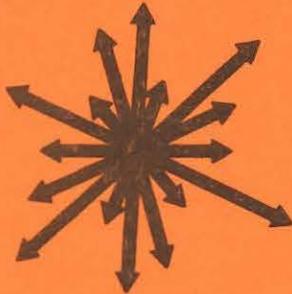


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The Metric System



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State of Iowa
DEPARTMENT OF PUBLIC INSTRUCTION
Educational Media Section
Grimes State Office Building
Des Moines, Iowa 50319

Commentary
and Review of
Selected Abstracts

on

THE METRIC SYSTEM

Prepared by

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State of Iowa
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INTRODUCTION

A METRIC AMERICA

Senator Charles Sumner of Massachusetts sponsor of the Metric Bill of 1866 stated that, "they who have already passed a certain period of life may not adopt it, but the rising generation will embrace it and ever afterward number it among the choicest possessions of an advanced civilization."¹ Unfortunately, over 100 years after adoption of this bill the United States is the only large country in the world not using the metric system in all areas of measurement.

The time is rapidly approaching when Federal law will dictate that the International System of Units (SI) be the system of measurement in the United States. A conclusion which resulted from the United States Metric Study Report was that for the United States metrication is a decision whose time has come.²

Without question the words, THINK METRIC should occupy a meaningful and high priority position in the minds of all Americans and participation in the metrication process by young and old alike should proceed in an orderly manner in the years ahead.

THINK METRIC!

Americans are being urged to increasingly THINK METRIC and to participate in metrication -- the process of changeover to the metric system of measurement in all aspects of American life.

Americans may feel that the metric system is highly foreign to the English system of measurement which is commonly used in the United States today; however, the English system is nearly the same today as when it was brought by the colonists from England. In actuality the metric system is not foreign, as it was adopted as the legal system of measurement in the United States, by Congress, in 1866.

The modern metric system of measurement now known as the International System of Units is a system dating back to 1790 and is the result of efforts to create a single measurement system to be used in all countries throughout the world.

¹Fred J. Helgren, "Schools are going metric", The Arithmetic Teacher, 20 (April, 1973), p. 265.

²Daniel V. De Simone, "A Metric America: A Decision Whose Time Has Come", National Bureau of Standards, Washington, D.C., July 1971, ED 055 884.

Metrication, when mandated by Congress, will not mean an overnight change-over to the metric system. Current proposals include a ten-year transition period, providing for a gradual shifting from the current system of measurement to the metric system. Momentum for metrication is increasing. A series of reports were written as a result of the three year metric study conducted by the National Bureau of Standards. In recent years the number of publications appearing in journals and magazines is rapidly multiplying. In addition to this, instructional aids (print and nonprint) related to the metric system are becoming more prevalent. This is indicative of the need for all educators to assume a leadership role in integrating the metric system into the total curriculum as well as selection of materials. (This packet will provide the educators with suggestions for accomplishing this task.)

The implications for educators are obvious. Through the guidance and leadership of educators and through the formal process of education in the United States lies the "key" to success in a smooth transitional metrication program in the years ahead. Metrication involves all Americans. The process will be successful dependent upon the leadership provided by educators in assisting individuals in accomplishing the changeover to a new system of measurement.

The following two articles should be helpful for educators in their metrication endeavors.

To highlight the nature of the measuring process, and to emphasize the arbitrary nature of standard units, it is advisable to begin with a nonstandard unit. For length, straws, pencils, or paste sticks are readily available and easily used. From such experience a standard unit, such as a meter, can be made from string or cardboard and used by pupils with a double goal—learning about measuring length and learning the meter as a unit.

The unit chosen should be appropriate to the size of the object measured. You would not use a kilometer to measure the length of a room, nor would you use a millimeter; you would likely use a meter.

2. *Use multiples of the basic unit, as the need arises for a larger unit, and subdivisions of the basic unit, where smaller units are needed.* By referring larger and smaller units back to the basic unit, which is well known, estimation of larger and smaller units is easier. Furthermore the construction of a measuring system becomes more evident.

Limitation of the number of larger and smaller units taught makes the learning goals more realistic and more manageable. The goal of thorough learning of a few larger and smaller units is much preferred to mere acquaintance with many different units.

3. *Limit expectations of mastery of conversions within a measuring system to commonly used units adjacent in size.* In the American system, feet are usually related to miles, and inches are related to feet; but not inches to miles. In metric, centimeters are usually related to meters, millimeters to centimeters; but very little is done in relating millimeters to meters.

4. *Use the approximate nature of the measuring process in the physical world as a theme.* Helping children to give measurements using language such as “more than 2 meters but less than 3 meters” and “a little more than a kilogram” provides experience with approximation. It also

points to the needs for smaller units and fractional numbers.

5. *Use measurement as motivation for fractions, for decimals, and for arithmetic.* There is no source of applications of arithmetic quite comparable to those that arise from measurement. An active measurement program provides a needed stimulus for learning many topics in arithmetic that are considered important to teach.

6. *Use the actual units as often as possible; avoid the scaled-down versions often found in textbooks or worksheets.* It is folly to try to teach the meter by drawing a scale version of it. Students have great trouble in responding to measurement questions and estimates using such “distorted” representations. The time for scaled drawings is much later, after the initial units are well learned and well understood.

No matter whether it is the American or the metric system, a sense of active involvement is essential. New life will emerge from measurement if simple relationships are emphasized, more estimation is done, and the process is directly taught—especially at an early age. The flavor of “hands-on” experience is much more important than anything else. Creative and interesting activities can be developed and can be used in the full range of management schemes from whole-class to independent work.

Specific guides for teaching the metric system

With an active point of view about measurement in general, what guides should be used specifically for teaching metric?

1. *In the elementary school, teach metric and American systems as dual systems.* This means that the major emphasis is on teaching the metric system in itself, with relatively little attention to the relation of units between the two systems; we want to encourage thinking within a system.

The need for American units in everyday affairs is likely to persist for some time after the adoption of metric units. Even though

primary, with the milliliter—also called a cubic centimeter—appearing in the middle grades.

Celsius temperature can be introduced at any level.

Much of the current material on today's market does not deal with the really significant concepts of the metric system and measurement. Rather, it tends to be a series of paper-pencil activities using the gamut of metric notions, without regard for the principles of estimation and measurement, or for the components of the metric system that our students will find necessary. For example, present-day metric materials often ask students to perform complicated and useless conversions within the metric system itself changing mm to m, km to dm, or mm to dm. Just as useless are exercises requiring addition of unlike units such as dm and m. Rarely are units mixed in a metric problem. Instead of using 3 dm 5 cm, the measure would be given as 35 cm. Instead of 3 m 22 cm, we would say 322 cm or 3.22 m. Poor instructional materials make the metric system seem complicated for children when it is relatively easy. Such materials should be screened and not purchased.

Metrication in the community

Schools should be expected to help parents understand the metric system. Parents will want information on what their children are being taught so they can provide reinforcement at home. School people in general, and mathematics educators in particular, should take the initiative in presenting metrication to the community. Let us not make the mistake of waiting for parents to demand it. It is our responsibility. Creative teachers can prepare single-concept handouts to send home periodically to the parents. Perhaps a metric newsletter can be developed with teacher and student input. Libraries could prepare displays of metric materials. For some school districts there is the possibility of developing parent workshops as an activity of the parent-

teacher organization. Metric education is our responsibility and we have the equal tasks of working with our students and with our community.

Conclusions

Our goal of metrication in the school program is realistic. The amount of new knowledge required is actually quite small. Success for the mathematics education community in making the change will depend on how well we follow guidelines such as those given here. It will depend on the degree to which we provide appropriate experiences for maximum development of student understanding.

In summary, these are the guidelines:

Teach students to **THINK METRIC**.

Concentrate on those units necessary from the utilitarian standpoint.

Develop meaning and feeling for units through experiences centering around estimating, and checking of the estimates.

Minimize conversions. Do not immerse students in the morass of computing conversions between the metric and American systems nor even within the metric system itself.

Use metric units at every opportunity. This includes use in other subject-matter fields. Elementary teachers—use them throughout the day. Secondary teachers—teach metric exclusively and provide inservice materials for your colleagues in other subject areas.

METRICATION IS UPON US. IT IS NOT IF, BUT HOW.

NCTM Metric Implementation Committee

Boyd Henry, *Chairman*

Stuart A. Choate

Donald Firl

4. Develop adult education courses in the use of metric measures.
5. Obtain and distribute (to local educators and community leaders) copies of the N.E.A. pamphlet, Think Metric, available in lots of 30 copies for \$2.25, stock No. 051-02242, from National Education Association, P. O. Box 327, Hyattsville, Md. 20781.
6. Here are other good buys:
 - For the price of three dollars, the following materials can be obtained from the Metric Association, Inc., 2004 Ash Street, Waukegan, Ill. 60085, a nonprofit organization interested in disseminating metric educational materials and information: One 20 cm plastic ruler; two 1.5 m plastic measuring tapes; two copies of the booklet, Metric Units of Measure; one copy of Metric Supplement to Science and Mathematics, a workbook for use by the teacher and the pupil; one GO METRIC bumper sticker; one price list of metric educational aids; an annual membership in the Metric Association, Inc., that includes a subscription to its newsletter published quarterly.
 - U. S. Department of Commerce publications: A Metric America--A Decision Whose Time Has Come (order by catalog No. C13.10:345, \$2.25) and U. S. Metric Study Interim Report--Education. This book should be "must" reading for educational policymakers (order by catalog No. C13.10:345-6, \$1.75). Both books from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Metric bathroom-type scales (they read in both kg and lb.) are available for \$9.95 each from Swani Publishing Co., P. O. Box 248, Roscoe, Ill. 61073.)
7. Beware of metric texts and teaching devices that haven't been evaluated and recommended by specialists in the field. Many extravagantly priced teaching aids are on the market, but some actually may impede learning of the metric system. Recommendation: Encourage teachers to make their own training aids. Most quart milk cartons, for example, will hold one liter. Our school bought a commercially marketed training kit for \$84. It consisted of little more than color slides and some booklets and was barely worth \$5, much less \$84.

At my school, Toll Gate High School in Warwick, R. I., we have what we believe is the first and only federally funded K-12 metric education project. (If you want federal aid, apply for a mini-grant through your state department of education.) At the beginning of the project last year, we tested nearly 3,000 children to determine their knowledge of, and attitudes toward, the metric system. Later this summer we plan to publish the test results. For your copy, write to John Izzi, Director, Metrication Project, Toll Gate High School, Warwick, R.I. 02886, and include a stamped, self-addressed envelope.

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Abstracts of
ERIC DOCUMENTS

To order entire document (in microfiche form)
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Example: ED 067 500

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ED 067 500

TITLE: Testimony of Nationally Representative Groups. U. S. Metric Study Interim Report.

PUBLICATION DATE: July 1971

DESCRIPTIVE NOTE: 173 p.

ABSTRACT: As the 12th in a series of interim reports prepared for the United States Congress on the metric system, this study was authorized by law to reduce uncertainties concerning the issue of converting to metrication and to provide a better basis upon which the Congress may evaluate and resolve it. The testimony of over 230 nationally representative groups is summarized, supplemented by information from experts in the areas of consumer activity and education. Over 700 trade associations, labor unions, professional societies, and other groups were invited to submit their opinions and cost-benefit estimates concerning a possible future conversion to the metric system. The organizational summaries are grouped into seven categories: (1) labor, (2) consumer affairs, (3) education, (4) construction (5) engineering related industry, (6) consumer-related industry, and (7) natural resources, transportation, health, small business, and others. The advantages and disadvantages associated with conversion include international standardization, consumer and industrial retraining and education, changing to new tools, and cost. However, 112 of these groups feel that a changeover is inevitable and desirable, although the complexity of the construction industry would require special planning. A majority of these groups favor a nationally coordinated program with some governmental assistance. (AG)

ED 068 330

TITLE: A History and Overview of Metrification and Its Impact on Education.

PUBLICATION DATE: 1972

PERSONAL AUTHOR: Jeffrey V. Odom

DESCRIPTIVE NOTE: 19 p.

ABSTRACT: This paper gives a brief history of measurement systems and of the controversy surrounding the adoption of the metric system as the standard system in the United States. The metric study called for by legislation in 1968 is described, and recommendations for a coordinated national program to change to the metric system are outlined. Some implications for education are discussed, with brief comments on curriculum, textbooks, teacher training, educational materials, and three general teaching suggestions. (DT)

ED 078 202

TITLE: Bibliography of the Metric System.

PUBLICATION DATE: 1968

PERSONAL AUTHORS: John T. Milek, Valerie Antoine.

DESCRIPTIVE NOTE: 88 p.

ABSTRACT: This bibliography lists 1,196 articles dealing with the metric system. Entries are arranged alphabetically by author and include the title, publication information, and date of publication. A subject index is provided. (SB)

ED 085 251

TITLE: Metric Exercises, Lively Activities on Length, Weight, Volume and Temperature.

PUBLICATION DATE: 1973

DESCRIPTIVE NOTE: 35 p.

ABSTRACT: This booklet of exercises and activities to help students learn the fundamentals of the metric system is designed for elementary, junior high school and senior high school students. It is organized under four topics (Length, Weight, Volume, and Putting it All Together Activities) and comes packaged with an ungraded thermometer, metric rulers, and a 1-gram centimeter cube. The activities and exercises can be simplified or extended to meet the needs of the class or individual students. An answer key is included as the final section. (JP)

ED 086 551

TITLE: Let's Use the Metric System: A Supplement to Mathematics K-6.

PUBLICATION DATE: 1973

PERSONAL AUTHOR: Leroy Negus

DESCRIPTIVE NOTE: 15 p.

ABSTRACT: This bulletin provides elementary school teachers with some information about the metric system and some suggestions for teaching it. A history of the development of the system is given followed by a grade by grade guide to objectives and activities to be used with lessons on measurement with the metric system. The activities stress the decimal character of the metric system and provide opportunities for the students to gain an intuitive feeling for the comparative size of the various units of measure. (JP)

Bibliography selected from

Current Index to Journals in Education

EJ 028 523

PUBLICATION CITATION: Science Teacher, November 1970, pp. 69-70.

TITLE: Experience, Key to Metric Unit Conversion

PERSONAL AUTHOR: Swan, Malcolm D.

ABSTRACT: Suggested learning activities utilizing real life experiences in order to provide students with references for estimating, measuring, and understanding various quantities and intervals for the system of measurement being studied.

EJ 046 652

PUBLICATION CITATION: Instructor, December 1971, pp. 69-70.

TITLE: Get Ready for the Metric System

PERSONAL AUTHOR: Bowles, D. Richard

ABSTRACT: A review, in question and answer format, of the background, general characteristics, and key issues pertaining to the metric system.

EJ 058 325

PUBLICATION CITATION: American Education, April 1972, pp. 10-14.

TITLE: Metrication: New Dimensions for Practically Everything

PERSONAL AUTHOR: Edson, Lee

ABSTRACT: Evidence is indicating that the U.S. is going to adopt the metric system of measurement. Although certain difficulties are anticipated, Britain has shown that major upheavals are unnecessary.

EJ 074 883

PUBLICATION CITATION: Mathematics Teacher, April 1973, pp. 297-302.

TITLE: Inching Our Way Toward the Metric System

PERSONAL AUTHOR: Vervoort, Gerardus

ABSTRACT: Different units of measurement are discussed, and an explanation of vocabulary and of units used in the metric system is given for secondary grades.

EJ 074 891

PUBLICATION CITATION: Arithmetic Teacher, April 1973, pp. 261-264.

TITLE: Metrication in Britain

PERSONAL AUTHOR: Williams, Elizabeth

ABSTRACT: The effect of metrication on the educational process is described for the first six years of schooling in Great Britain.

EJ 074 892

PUBLICATION CITATION: Arithmetic Teacher, April 1973, pp. 269-273.

TITLE: Experiences for Metric Missionaries

PERSONAL AUTHOR: Viets, Lottie

ABSTRACT: Measuring activities using the metric system are suggested for the elementary level.

EJ 074 893

PUBLICATION CITATION: Arithmetic Teacher, April 1973, pp. 280-287.

TITLE: Ideas

PERSONAL AUTHOR: Immerzeel, George; Wiederanders, Don

ABSTRACT: Worksheets for the lower grades use the number line to relate basic units of measure within the metric system. Upper level activities use the number line to relate English units and metric units. (Related citation - EJ 060 851).

EJ 076 537

PUBLICATION CITATION: Arithmetic Teacher, May 1973, pp. 390-394.

TITLE: Teaching the Metric System as Part of Compulsory Conversion in the United States

PERSONAL AUTHOR: Hawkins, Vincent J.

ABSTRACT: How conversion to the metric system can occur in our educational system is illustrated by an outline of a model program for students (pre-school through senior high school).

EJ 076 538

PUBLICATION CITATION: Arithmetic Teacher, May 1973, pp. 395-396.

TITLE: The Metric System -- Let's Emphasize its Use in Mathematics

PERSONAL AUTHOR: Alexander, F.D.

ABSTRACT: The simplicity of the metric system is contrasted with the English system. Advantages and disadvantages are discussed.

EJ 076 539

PUBLICATION CITATION: Arithmetic Teacher, May 1973, pp. 397-399.

TITLE: Bilingualism in Measurement: The Coming of the Metric System

PERSONAL AUTHOR: Bright, George W.

ABSTRACT: Focus is on teacher motivation to make themselves bilingual in the English and metric languages. Advantages of the metric system in the problem solving process and development of bilingualism through use of rule of thumb conversions are presented.

EJ 076 540

PUBLICATION CITATION: Arithmetic Teacher, May 1973, pp. 400-402.

TITLE: Metric is Here; So Let's Get on with It

PERSONAL AUTHOR: Fisher, Ron

ABSTRACT: Utilization of the metric system in the U.S. and anticipated changes are discussed. A listing of metric activities involving investigation, observation and measurement skills is presented.

EJ 091 880

PUBLICATION CITATION: American Metric Journal, January/February 1974,
pp. 11-13,20,56,58.

TITLE: Education and Training in SI Units

PERSONAL AUTHOR: Sokol, Louis F.

ABSTRACT: Focus is on the importance of education in educating children and adults to think in metric terms. Emphasis is on a workshop approach and an outline for this is provided.

EJ 093 622

PUBLICATION CITATION: Social Education, March 1974, pp. 269-272.

TITLE: The Metric System: Preparing Your Students for the Big Change

ABSTRACT: Information sources to assist teachers and students in making a smooth and efficient transition to the metric system include an annotated bibliography of literature dealing with the history and present state of measurement in the U.S., with the metric system generally, and with problems involved in metric conversion.

