Metrication Madness and a Few Cures

by *Elaine V. Alton, Judith L. Gersting, Joseph E. Kuczkowski*
Department of Mathematical Sciences
Indiana University - Purdue University
Indianapolis, Indiana

"The metric system" is a phrase which has in recent months been chanted ever more insistently in our ears like a rising Greek chorus. We see increasing numbers of articles in the newspapers and in professional journals relating to the coming change to the metric system in the United States, the need for this change, and what effect it will have in business, industry, and education. There is widespread concern that this almost inevitable change in our measurement system be accomplished with a minimum of confusion and inconvenience. The role of this country's schools and teachers in educating children to be at home with the metric system has been cited by the National Council of Teachers of Mathematics as well as other groups and organizations. Units on metric measurement have already been incorporated into the mathematics programs of a number of school systems nationwide and are under study in others.

Along with these legitimate concerns and activities has come a veritable wave of commercial products which threatens to inundate us. Metrication has become a commercial bandwagon, an easily definable happening in which many people and groups share an interest, and one for which it is easy to design and produce profitable products. Business and industry are faced with a wide array of calculators and other devices specifically designed for conversion between metric and English units of measurement. In education there is less emphasis on conversion and more on "think metric," yet here also is a bewildering panorama of instructional materials - textbooks, pamphlets, filmstrips, manipulatives and just plain gimmicks - all purporting to aid the teacher in presenting a unit on metric measurement. Teachers and school systems faced with this mounting pile of "stuff" may be led to believe they cannot be doing a good job of instruction because they lack many of the expensive materials and gadgetry. On the other hand, and what may be even worse, they may believe that because of the large amount of materials they have acquired, they must perforce be doing a good job! We all know, however, that gadgetry is not necessarily equated with good instructional equipment.

Many of the commercially-produced materials for teaching metric are excellent. It is important, however, that we identify our objectives in teaching the metric system in order to choose out of the wide range of instructional aids available those which will truly support our objectives.

Specific instructional objectives in a unit on the metric system must be chosen by the teacher to suit his or her own classroom situation, consistent with the requirements of the department and the school system. The authors believe that one overriding consideration should serve as a framework within which to formulate these objectives. This consideration is really a matter of perspective, namely, keeping in mind that the metric system of measurement is just that, one more system of *measurement units*. We have been teaching the principles of measurement and various measurement units in our classes for a long time. We mislead our students if we present THE METRIC SYSTEM as a totally new, awesome, and exotic concept. We tend to forget that children are more adaptable than adults, and can live quite comfortably with, for example, two languages at once. Why not, then, can they not live comfortably with more than one system of measurement?

Of course, we do already teach more than one system of measurement; we teach time measurement and money measurement, for example. This is not quite the same as using two systems of units for measuring the same quantity, but these examples certainly reinforce the important aspects of any measurement system, namely, a standard of reference and the relationships between units within that system. (As an aside, the units of dollar, dime, penny, and mill in the monetary system provide a nice example of conversions within a system based on 10.)

Individual school systems and teachers will decide what respective emphasis is to be placed on metric units versus English units at each grade level, and this emphasis will undoubtedly shift as time goes on. Meanwhile, there is a nice analogy between the two systems of measurement and various systems of numeration. We can do all our arithmetic operations in any base - for example, base 5 or base 10. The latter base is more generally used, but each is a perfectly good system within itself. We do teach conversion from base 5 to base 10 but this is only a means for being able to interpret an arithmetic problem in the more familiar base 10 setting.

In summary, then, let's remember not to make too big a deal out of the metric system but to present it in context as an emerging aspect of a standard part of our mathematics curriculum. This point of view leads us to certain guidelines in the selection of materials to be used as teaching aids no matter what particular instructional objectives are decided upon. These quidelines are listed below, not in any particular order of importance.

1. The materials we use and activities we devise for teaching the metric system should be as uncomplicated and underwhelming as possible and should relate metric units to everyday objects in the child's experience. When first introducing the kilometer, for example, the fact that 1 kilometer is about 9 1/4 times around a regulation baseball diamond is more meaningful to a child than the fact that the mean distance between the earth and the moon is about 384,633 kilometers.

2. Materials should be sought which teach general principles of measurement; within this framework the metric units should be developed as one possible standard. For instance, when introducing the concept of area, we must first present the fundamental idea of covering a region of the plane by an arbitrarily chosen basic unit. This basic unit is, of course, another region of the plane and may be triangular, circular, rectangular, etc. The idea can then be developed that the area of a region is the number of times the basic unit is used to cover that region. Use of standard units such as square centimeter and application of formulas which use linear units come after the basic concept of area is established. Both physical activities which involve the measurement process and pencil and paper activities which emphasize equivalent measures should be utilized.

3. We should be on the lookout for ways to integrate the teaching of metric units into the total school curriculum. Can a science project illustrate the use of the gram as a unit of mass or weight? Can a social studies unit point out business and transportation applications of metric measurement? What about distance in kilometers sneaking into a geography lesson?

4. Instructional aids that emphasize conversion of units within a system rather than between systems of measurement should be chosen. For example, 3 meters = ? centimeters, not 3 meters = ? inches. While we do not convert between the metric and English units, this does not mean that we neglect to present approximate relationships between appropriate units. Thus, we can point out that a meter is slightly longer than a yard and a liter is slightly more than a quart.

5. We want to avoid materials which mislead our students by a careless approach to the prefixes of the metric units. For instance, emphasis on the prefix "deca" meaning 10 times as big, can, if no further explanation is provided, lead the student into the error of converting 20 meters into 200 decameters because his eye picks out "deca" and he thinks of multiplication by 10.

6. In working with equivalent measures, classroom presentations should emphasize that a certain number of a given unit, expressed as an equivalent measure using a larger unit, will be denoted by a smaller number of that larger unit. Thus, 300 millimeters is equivalent to a smaller number of a larger unit, such as centimeter; 300 millimeters = 30 centimeters. Likewise, a specified number of a given unit, expressed as an equivalent measure using a smaller unit, will be shown by a larger number of that smaller unit. Thus, 4 meters is equivalent to a larger number of a smaller unit, such as centimeter; 4 meters = 400 centimeters.

7. We should take advantage of instructional aids which present the sequence of metric prefixes as a logical continuum. Thus, one appropriate instructional goal would be to teach the following sequence of metric units of length: kilometer, hectometer, decameter, meter, decimeter, centimeter, millimeter. We can stress the theme that to convert a measure in one of these units to an equivalent measure in terms of a unit listed to the immediate right, one simply multiplies by 10. Similarly, division by 10 will convert a measure in a specified unit to an equivalent measure in terms of a unit listed to the immediate left of that unit. In addition, it should be made known to students that the millimeter is not the smallest possible unit of length in the metric system nor is the kilometer the largest possible. Presentation of the spectrum of prefixes demonstrates the simplicity of the metric system structure, even though current experience indicates that certain of the metric units will appear more often than other units. Moreover, we cannot foresee the specific metric units that may emerge as appropriate to developing technologies or occupations.

8. We want to be sure that materials we use do not irrevocably tie the metric system to computation with decimals. Some articles have been written which discuss the need to teach decimals before dealing with metric units of measurement, the implication being, of course, that either decimals should be taught at a much earlier grade level or that metric units of measurement should be delayed until the fifth or sixth grade. The fact is that students do not need to know how to use decimals in order to understand the relationships between equivalent measures in the metric system. Practice problems can easily be limited to those in which only whole numbers are involved. For example: 400 centimeters = ? meters; 40 decameters = ? decimeters; choose the larger, 23 decimeters or 2 meters. Problems such as .3 meters = 3 decimeters can be introduced later along with computation with decimal numerals.

The remaining three guidelines apply equally well to selections of teaching materials for any topic, not just the metric system.

9. Once specific instructional objectives have been chosen, care should be taken to select materials which fulfill these objectives as closely as possible. Why waste money on frills to achieve five goals of which only two coincide with the chosen objectives?

10. When searching for ways to present the metric system, existing teaching aids should be employed where feasible. New materials, just because they are labeled "metric," may not be a significant improvement over materials already in the classroom. The Cuisennaire rods which have been used for a wide variety of

activities can also be used to illustrate metric units of length, area, and volume; containers marked in liters and milliliters and scales calibrated in grams are likely to be part of the available science equipment.

11. Teaching materials can often be homemade or acquired with little cost. Perhaps a local bank or hardware store is giving away meter sticks as a publicity item. We can always create homemade games - metric bingo, for example, where a square array of metric measurements is displayed and equivalent metric measurements are called out - which can be produced on ditto sheets. Some canned goods in stores already carry dual labeling and are easily obtained as display items; these are also appropriate for a unit on consumer education.

All in all, in the flurry of newness over teaching the metric system and the competing demands for adoption of instructional materials, the teacher's own common sense remains, as always, the best guide.

****

Mathimagination

Grades IV - IX

This is a series of 6 exciting workbooks designed to provide practice in basic math skills. The practice is embedded in a variety of highly motivating puzzles and activities which make students eager to learn. Students work problems in order to decode limericks, jokes, and riddles, solve mazes, reveal hidden messages, or create pictures or punch lines. The puzzle solution is a built-in reward. The puzzles are self-correcting, since the student discovers his work is correct when it yields a puzzle solution. This feedback, plus humor, cartoons, and fun graphics, combine to make the puzzles especially motivating and effective. Drill is almost painless!

MATHIMAGINATION is available in a teacher edition designed for thermal reproduction, with the answers printed on each page in nonreproducing blue. Each puzzle focuses on a specific objective listed in a table of objectives in each book. Puzzles can be used as class assignments or to meet specific needs in an individualized program or math lab. Each book contains about 40 puzzles.

BOOK A - Beginning Multiplication and Division

BOOK B - Operations with Whole Numbers

BOOK C - Number Theory, Sets, Number Bases

BOOK D - Fractions

BOOK E - Decimals and Percent

BOOK F - Geometry, Measurement, Cartesian Coordinates

Available at:

WESTERN EDUCATIONAL ACTIVITIES LTD.
10577 - 97 Street
Edmonton, Alberta