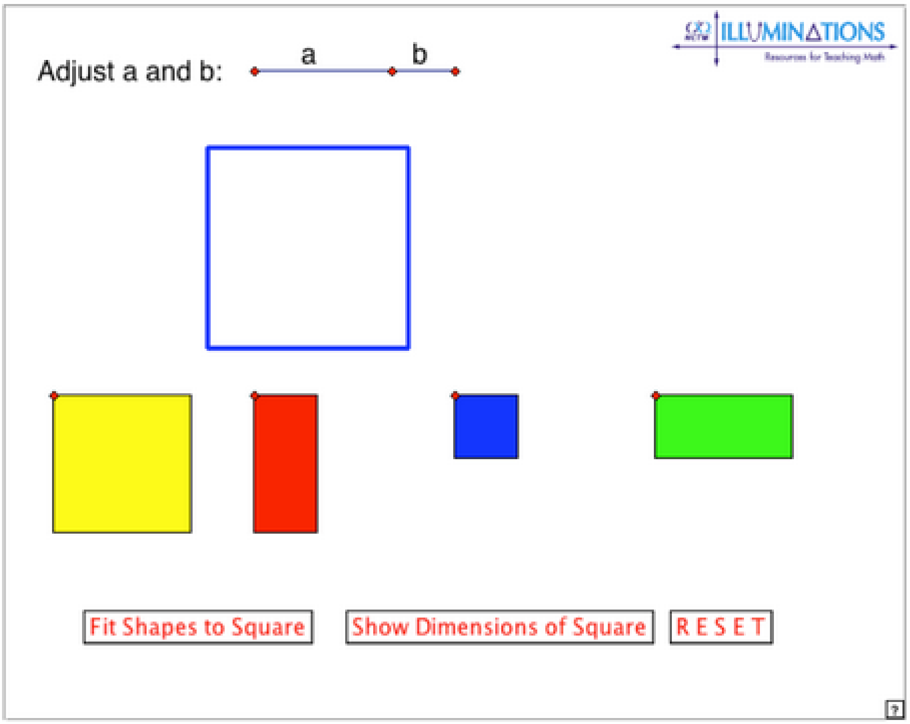
[Geometric Investigation of (a+b)^2]

Curator: Stephanie Donelko



This Illuminations activity depicts a geometric representation of (a+b)^2 in order to show that the expanded version does not equal a^2 + b^2. One can manipulate the size of lengths (a) and (b) by moving the slider. The technology displays the dimensions of the square as well as the expanded area of the square.

Grade Level: Grades 8-10
PSSM Content Standard: Algebra: use symbolic algebra to represent and explain mathematical relationships, understand the meaning of equivalent forms of expressions, equations, inequalities, and relations
CCSSM Content Standard: CCSS.Math.Content.HSA-SSE.A.2 *and* CCSS.Math.Content.HSA-SSE.A.1
Math Content: binomials, multiplication with binomials, perfect squares

Evaluation

What is being learned? What mathematics is the focus of the activity/technology? Is relational or instrumental understanding emphasized?

The focus of this activity is to show the geometric relationship between (a+b)^2 and the computational relationship. One learns that (a+b)^2 depicts a square geometrically. Those who use this technology can experiment with different sizes of a and b and see that they still make up a square area. The understanding that is emphasized is a relational understanding. Students can make a connection between the algebraic understanding of (a+b)^2 and the geometric (visual) meaning of (a+b)^2.

How does learning take place? What are the underlying assumptions (explicit or implicit) about the nature of learning?

Learning takes place when students recognize that (a+b)^2 resembles a square area with side lengths of measure a+b. Students can individually place the squares to make the square or they can have the activity do it for them. They can then display the total area of the square with the dimensions displayed. The assumptions are that students will explicitly see the connection between the geometric representation and the algebra behind expanding perfect squares. When students see the connection they will hopefully always remember to appropriately distribute the dimensions when multiplying and not apply properties of exponents in order to find the algebraic value of (a+b)^2.

What role does technology play? What advantages or disadvantages does the technology hold for this role? What unique contribution does the technology make in facilitating learning?

This technology allows for students to play with algebra tiles to create a geometric representation of an important algebra concept, perfect squares. The advantages of using this technology are that students can see an important relationship that often goes unseen. They can utilize the slider to change the dimensions of a and b to recognize that a perfect square is still formed. The disadvantages of using this technology are that numerical values are not substituted for the values of a and b. The unique contribution that the technology makes to learning is that students get to experience the unique connection of an algebraic concept to geometry.

How does it fit within existing school curriculum? (e.g., is it intended to supplement or supplant existing curriculum? Is it intended to enhance the learning of something already central to the curriculum or some new set of understandings or competencies?)

Students are required to multiply various binomials together as well as perfect squares, thus by using this technology they can make a clear understanding of why it is important to expand squared binomials. This activity is intended to supplement existing curriculum and instruction. It is intended to enhance the current curriculum by providing a visual context for students to relate the mathematics to. Students can make a connection to mathematics they have already learned or experienced. This technology will also prepare them for geometry courses.

How does the technology fit or interact with the social context of learning? (e.g., Are computers used by individuals or groups? Does the technology/activity support collaboration or individual work? What sorts of interaction does the technology facilitate or hinder?)

This technology promotes collaborative work in that students can work together to create a perfect square and to model the area by expanding two binomials. Students could work independently or collaboratively on computers in order to complete the activity. Students can have quality discussions about why a perfect square is created and how the mathematics plays out to make this happen.

How are important differences among learners taken into account?

Differences among learners is taken into account in this technology by providing a visual for students to connect algebraic concepts to. Students who need a visual representation to see why (a+b)^2 = (a+b)(a+b) can utilize this program to see the geometric explanation.

What do teachers and learners need to know? What demands are placed on teachers and other "users"? What knowledge is needed? What knowledge supports does the innovation provide (e.g., skills in using particular kinds of technology)?

Teachers and learners need to know that the values of a and b can be changed using this technology but are not explicitly depicted with numerical values. This technology is easy to use and navigate and provides both the algebra and geometry behind the mathematics being displayed. Students utilize spatial reasoning to correctly place the individual quadrilateral pieces into the larger square. The activity also supports basic technology use.