Instruction matters!

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Vocabulary & Notation

A newsletter for middle school math teachers addressing best practices

Vocabulary & Notation

A certain amount of thoroughness, precision, and formality is required in mathematics and specifically in terms of vocabulary and notation; these are the building blocks of concepts and therefore their correct use is vital. So while initially introducing new concepts in familiar language should be encouraged, by the end of the lesson, more formal language should be used to describe the mathematics.

Mathematics notation is a system of shorthand for the language of mathematics. This notation utilizes symbols to denote quantities, relationships, and operations and has evolved over time to enable us to show the manipulation of data and ideas. Notation enables us to designate mathematical concepts and processes with precision and clarity.

According to the research, there is no more single important factor that affects student achievement than vocabulary and notation. All too often student difficulty in mathematics is a direct result of a lack of understanding of the vocabulary and notation. For example, when algebra students are asked to find the degree of a monomial, $5x^2y^3z^4$, many are unable to do so. To find the degree of a monomial, you merely add the exponents. The answer is 9. It is not that the mathematical concept is difficult, but rather students do not understand what the question is asking. Therefore, the precise use of vocabulary and notation is essential.

Knowing and understanding vocabulary and notation teacher modeling; students seeing it, saying it, reading it and writing it. There is, and should be, an expectation that students can understand, read, and write mathematics. Students in elementary school should be able to read 16.023 as sixteen and twenty-three thousandths – not sixteen point zero, two three. Similarly, secondary school students should be able to read $_nP_r$ as a permutation of n things being taken r at a time – not as "npr".

Clearly, this falls under the category of language acquisition. Students not acquiring the vocabulary and notation will have great difficulty on high stakes tests. And teachers need to remember, this is not just a problem for non-English speakers, it's a problem for all students.

Without direct, explicit instruction, students will translate four less than a number as $4 – n$ because they are very literal and will translate the phrase into mathematics from left to right as they read it from left to right. The correct translation is $n – 4$.

The words we use in a math classroom are used differently outside of school. When we think of mean, we are thinking of measure of central tendency, kids might be thinking about a person they think is not nice. Operations in math typically look like computations, outside of school, operations might have something to do with surgery. Volume in a math classroom is about capacity, at home it might be about the TV or IPOD.

Assessment

Students know what teachers value by what is tested. If vocabulary and notation are not tested, students will place little value in learning it. That deficiency will result in diminished scores on achievement tests.

Division by Zero

Definitions allow teachers to explain the "why" behind many of their questions. For instance, most students know they are not allowed to divide by zero. The reason most often cited for this rule is *my teacher said so*.

By using a concrete example, then generalizing that using variables, often times we can make these rules make sense.

By definition we know that 8/2 = 4 if and only if 8 = 2 x 4

An *if and only if,* abbreviated "iff", statement means the statement is true and its converse is true. Generalizing that, we have **a/b = c iff a = b x c**

Using that definition, 8/0 = some number, or 8/0 = # iff 8 = 0 x #. Notice that 8 will never be equal to zero times some number. Because dividing by zero does not meet the conditions set forth in the definition, we are not allowed to divide by zero. Its that simple.

Adding Fractions

Many students like to add both numerators and denominators when adding fractions. Again, many students don't understand why they can not add the denominators – they only know they were told they can't.

Again, a good definition would resolve that issue. If student were taught **a fraction is part of a unit, made of a numerator and denominator, and the denominator described how many equal parts made <u>one whole unit</u>,** the students might be less likely to want to add denominators. By adding the denominators students would be able to see that sum was more than one unit and does not meet the conditions set forth in the definition. Therefore, you don't add denominators when adding fractions.

When students encounter difficulty in understanding mathematics, my suggestion is to go back to the definition. My second suggestion is make sure you test students on vocabulary and notation if you are serious about increasing student achievement.