Specificity and Correctness: Necessities for Reaching and Assessing the Goals and Outcomes of the WNCP

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The content of this article is based on the assumption that without the use of specific, nonsubjective language and correct mathematical terminology, many of our students could experience difficulty as they try to reach the goals and outcomes of the Western and Northern Canadian Protocol (WNCP). The examples used here have been selected from comments on assignments made by teachers and teachers-to-be, from comments overheard at conferences and meetings I have attended, and from statements found not only in newspapers but also (I am sad to say) in many professional journals.

Statements of a general nature—and I am going beyond those that end in *etcetera* or *blah blah blah*—tend to be part of our everyday conversations. There are many times when I ask (or am tempted to ask), "What do you mean?" or "What options or what examples might you have in mind?" For example, a degree of specificity would be advantageous in statements that include phrases such as *will be there shortly, won't be long* and *will be right there,* especially when one is waiting for a taxi or assistance of some sort.

Statements Related to Assessment

A lack of specificity and a degree of subjectivity are present in many statements that involve aspects of assessment in the mathematics classroom. Students' comments are sometimes referred to as being "very clear" or indicating "good understanding," "logical estimation skills" or "deep knowledge." These examples begin to illustrate my concern. There is no doubt in my mind that these descriptions can sound impressive; however, interpretation of intent is not possible. The levels of clarity, understanding, estimation ability and knowledge that those making the statements have in mind are not known. Even if a list of categories were included, any interpretation would involve a high degree of subjectivity and would likely differ from one person to another.

Many checklists and assessment rubrics suggested for use in the mathematics classroom include descriptors of the type *rarely, sometimes* and *often.* If those who are trying to use scales of this sort are not told what, for a given grade, might be considered *rarely, sometimes* and *often,* a range of differences for classifying responses is sure to exist. Some of those differences could be related to such things as years of teaching experience and background knowledge in the subject area. Familiarity with the curriculum and the specific learning outcomes for a grade (as well as for the previous grades) should allow teachers to be specific and make numerical suggestions, or at least a range of numerical suggestions, for categories of this type.

Since conceptual understanding and number sense are two important WNCP components of mathematics learning, parents should be informed about their child's progress in those areas of numeracy. Reports should be specific, and any degree of subjectivity should be avoided. It may be tempting to generate impressive-sounding statements such as "Abby has good conceptual understanding" and "Ryan is developing number sense." But these statements do not tell a parent anything about learning outcomes that have been met or any indicators of the child's conceptual understanding or number sense that have been observed and collected.

I believe that many proposed assessment criteria and many current examples of assessment statements are much too general and therefore meaningless—and that includes some statements that have been published and recommended as effective and appropriate.

A colleague (who teaches measurement and evaluation courses) and I have on occasion examined teachers' report card remarks. Close scrutiny has revealed that little, if any, specific or valuable information about students' performance and abilities is provided. My colleague shared his insight on the following three comments, each intended to tell parents something different about their child's adjustment:

- "Your child is adjusting to the routines and procedures of the full-day kindergarten program."

- "Your child has adjusted to the routines and procedures of the full-day kindergarten program."
- "Your child is having difficulty adjusting to the routines and procedures of the full-day kindergarten program."

He suggested that a parent who received one of these comments without seeing the others would not know whether anything was wrong—or right, for that matter. I agree. Without indicators that describe aspects of adjustment, the statements are empty and meaningless.

The following have been recommended as effective statements, but as my questions show, they are too general:

- *"The child is developing a better attitude toward ..."* Better than what? How was this change in attitude assessed? What were some of the indicators?
- *"The child is learning to be a better listener."* Better than what? How was this conclusion reached? What are some areas of difficulty right now?
- *"The child is learning to be careful, cooperative and fair."* Why list all these important characteristics in one statement? Are all three currently lacking? How was the learning observed?
- *"The following suggestions might improve the child's ..."* Why the caution? What might the possible improvement depend on? If the teacher is not sure about a suggestion for improvement, how can it be of help to a parent—or to most parents?
- *"The child needs to apply skills to all written work."* What are the skills? What is included in *all written work?*

It would be interesting to see readers' reactions and the questions they would pose about suggestions such as "Megan needs to work democratically with others," "Brandon needs to be urged," "Jessica is maturing" and "Please try to encourage Matthew to do things on his own." Teachers-to-be have shared some interesting and sometimes even amusing reactions with me.

Perhaps these and other general statements are a result of some of the vagueness and subjectivity found in the assessment strategies and rubrics recommended for use. The following information comes from rubrics provided by various authors in the Spring 2006 issue of *Vector*, the journal of the British Columbia Association of Mathematics Teachers (pp 16 and 37):

- *The category Meets Expectations is described as follows: "The work satisfies the most basic requirements of the task, but is flawed in some way. The student may need some help."* How is *most basic* defined? If something is flawed, why say that the student *may* need help?
- *A description of the category Fully Meets Expectations includes the expressions "minor errors" and "simple extensions."* What are some examples of minor errors and simple extensions? How are *minor* and *simple* defined? Without examples or definitions, is it possible to reach agreement about these terms?
- *In the category Exceeds Expectations, reference is made to being efficient.* How might we assess efficiency, or is it even possible?

In a math writing rubric, the category labelled Meets Expectations (Minimal Level) contains this statement: "May include some illogical and irrelevant mathematical ideas." How are *illogical* and *irrelevant* defined? It would be interesting to examine examples of illogical and irrelevant mathematical ideas and the level of agreement reached by people with different backgrounds. The use of the word *minimal* reminds me of a report in the local newspaper about the sinking of the Queen of the North. The fuel leak on the ferry was described as being "fairly minimal." Such a description raises questions about the meaning of *minimal.* Without any kind of reference point, the description is meaningless.

The category Fully Meets Expectations includes this description: "Usually uses mathematically sound, relevant arguments to support the main idea." How can something that occurs only "usually" be classified as fully meeting expectations? How would *sound, relevant*, and *sound, relevant* be defined, and what would be some examples of such arguments? Should all three of these phrases be in the same descriptor?

Not too long ago, we were informed by the then British Columbia minister of education that eduspeak and sugar-coated report cards for students in BC public schools were on the way out. To illustrate the intent, the minister used the following example:

> A student struggling with fractions would receive a report card stating, "Johnny needs help with fractions" rather than putting a positive spin on Johnny's learning by saying he "understands addition and subtraction and is working hard in other areas."

Aside from wondering why it is always a Johnny when a student experiencing difficulty is discussed, I think that both statements lack the necessary specificity and are therefore meaningless. It would be impossible to plan and prepare a student's IEP (individual education plan) based on an observation that the student simply "needs help." Unless the minister was misquoted (which I unsuccessfully tried to determine), the conclusion has to be that eduspeak is present in both statements. Parents receiving either of these comments would not learn anything specific about their child.

Another example of a lack of specificity is a newspaper advertisement for a math program, which informs us of the following program features:

- *"Materials correspond exactly with the learner's level of ability."* We are not told what abilities this might refer to (recall, reflective problem solving, computation, employing personal strategies).
- *"Rate of progress is determined by that student's achievement, not by the teacher."* Wow! This sounds impressive indeed, but what is the ad trying to tell us? What achievement, or achievement of what? Who determines and interprets the achievement?
- *"Material is skilfully organized into natural, coherent and logical progression, so students stay focused and are able to enjoy meaningful results."* It is tempting to request an example of materials that are unskilfully organized into unnatural, incoherent and illogical progression. The claim about resulting focus and enjoyment of meaningful results requires a lot of elaboration.

No doubt many will be impressed by these claims and tempted to buy the goods being sold.

Correctness: Expressions and Terms

In a letter to the *Vector* editors,[1] Barnes presents and discusses a common error made in the mathematics classroom: teachers' saying or writing "Consider the function *f(x)*" rather than "Consider the function *f*." Barnes asks, "Can we blame our students for getting confused and acquiring a distaste for mathematics?" A lack of specificity, along with common errors, can contribute to confusion about mathematics in students, parents and teachers.

Another error encountered frequently—during conversations, in newspapers, in mathematics references—is the confusion between *amount* (continuous quantity) and *number* (discontinuous or discrete quantity). Whenever I see the phrase *amount of people,* I try to visualize an attempt to determine mass. To foster the development of number sense, which includes the visualization of number, the manipulative materials children use must clearly illustrate discreteness. Some young children find it difficult to deal with and interpret anything presented in a row-and-column matrix. (Since it is impossible for young children to develop aspects of number sense by looking at a matrix of ordinals, the WNCP does not make reference to calendar math.)

Failing to distinguish between number (numerousness, cardinal number) and a name for numbers (numerals) can be confusing for young children and detrimental to the development of number sense, which is a key goal of the WNCP. Adults can use context to determine whether the word *number* refers to a discrete quantity or to a symbol assigned to the quantity. Young children are not able to do that. Teachers need to know what young children are thinking when they are asked to think of a number, and children need to know what to do when they are requested to use a drawing to show a number. For children who know the difference between number and name for a number, a request like "Print a number" would not make sense.

Relating numbers and names for numbers is an important aspect of the development of number sense. The language of comparisons is often used incorrectly and carelessly, and as a result many of our students (as well as many adults) are confused. They need to learn when it is appropriate to use the phrases *more, fewer, as many as, greater than* and *less than.*

Many people, including teachers, fail to distinguish between *guessing* and *estimating.* Sometimes subjective descriptors such as *intellectual, logical* or *very good* are used for these terms. There are some who combine the terms and talk about *guesstimates.* How confusing it must be for students to attempt to sort through these terms and descriptors! There is a need for clarity and correctness, and future students should benefit from the related specific learning outcomes and the achievement indicators in the WNCP.

A failure to distinguish between *figure* and *shape* also leads to a lot of confusion, as can be observed in many adults who have gone through our school system. Names of shapes are assigned to three-dimensional objects (for example, a triangular-shaped pattern block is referred to as a triangle). In references for teachers, students are requested to perform an impossible task: "Select and pick up the different triangles." If no differentiation is made between two- and three-dimensional figures (objects) and their characteristics (shape), confusion will remain throughout school and beyond.

When everyday usage of terminology differs from usage in the mathematics classroom, confusion can result, especially if students are not reminded about the differences. Use of the term *fraction* is an example. When fractions are introduced, equal regions are used—where *equal* refers to the same size and shape. At home or outside the classroom, a piece of any size or shape is often referred to as a fraction. If students are not reminded of these different usages, it is not all that surprising that a published test result showed that most students were unable to correctly select a diagram representing one-third. Only 24 per cent were able to do so by Grade 8; 43 per cent selected a diagram showing three pieces that were not equal (Lesh and Zawojewski 1988, 63–64).

Our students also need to know the difference between *design, pattern* and *design with a pattern.* Many times people say, "That is an interesting pattern," when in fact the term *design* would be correct. If no distinction is made between *design* and *pattern,* students will be confused. Students also need to know that patterns can be repeating and growing and that it is easy to change one type into the other. Patterns allow us to correctly describe a member or members of a pattern that are hidden.

Flexible thinking about numbers is an important aspect of number sense; numbers can be shown and named in different ways. This aspect allows us to avoid such a nonmathematical expression as *borrowing* (which is used differently in the mathematics classroom than it is outside of the classroom—unless, of course, one has neighbours who "borrow" something and never give it back). Some student and teacher references would identify, for example, *20 + 4* and *2 tens and 4 ones* as different names for *24,* which is not the case. They are the same. A different name for *24* would be *1 ten and 14 ones.*

Does a lack of agreement on definitions, or the inability to define terminology frequently used in mathematics and mathematics education, contribute to confusion? I believe it does. Teachers and parents talk about *the basics* without ever attempting to find out if they are thinking about the same ideas and skills. (For some surprising responses, ask several people what they think the basics are). *The basic facts* (that is, *the basic addition facts*) are an important part of the curriculum, yet few people are able to define what they are. People—including teachers—also have different definitions for *times table* (for example, some will refer to "the 6 times table"). This lack of agreement on definitions contributes to students' confusion.

Confusion can be avoided if the terminology we use is accompanied by a list of criteria or examples. It is easy to utter such important-sounding phrases as *mathematical reasoning* and *computational fluency,* but if we do not inform the reader or listener of the intent or parameters of such utterances, too many different meanings will be attached to them. Even a group of mathematics educators, who might be tempted to declare that there is no need to define those terms for themselves, would come up with definitions that differ from one person to the next—which is a somewhat sobering thought.

Conclusion

A new curriculum (WNCP) provides us with a golden opportunity to focus on specificity and objectivity and to rid ourselves of possible causes of confusion. As a result, our students and future students should and will benefit.

Allow me to pose the question, Is it possible to be too specific? As far as learning outcomes for students are concerned, no. As a speaker at a conference I attended stated, "Without specific outcomes, nothing specific will come out!"

However, two examples come to mind when I think about something being too specific.

The first example is the question, "Do you have the correct time?" The range of response options is reduced by this very specific question—even if one is tempted to utter a few somewhat facetious remarks as part of the response. What are people who ask a question like this thinking? What are they worried about?

Another example is a pamphlet on Air Canada flights that informs passengers of the ranges of the planes in the airline's fleet. The range, believe it or not, is given to the nearest kilometre, which is difficult to fathom. For example, the range of an Airbus A319 is given as 4,442 km, at a cruising speed of 837 km/h. Amazing accuracy! One cannot help but think about the number of test pilots who might have been lost trying to arrive at this result, while smiling at the lack of number sense evident when someone converts miles to kilometres with a greater degree of precision than possessed by the original measurement.

Note

1. M Barnes, letter to the editors, *Vector* 47, no 1 (2006): 7.

Reference

Lesh, R, and J Zawojewski. 1988. "Problem Solving." In *Teaching Mathematics in Grades K–8: Research-Based Methods,* ed T R Post, 40–77. Boston: Allyn & Bacon.

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