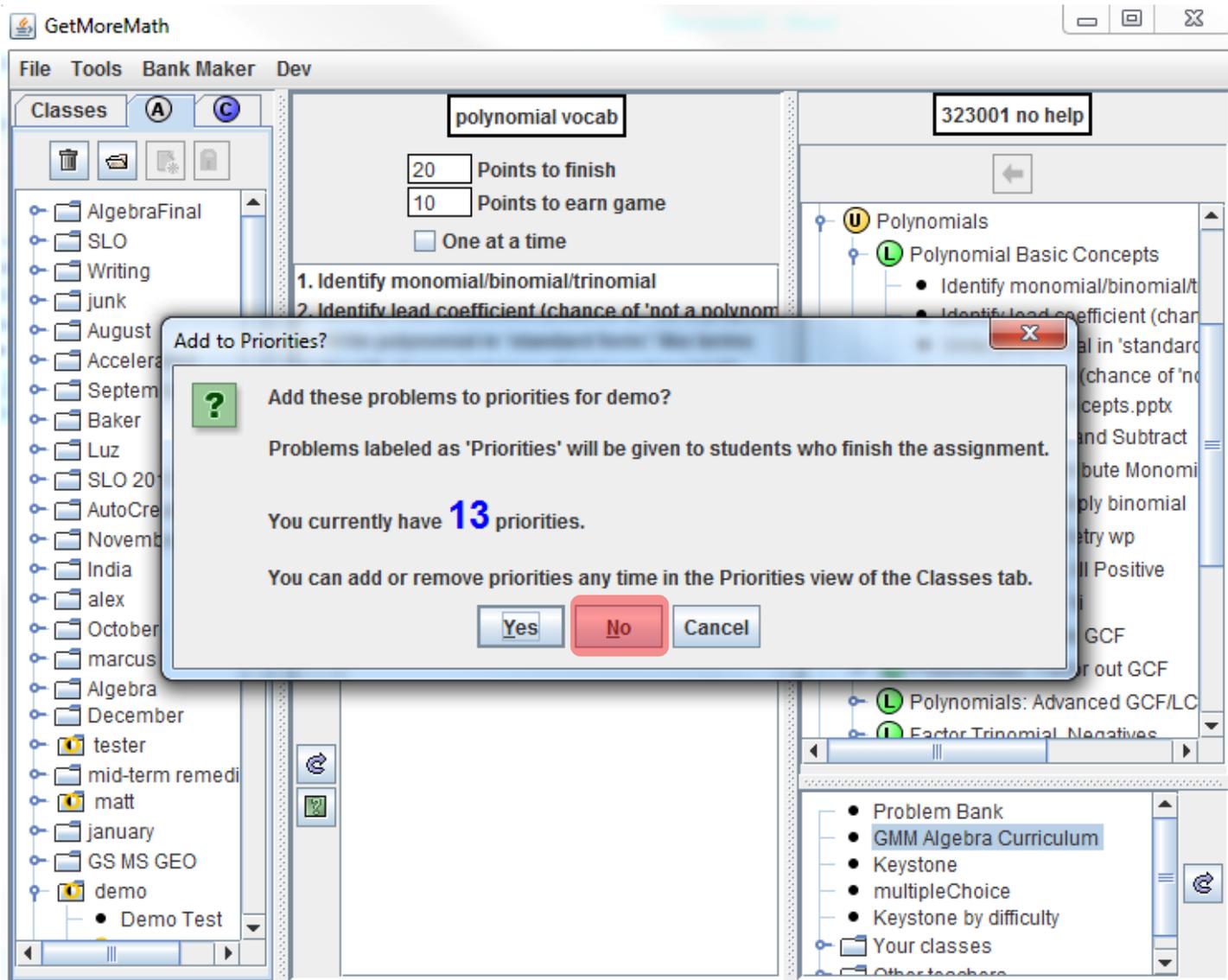
*** If this is the FIRST assignment you've ever given, you should choose YES when you see the above message!

Adding and Subtracting Polynomials

We have three paths for teaching addition and subtraction of polynomials. Each path targets a different level of student.

Challenging

For our strong students, we teach an adding and subtracting lesson with a few basic examples. For the curious, you can access the exact examples on the PowerPoint.
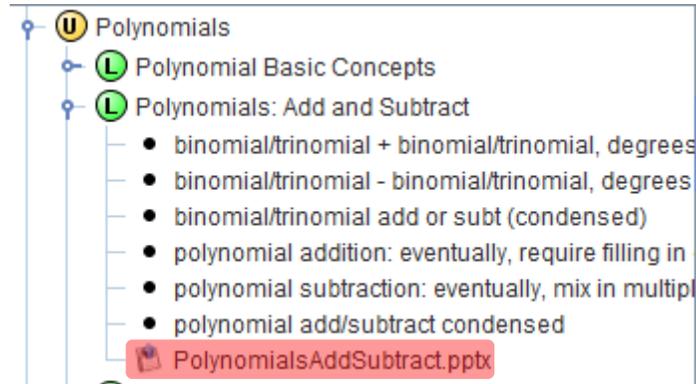
We create an assignment that uses the two types of skills shown below:
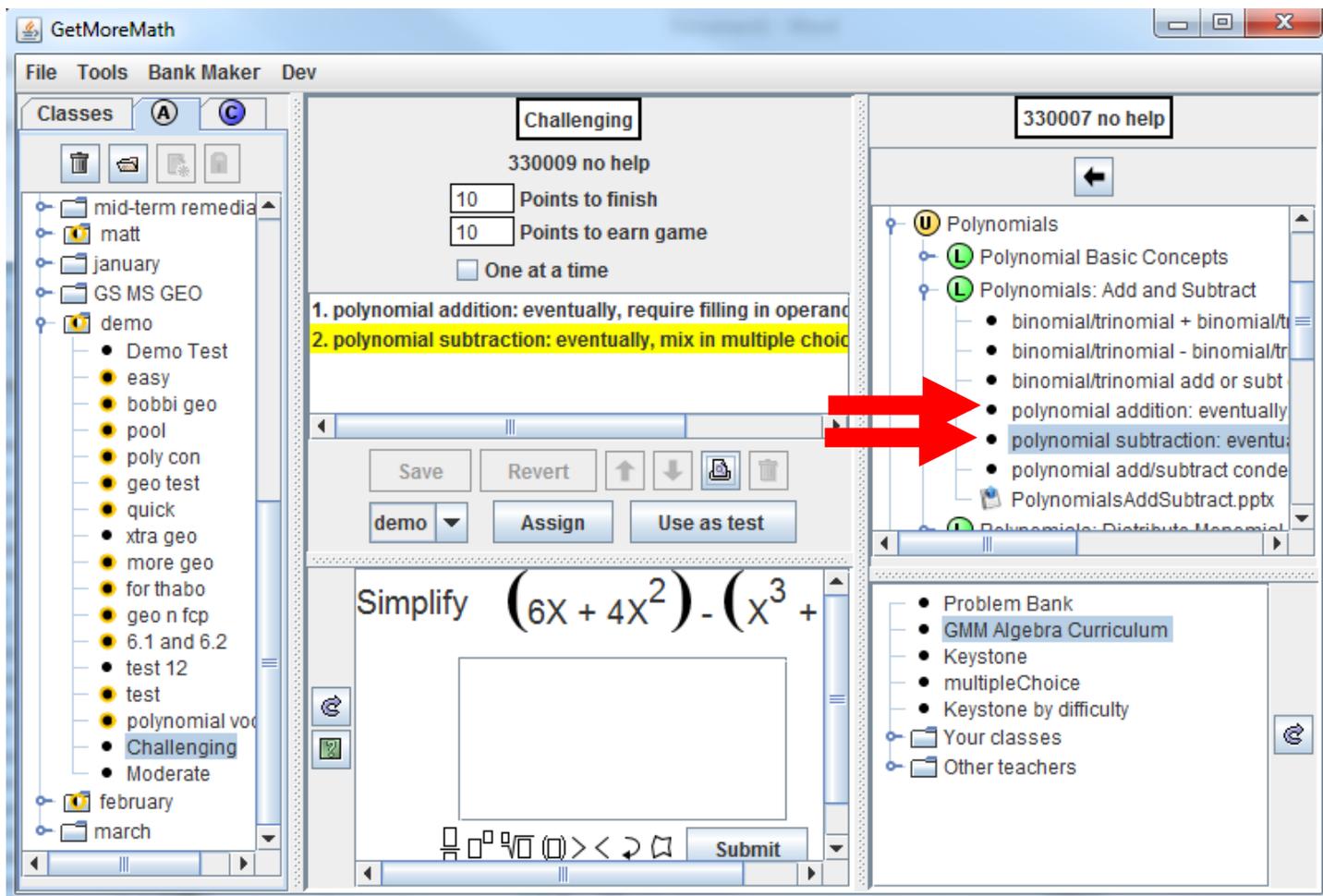
Here is the beauty of these skill variants. After a few simple add/subtract problems, GMM will sporadically include alternately worded questions such as the following. We do NOT show any examples like this ahead of time. It is up to the students to independently figure out how to apply the new ideas in these alternately phrased situations.

Gretta started with this polynomial: $4X^3 - X^2 - X$

She added another polynomial.

The sum was: $4X^3 + 4X^2 - 3X - 1$

What was the second polynomial?

Finn started with this polynomial: $2X^2 + X + 3$

He subtracted another polynomial.

The difference was: $5X^2 + 3X + 6$

What was the second polynomial?

- [ ] $3X^2 - 2X + 3$
- [ ] $3X^2 + 2X + 3$
- [ ] $-3X^2 - 2X - 3$
- [ ] $-3X^2 - 2X + 3$

Moderate

For students who may need a little more preparation before they hit problems like the ones shown above, we teach the same lesson, but then give an assignment that covers only basic variants.

At a later time (maybe a day, maybe a week) we might remove those two types from Priorities, and then assign the assignment shown in the Challenging section, above. When we did this, we would monitor student progress to see which students are able to independently figure out the new 'tough ones.' After a while, we would teach a lesson to the students who could not work them out on their own. The students who could work them out independently would stay at their computers (skip the lesson). We love not wasting student time!

Lower Ability

With our lowest students, we would start with the same assignment as the one shown above in the Intermediate section. However, before eventually transitioning to the harder variants (the Challenging assignment), we would explicitly prepare the entire class with an additional addition/subtraction discovery-based lesson. We would provide lots of support and practice so that we knew all students were well-prepared before we sent them to computers for the harder types. Otherwise we would be in for a train wreck (lots of stuck kids, penalties, and frustration).

OR

With a very weak group, we might never introduce the harder variants.

Condensing (You'll need this when you are more experienced. Read now for exposure.)

Eventually (a month or two later) we remove the adding and subtracting skills from Priorities and add the single skill that condenses those two. For any group that has had the challenging problems, here is what that would look like. Choose the **Classes** tab, then click on the small 'handle' next to a class, then click on Priorities:

Next, click on the **C** tab near the middle of the screen (see above).

Click on **Click to Load Curricula**, then click on the small 'handle' next to the word **Curricula**. Navigate to **Britton, Josh** and then select **GMM Algebra Curriculum**.
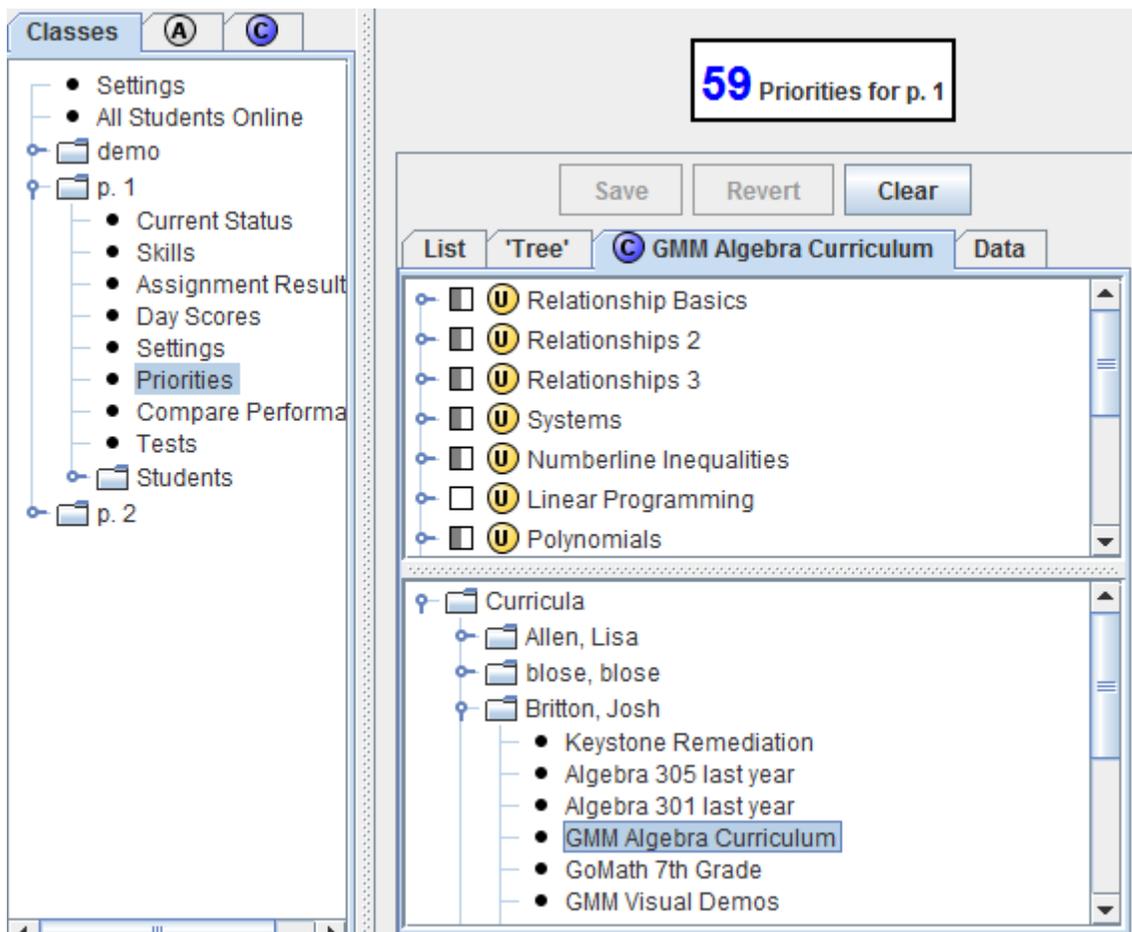
Navigate to the Polynomials unit, deselect the addition and subtraction skills, and select the condensed version. Then click **save**.
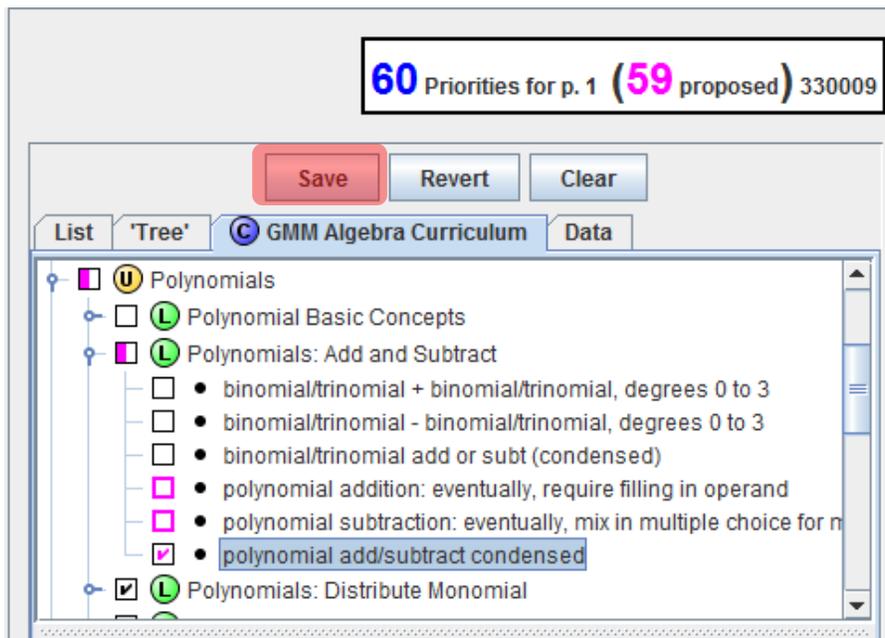
Multiplying Polynomials

We like to start with a monomial times binomial or trinomial lesson:
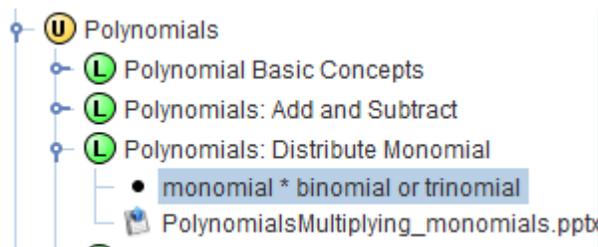
When we teach the concept, we only do 'vanilla' examples (regardless of level), but be warned: after a few successful problems, students will encounter the same concept in an alternate format. We prefer to encourage them to sort this out for themselves, rather than rely on teacher explanation. However, we usually find in our lower groups that a subgroup cannot decode the alternate format problems. We teach this group separately, either one-on-one or in a break-out lesson (while everyone else stays at computers).

Vanilla	Alternate

Vanilla:

Simplify $3X^4\left(3X^3 - 5 + 7X^2\right)$

Alternate:

For which value of Y will the following be true:

$$-4X^Y\left(7X^2 + 4X^3\right) = -16X^7 - 28X^6$$

☐ 1

☐ 2

☐ 3

☐ 4

Our next lesson covers binomial times binomial, using this problem type:

- U Polynomials
  - L Polynomial Basic Concepts
  - L Polynomials: Add and Subtract
  - L Polynomials: Distribute Monomial
  - L Polynomials: multiply binomial
    - • binomial multiplication, condensed
   - 📄 PolynomialsMultiplying_binomials.pptx
  - L Polynomial Geometry wp
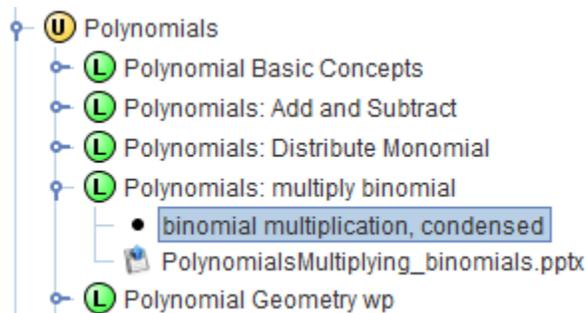
Next, we spend a few days on 'Polynomial Geometry.' This is really just a chance to nurture early polynomial operations questions with alternate formats. As with the prior lessons, we find that many students are capable of mastering these two skills without ANY teacher talk or formal lesson. Sometimes we say: "A new type of problem is about to show up on your screen. See if you can figure out how to handle it. If you can't, come over here for a lesson." Here's where to find the problems and what they look like:

- U Polynomials
  - L Polynomial Basic Concepts
  - L Polynomials: Add and Subtract
  - L Polynomials: Distribute Monomial
  - L Polynomials: multiply binomial
  - L Polynomial Geometry wp
    - • Find area or perimeter of rectangle given algebrai(
    - • Find area of shaded region. Requires computing
    - 📄 PolynomialsGeometry.pptx
 - L Factor Trinomial, All Positive
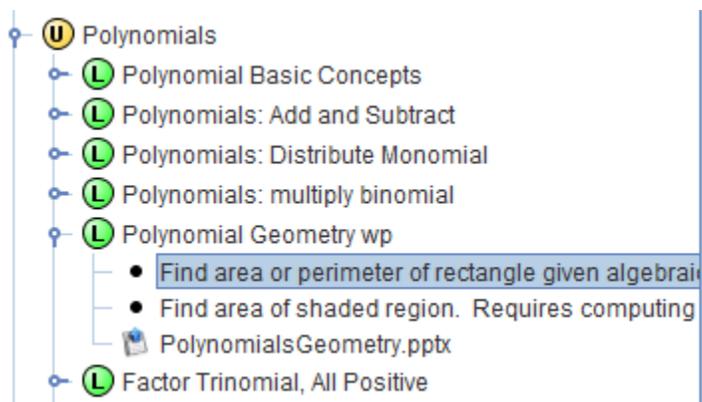
Day 1

The dimensions of a rectangle are:

X - 3 and -2X - 6

Write the simplified expression for the rectangle's area.

Write the simplified expression for the rectangle's perimeter.

X - 8

X + 6
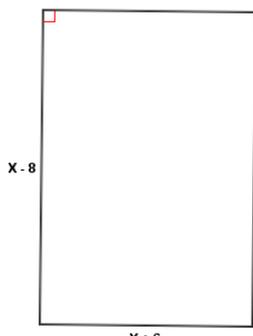
Day 2

Write a simplified expression for the shaded area.

3X + 8   2X + 7

-4X

-3X
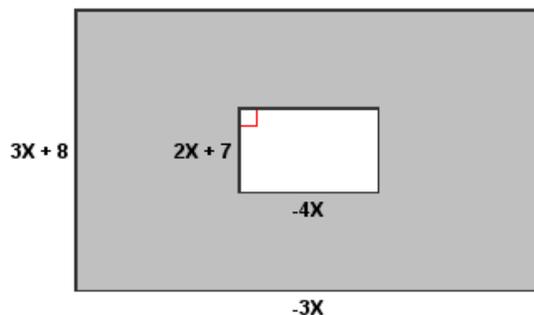
Factoring

The next few paragraphs are not really about GMM. Skip them if you just want the nuts and bolts.

Next, we plunge into factoring. In our opinion, it is possible to 'teach' factoring trinomials without ever formally teaching to about 90% of our students. They figure it out for themselves!

Here's how I (Josh) get that to happen. First, I have them do an assignment on GMM with about 4 multiplying binomials problems. They learned this skill several days earlier. Once everyone is done (all students have been shifted to Priorities), I tell them we have a pop quiz on multiplying binomials, but to make it a little easier they can take the quiz as partners.

While announcing the quiz, I get out a stack of small posters clearly marked 'ANSWERS' on one side. I make sure they can see that word, but also that I can't, so they have the impression that I am mistakenly about to show them a bunch of answers. Then when they have numbered a blank paper and are ready for the quiz, I turn around the first poster and pretend to be surprised to find a trinomial answer there. "OOOPS!" I frantically look around for the quiz questions, but can't find them!!! Then I suggest that since the quiz is ruined, maybe they can help me rebuild it. I leave the first answer trinomial where they can see it and simply say: "I got this when I made the quiz this morning. I multiplied two binomials, and this was the answer. What were the binomials?"

That is ALL I ever have to do to get almost every student up and running successfully with factoring!

There are a lot of factoring skills listed in GMM. Here are the three we use. We don't get to the second and third until several days after the first.