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The Status of Metric Conversion in Industrial Education Programs in Utah With Recommendations for Statewide Training Programs

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THE STATUS OF METRIC CONVERSION IN INDUSTRIAL EDUCATION PROGRAMS IN UTAH WITH RECOMMENDATIONS FOR STATEWIDE TRAINING PROGRAMS

by

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Approved:

Major Professor	Committee Member
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Thomas John Brames

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ABSTRACT

The Status of Metric Conversion in Industrial Education Programs in Utah with Recommendations for State-wide Training Programs

by

Thomas J. Brames, Doctor of Education

Utah State University, 1975

Major Professor: Dr. Austin G. Loveless
Department: Industrial and Technical Education

The purpose of this study was to obtain information from Industrial Education teachers in Utah concerning their feelings and attitudes toward conversion to the Metric System in the United States and to determine their present familiarity with that system. The study was also designed to identify potential problem areas which would tend to influence educational programs on the Metric System for Industrial Education teachers in Utah.

A select sample of four-hundred twenty-three Industrial Education teachers representing over twenty occupational areas was chosen as the population for the study. Two-hundred ninety-seven usable questionnaires (70.2 per cent) were returned and tabulated as follows 1. the total group of Industrial Education teachers responding to the survey 2. each occupational area was tabulated separately, and 3. each occupational area was compared

to the total group of Industrial Education teachers responding to the survey.

The study focused on obtaining answers to the five following questions:

1. How familiar are Industrial Education teachers in Utah with the base units of the Metric System?
2. Which subject area teachers have the least understanding of the base units of the Metric System?
3. Which sources of Metric System information have been of greatest value to Industrial Education teachers as sources of general and teaching information?
4. What types of educational programs would be appropriate for familiarizing Industrial Education teachers with the Metric System?
5. Which types of metric information are currently being used by Industrial Education teachers in Utah?

The analysis of the data and the basic findings of the study warranted the following conclusions:

1. Industrial Education teachers in Utah are in need of instruction in various portions of the Metric System of measurement. Electronics teachers as a group, do not need further instruction, since electronics is already taught using metric terminology and measurement.

2. Woods teachers do not see the necessity for metric measurement in their occupation, nor do they see economic advantages in the conversion.
3. Curriculum guides in Utah have been of little value to Industrial Education teachers in Utah, as sources of metric information.
4. Most subject area textbooks are not written in Metric terminology and are of little value to Industrial Education teachers as sources of metric information.
5. The Utah State Board of Education needs to provide additional guidance for Industrial Education programs on conversion to the Metric System of measurement.
6. General informational programs on the Metric System as well as specific instruction on the use and application of the Metric System of measurement are needed by Industrial Education teachers in Utah.

(225 pages)

INTRODUCTION

The United States is currently the only large industrialized nation of the world not committed to converting to the International System of Measurement (SI), herein after called the Metric System. All other countries of the world with the exceptions of Ghana, Tonga, Sierra Leone, Gambia, Barbados, and Southern Yeman have either converted to the Metric System or are in the process of making that conversion.

On May 8, 1975 the Subcommittee on Science, Research and Technology of the House of Representatives concluded 6 days of public hearings on metric conversion legislation. Congressman James W. Symington (D-MO), chairman of the Subcommittee, conducted the hearings on a total of 10 bills. The May 1975 U.S. Metric Association newsletter reported:

> 20 invited persons representing different sectors of the economy testified. All witnesses favored metric legislation with the exception of three witnesses from labor unions (IBEW, AFL-CIO, UBCJA) and a representative from the National Federation of Independent Business. It is expected that the Committee on Science and Technology will now come up with a compromise bill which is expected to be presented soon to the House Rules Committee for a rule to place it on the agenda for Floor debate and action. Indications are that chances for passage of metric legislation are better than in previous years.[1]

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[1] U.S. Metric Association Newsletter. Vol. 10, No. 2, May 1975, p. 2.

It is probable that the United States will adopt a national conversion policy during 1975 which will spell out specific actions to be taken over a period of time. It is expected that union and small business opposition will diminish as compromise bills are introduced.

With or without national guidelines, the conversion process has already begun in many industries of the United States. The pharmaceutical, optical, and microfilm industries have totally converted to the metric system over ten years ago and the Timken Company, Bendix Corporation, The National Aeronautics and Space Administration (NASA), The International Business Machine Company (IBM), The John Deere Corporation, Caterpillar Company and the American automotive industries have fully or partially converted to metric measurement. The American Management Association's survey conducted in 1974 discovered that:

> More than 75 per cent of the business firms favored national conversion to the metric system, preferably over a ten year period. Slightly more than 50 per cent of the 1000 firms responding wanted subsidies or tax relief during conversion.[2]

World-wide economic conditions, an increasing world market, and pressure from industry have effectively forced the conversion decision years ago.

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[2] U.S. Metric Association Newsletter. Vol. 9, No. 3, August 1974, p. 6.

The question of how and when the United States will officially convert to the predominate use of the Metric System has enormous implications for education since metric instruction will need to be introduced into a number of different grade levels and subject areas at about the same time.

Students in Industrial Education programs will be living and working in a metric world in the near future. In many industries, metric proficiency will be a condition of employment. The implications are obvious, metric measurement must be incorporated into existing educational programs as soon as possible. To wait until federal legislation has been passed and until the various states formulate their own guidelines and programs, could deprive our students of the skills they need now.

Background

The metric controversy has raged for over 200 years in this country. Thomas Jefferson, Benjamin Franklin and John Quincy Adams were strong supporters of a metric measurement system for the United States but the strings of attachment to the mother country England were too strong to break. In reality, the Anglo Saxon or Imperial System of Weights and Measures that we have accepted for nearly 200 years in the United States is based, in part, on the metric system. Our familiar yard is legally defined by the

National Bureau of Standards as 0.9144 meter and our pound as 453.6 grams.

The nation has not been idle however; the United States Congress approved a U.S. Metric Study in August 1968, and the results of that study by the U.S. Department of Commerce were submitted in a report to Congress in 1971. Maurice H. Stans, the Secretary of Commerce submitted the report and made these recommendations to Congress:

> That the United States change to the International Metric System deliberately and carefully:
>
> That this be done through a coordinated national program:
>
> That Congress establish a target date 10 years ahead:
>
> and that there be a firm Government commitment to this goal.[3]

On August 18, 1972, the United States Senate passed on a voice vote, the Metric Conversion Act of 1972 (S.2483). Action was not taken by the House of Representatives during the final weeks of the ninety-second Congress, so the bill died. The Metric Conversion Act of 1973 (H.R. 11035) was narrowly defeated in 1974, with opposition coming primarily from organized labor. The opposition was concerned with financing of metric

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[3] Maurice H. Stans, A Metric America - A Decision Whose Time Has Come, United States Department of Commerce, July 1971 p. III.

tools for the worker. The opinions of many legislators indicate that a compromise bill will overcome previous opposition and that a National Metric Conversion Act will become law during 1975.

Within the past ten years support for conversion to the Metric System has been steadily growing, with the major effort coming from industry. Although the United States has yet to formulate a National Policy, many governmental agencies have converted to the Metric System or developed plans to do so. Some of these agencies are:

Department of Defense
Department of the Interior
Environmental Protection Agency
Federal Communications Commission
Department of Commerce
Federal Highway Administration
Interstate Commerce Commission
National Geodetic Survey
National Maritime Commission
United States Department of Agriculture
United States Forest Service
United States Patent Office[4]

Educators have been taking an active role in support of metric conversion and presently includes support from many organizations such as:

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[4]Richard A. Kruppa, How to Implement the Metric System, A Technical Paper Presented to the AIAA Convention in Cincinnati Ohio, April 1975. p. 4.

California Teachers Association
National Education Association
American Vocational Association
The National Association of Secondary School Principals
The National Council of Teachers of Mathematics
The Council for Exceptional Children
The Association of American Colleges
The Association of Classroom Teachers
The National Science Teachers Association
The American Society for Engineering Education
The National Congress of Parents and Teachers
The American Home Economics Association
The U.S. Office of Education
The National Science Foundation
The American Industrial Arts Association

Metric conversion cannot be considered only as an industrial problem nor is it of concern for only the mathematics teacher. Each and every citizen, regardless of occupation or interest, will be affected by the change. Road signs, paper sizes, grocery store merchandise, clothing and shoe sizes as well as all other weights and measures will be a part of our metric world. Most educators recognize that metric conversion is a challenge for all of us and has implication beyond the classroom.

Problem statement

The effect of all the metric conversion bills before Congress will be to convert to the predominate use of the SI Metric System in the United States over a planned period of time. At the time of this study it was not known if Industrial Education teachers in

Utah were prepared to incorporate metric measurement in their educational programs nor what their feelings and attitudes were toward metric conversion.

Purpose of the study

The major purpose of this study was to obtain information from Industrial Education teachers in Utah concerning their feelings and attitudes toward conversion to the Metric System in the United States and to determine their present familiarity with that system. The study was also designed to identify potential problem areas which would tend to influence educational programs on the Metric System for Industrial Education teachers in Utah.

Objectives of the study

Considering the potential impact that national metric legislation will have on industrial education in the United States, this study attempted to answer the following five questions:

1. How familiar are Industrial Education teachers in Utah with the base units of the Metric System?
2. Which subject area teachers have the least understanding of the base units of the Metric System?
3. Which sources of Metric System information have been of greatest value to Industrial Education teachers as sources of general and teaching information?

4. What types of educational programs would be appropriate for familiarizing Industrial Education teachers with the Metric System?
5. Which types of metric information are currently being used by Industrial Education teachers in Utah?

Method and procedure

The basic purpose of this study was to obtain information from a select sample of Utah Industrial Education teachers concerning their feelings and attitudes toward converting to the Metric System of measurement in the United States. A second purpose of this study was to determine their present knowledge of the Metric System as well as their present and future utilization of the Metric System in their occupational classes. Lastly, the purpose of this study was to identify potential problem areas which would tend to influence educational programs for Industrial Education teachers in Utah.

Selection of population

The October 1974 issue of the Utah Industrial Education Association Journal contains a directory of 846 Utah Industrial

Education Teachers, identified by school and subject specialty. Junior high school, high school, post-secondary and special institution teachers are listed.

A select sample of every other teacher was chosen from the directory as the population for this study. Where an administrator or other non-teaching person was identified, the next immediate teacher name was used. A total of 423 teachers were identified as the population for this study. No attempt was made to select the population on the basis of listed teaching assignment or subject specialty, since there was little uniformity of subject area titles.

Development of the instrument

The survey instrument used in this study consisted of a questionnaire (see Appendix A). Seven categories of information were identified for the questionnaire, representing fifty possible responses. The grade level and subject area responsibility was also solicited from the respondents. The listing of the teacher's name on the questionnaire was an optional response. Through numerous suggested designs, the questionnaire was limited to two legal size pages, thereby keeping the eventual questionnaire mailing withing the minimum first-class mail rate.

Procedures in obtaining data

A suitable cover letter (see Appendix B) was prepared and included as part of the mailing to the selected population. A postage-paid, self-addressed envelope was included to facilitate questionnaire returns. The instructions for completing the questionnaire were contained on the first page of the instrument, thereby eliminating the need for a separate instruction sheet.

The mailing, consisting of the questionnaire, cover letter and return envelope, was completed on May 10, 1975. Questionnaire returns were received during a five week period commencing May 21, 1975 and ending June 25, 1975. 302 questionnaires (71.4 per cent) were received by June 11, 1975.

Method of procedure

The procedure utilized in developing this study was divided into eight general areas:

1. Review of literature.
2. Development of a suitable questionnaire.
3. Preparation and mailing of the questionnaire and cover letter to 423 Industrial Education teachers in Utah.
4. Compilation of the data from the questionnaire returns.

5. Interpretation of the data by grade level and subject matter.
6. Summary.
7. Conclusions.
8. Recommendations.

Limitations of the study

The research study was circumscribed by the following limitations:

1. The study was limited to a select sample of Utah Industrial Education Teachers chosen from the October 1974 issue of the Utah Industrial Education Association Journal. The random sample was obtained by selecting the alternate names of the listed teachers. Where an administrator (non-teacher) was selected in the sampling technique, the next immediate teacher's name was selected instead.
2. Vocational Directors and other administrators were not considered in this study.

Definitions

The following are definitions of the terms frequently used and pertinent to the study:

Metric System - "Systeme International d'Unites", as designated by the Eleventh General Conference of Weights and Measures in 1960. The universal abbreviation "SI" applies to this latest version of the metric system.[5]

Imperial System - ANGLO-SAXON SYSTEM - CUSTOMARY SYSTEM - The conventional system of weights and measures used by Great Britain and the United States which employs feet, yards, inches, pounds and quarts.[6]

Summary

With or without national guidelines, the United States is proceeding rapidly along the road to near total use of the Metric System (SI) in it industries, businesses, and educational systems. Further, it appears that some type of Federal Legislation will become the law of the land sometime during 1975. Once this occurs, the various states will formulate plans for carrying out the provisions of the Federal Law. The major impact of the conversion will fall upon education almost immediately and it is not certain that education is prepared to make the necessary adjustments.

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[5]Maurice H. Stans, A Metric America - A Decision Whose Time Has Come, United States Department of Commerce, July 1971, 1. 20.

[6]Ibid., p. 7.

Students in Industrial Education programs will be among the first to be affected by a predominately metric world of industry. Industrial Education teachers must be prepared to meet this new challenge when it occurs. It is therefore necessary to know the status of metric education as well as recognize the potential problems that might occur.

Therefore, this study was an attempt to obtain information from Industrial Education teachers in Utah on the status of metric education, the opinions of teachers concerning the conversion and to identify problem areas that could prevent an effective Metric training effort.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The review of literature was divided into three specific areas:

1. The historical implications of the Metric controversy on the United States.
2. The Metric System and Education.
3. Opposition to the Metric System Conversion.

Historical

At the time of this study, the United States found itself embroiled in a controversary that had raged endlessly for over 150 years and is likely to continue into the forseeable future. The issue is this; whether to change our system of weights and measures from the Customary or Anglo-Saxon system to the Metric System.

The United States Constitution gives Congress the power to fix standards of weights and measures for the Nation, and in 1821 John Quincy Adams, at the request of Congress, conducted a study of measurement systems. His recommendations were:

> ...to standardize the familiar Anglo-Saxon units and to have the President of the United States negotiate with certain European countries to establish a system of uniform international measurement.[1]

The Adams report was not acted upon by Congress so the issue lay dormant for nearly 40 years until 1865, when a physicist named Joseph Henry wrote a report favoring adoption of the metric system. As a result of that study and the support of the National Academy of Science,

> Congress in 1866 legalized the use of metric weights and measures without making the metric system compulsory. (In fact, in 1866 the metric system became the only legal measurement system in the United States. Since Congress has never officially approved our Anglo-Saxon weights and measures, as John Adams suggested, the customary system is not law, but merely tradition.)[2]

At this point in history, the battle lines were drawn between opponents and proponents of the metric system. One of the first groups to express organized opposition to the metric system was the International Institute for Preserving and Perfecting Weights and Measures. Organized in Boston in 1879, its members believed:

> their "ceaseless antagonism to the great evil, the French Metric System," was the will of God. (Throughout much of the 19th century, the principal argument against the metric system was on religious grounds. Anti-metrics accused the French of being atheists, and claimed metric weights and measures originated in the "Bottomless Pit.")[3]

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[1] Susan Fraker Holt, The United States and the Metric System. Federal Reserve Bank of Minneapolis, June 1973. p. 6

[2] Ibid., p. 6.

[3] Ibid., p. 7.

Pro-metric supporters continued their battle, and in 1893, the Secretary of the Treasury, by administrative order, declared that;

> metric standards were the nation's "fundamental standards" of length and mass. This meant the United States became an official metric nation, with the foot, the pound and other customary units being defined in terms of standard metric units. The inch became the length of 25.4 millimeters; the yard was declared to be 0.9144 meter.[4]

Although the United States had effectively joined with every other major nation of the world in endorsing the metric system as the internationally preferred system of weights and measures, and through which, measurements are made internationally compatable at the highest level of accuracy, there was no immediate and concerted effort to convert the nation to the system it had approved officially.

An attempt was made to convert the nation to the metric system in 1896, and it almost succeeded. Representative Dennis Hurley introduced a bill providing that all government departments should;

> "employ and use only the weights and measures of the metric system" in transacting official business and that in 1899 metric would become "the only legal system recognized in the United States." Ardently supported by the Committee on Coinage, Weights and Measures, the bill passed the House by the bare margin of 119 to 117. But immediately, opponents

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[4]Ibid., p. 7

> forced a reconsideration and launched an attack stressing the difficulty of making a change.....the bill was sent back to Committee, and there it died.[5]

Between 1900 and 1930 over 30 metric bills were proposed, but none were acted upon. Most of the support for the bills came from scientists, educators, and a few government officials. The opposition claimed that the foreign system could not be as good as the American system. Further, many influential manufacturers financed the anti-metric organizations including some trade and professional journals. One series of attacks on the pro-metric forces found its way into print in 1920 through articles titled;

> "What Real He-Men Think of the Compulsory Metric System"
> "Metric Chaos in Daily Life"
> "A Metric Nightmare"[6]

The major force opposing the metric system was the American Institute of Weights and Measures, led by Frederick A. Halsey, a New York Engineer and Samuel S. Dale, the editor of a Boston textile magazine. Claiming to be "practical men, not closet philosophers or theorists",[7] they charged that the metric system was a total failure in countries that had adopted it. They further argued that the English and U.S. weights and measures were still

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[5]Maurice H. Stans, A Metric America - A Decision Whose Time Has Come, United States Department of Commerce, July 1071. p. 16.

[6]Ibid., p. 18.

[7]Ibid., p. 19.

the ones most commonly used in those countries. The U.S. manufacturers generally chose to support this anti-metric effort since there was no economic benefit for them to do otherwise.

Pro-metric organizations were still speaking out, primarily through two groups; the American Metric Association which had been formed in 1916, and the World Trade Club which was founded in 1917. These two organizations drew most of their support from pro-metric groups of the past; scientists, educators, engineering groups, and members of medicine. Endorsement and some financial support was received by the following organizations:

> The American Chemical Society
> The American Pharmaceutical Association
> The American Association for the Advancement of Science[8]

General Electric Company and the Goodyear Tire and Rubber Company were both represented in the American Metric Association but had little influence when compared with the anti-metric industries.

In the post-World War I and pre-depression years, the metric system controversy lay dormant. The nation was too busy to consider the issue during World War II, and at the end of the war, dominated the world market to such an extent, that there seemed no need for a change to a new system.

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[8]Ibid., p. 19.

In 1957 Sputnik was launched by Russia, creating in this country a frantic interest in scientific education, and renewed interest in the metric system, the predominate measurement language of science. The Government again rekindled some old ashes but found little support for conversion to metric.

In 1960, the metric system was refined by the General Conference of Weights and Measures, in which the United States participated. In effect, this conference agreed on a standard and universal metric system which was named Systeme International d'Unites.[9]

The United States was moving closer to the Metric System but lacked the momentum to achieve it. In May 1968, the President of the British Board of Trade announced in Parliament the United Kingdom's intention to adopt the Metric System over the course of ten years. This action by one of our closest allies placed the United States in a singular position; the only large industrialized nation of the world still using the Customary System of Measurement.

> "With the knowledge that the United States would be the only major industrialized country still using the old customary system, several Congressmen (Congressman Miller and Senator Pell) began working to pass a metric study bill in Congress. The result was Public Law 90-472, The U.S. Metric Study Bill of 1968[10]

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[9]Ibid., p. 20.

[10]Susan Fraker Holt, The United States and the Metric System. Federal Reserve Bank of Minneapolis, June 1973. p. 8.

At the completion of the three year metric study, the Secretary of Commerce, Maurice H. Stans submitted the report to Congress in 1971 with the following nine recommendations:

1. That the United States change to the International Metric System deliberately and carefully;
2. That this be done through a coordinated national program;
3. That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsive to all sectors of our society;
4. That within this guiding framework, detailed plans and timetables be worked out by these sectors themselves;
5. That early priority be given to educating every American schoolchild and the public at large to think in metric terms;
6. That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;
7. That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall "lie where they fall";
8. That the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the U.S. will have become predominately, though not exclusively, metric;
9. That there be a firm government commitment to this goal.[11]

Since 1971 a number of bills have been introduced but none have become law to date. Although a National Metric Conversion Bill is yet to be passed, the Government has acted to support metric education. On August 21, 1974, P.L. 93-380, Amendments to the Elementary and Secondary Education Act of 1965, was signed into law, which provided,

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[11] Maurice H. Stans, A Metric America - A Decision Whose Time Has Come, United States Department of Commerce, July 1971 p. III.

> The expenditure of $10 million dollars for each of three fiscal years beginning in 1975...to encourage educational agencies and institutions to prepare students to use the metric system...[12]

Although there is no guarantee of passage, it appears that a compromise metric conversion bill will be passed during 1975. The various bills before the 94th Congress are very similar in intent and follow closely the 1971 report to Congress by the Secretary of Commerce. It is likely that a compromise bill will rectify the present labor opposition to metric conversion.

The Metric System and education

The key to effective conversion to the Metric System will and should fall upon the shoulders of education, for it is only through an enlightened populus that wide-spread use and acceptance will occur. Historically, education has played a supportive role in the metric controversy and today that support is even more positive. The National Education Association responded as an organization to Metric Conversion in its 1972 Resolution C-17, "Conversion to the Metric System"

> The National Education Association believes that a carefully planned effort to convert to the metric system is essential to the future of American industrial and technological development and to the evolution of effective world communications. It supports federal legislation that would facilitate such a conversion.

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[12] Metric Association Newsletter, Vol. 9. No. 3. Aug. 74. p. 2.

> The Association declares that teachers of all grades should teach the metric system as the preferred system of weights and measures of the United States, and beginning in 1973-74, should teach the metric system with greater emphasis to assure, as a national goal, the orderly transition to the use of the metric system as a primary system by 1980.[13]

The American Home Economics Association added its support to the adoption and use of the Metric System at its 1967 Annual Meeting when it passed the following resolution:

> Whereas, The program of work of the American Home Economics Association emphasizes the need to interpret and disseminate research findings, and
>
> Whereas, Standards of measurement become paramount in scientific activity, and
>
> Whereas, In relation to measurements all scientists meet on a common ground, and
>
> Whereas, the American Home Economics Association promotes programs which develop standards for consumer goods, and
>
> Whereas, The American Home Economics Association promotes programs to increase the understanding of cultural patterns in the United States and other countries, and
>
> Whereas, Standards of measurements are becoming increasingly significant in all aspects of our culture and will help eliminate unnecessary inconveniences; therefore, be it
>
> Resolved, That the American Home Economics Association give its support to measures which promote the adoption and use of the metric system in the United States as they affect supplies and equipment used in the home by individuals and families.[14]

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[13] The National Education Association Briefing Memo, September 1974, No. 7.

[14] Resolution in Support of the Adoption and Use of the Metric System, American Home Economics Association Annual Meeting 1967.

Five years later, the American Home Economics Association re-affirmed its support of metric conversion. In a statement presented by Dr. Doris E. Hanson, Director of the American Home Economics Association before the United States Commerce Committee on S-2483, Metric Conversion Act of 1971, Dr. Hanson summarized her statement as follows:

> ....In summary, then we would say that a planned conversion to the metric system will create no undue hardship on the consumer sector of society and in the long run promises to bring certain advantages. "Going Metric" will be of special advantage to consumers if a more rational market place can be created in the process by paying definite heed to the need for concurrent planning and standards work related to dimensioning and labeling".[15]

The American Industrial Arts Association added its support to the metric conversion issue in 1971, by passing resolutions endorsing and lending support to the international movement to standardize and convert to the metric system. The AIAA position is that

> "This association shall employ such activities that: a goal of complete conversion to the metric system within the decade of the 70's be adopted by the government of the United States of America. Instruction in the metric system be made effective in all elementary and secondary schools, colleges, and particularily in teacher-education institutions".[16]

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[15] Dr. Doris E. Hanson, A Statement Presented for the AHEA Before the U.S. Senate Commerce Committee, March 1, 1972. p. 7.

[16] Oliver Oberlander, Let's Start Metrics Now, School Shop, June 1972, Vol. XXXI, No. 10, p. 26.

The American Vocational Association has been actively involved in the metric conversion controversy for a number of years, commencing primarily in 1970 when the AVA organized a task force on metrication. Each division of the AVA was represented on this task force and reports from each division served as partial input for the report to Congress titled, "A Metric America - A Decision Whose Time Has Come". In addition to this monumental task, the AVA House of Delegates passed the following resolution at its annual convention in New Orleans in December 1974. The AVA resolution states:

> Whereas, there is a well recognized and established International System of Units (SI) based upon the metric system of weights and measures, and
>
> Whereas, the scientific community the world over has adopted the metric system of weights and measures as the standard for world communication of identities, and
>
> Whereas, the SI system of weights and measures has been adopted as the standard for commerce and industry in every recognized country of the international community except the United States, and
>
> Whereas, nearly every aspect of commerce and industry in every country is affected by the internationally accepted metric system of weights and measures, and
>
> Whereas, the Congress of the United States is currently considering legislation calling for adoption of the SI system of weights and measures in commerce and industry, and
>
> Whereas, the Congress has adopted legislation stating that it is the policy of the United States to prepare students to use the metric system with ease and facility, and
>
> Whereas, there is a momentum in the United States to establish the SI system of weights and measures in commerce, industry, sports and among the populus in general;
>
> Therefore, Be it resolved, that the AVA convey to Congress its support of legislation calling for the adoption of the SI system as the standard for communication of weights and measures; and

> Be It Further Resolved, that the AVA support the resolution of the Congress calling for educational programs to prepare students to use the SI system by encouraging each of its affiliated state and territorial associations to engage in an effort to ensure that students enrolled in all vocational education programs are exposed to those units of the SI system which are appropriate and relevant to the subject matter being taught.[17]

Mr. Joseph L. Pokorney, president of Innovative Management Systems of Northbrook, Illinois wrote an article for the Illinois Career Education Journal in the spring of 1973. He presents several points of view concerning Metric Considerations in Vocational Education;

> Because measurement is used in various degrees in all occupations, the use of metric units will have to be included in all occupational education programs. The long lead time associated with many occupational education programs dictates that metric units be introduced now in these programs if metric qualified graduates are to be available to industry by 1978[18]

> The adoption of metric measurement represents a major change in skills that are very basic to most individuals. The resistance to this change may be monumental and must be overcome if the program is to be successful. The use of metric units must have a firm commitment from administrators and educators and must be sold in a very positive manner to overcome this resistance.[19]

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[17] Donald L. Rathbun, Letter and enclosure from AVA Associate Director, dated January 22, 1975.

[18] Joseph L. Pokorney, The International Metric System, Illinois Career Education Journal, Spring 1973, p. 4.

[19] Ibid., p. 4.

> Since both customary and metric units will be in use for many years to come students will have to be familiar with both measurement systems. To generate this dual capability, occupational education programs must become bilingual in their use of measurement units.[20]

> Metric measurement will have an impact on all occupational areas including the biological, agricultural, business, health, industrial, personal and public service occupations.[21]

> Planning is essential to assure that effective metric training is provided at the right time to all students.... ....each vocational and technical institution must initiate a metric conversion program at its earliest opportunity.[22]

The Superintendent of Public Instruction in California, Dr. Wilson Riles spoke to the participants at a Metrics Conference at the University of California, Los Angeles in September 1973. He made the following comments:

> It is difficult for me or anyone to visualize clearly how this nation and society will be changed in thirteen years. We cannot peer that far into the future and know precisely the patterns and problems of the nation's economy, its politics, its needs for different skills...But I am sure of one change. In thirteen years, I am convinced this nation will have gone metric.
>
> As State Superintendent of Public Instruction in California, I am seeking a changeover to metric instruction in the schools, with all the careful planning that is necessary, but also as quickly as possible.[23]

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[20] Ibid., p. 4.

[21] Ibid., p. 4.

[22] Ibid., p. 8.

[23] See Appendix C.

The U.S. Metric Association publishes a quarterly Newsletter in which they report on nearly every facit of metric activity in the world. Many of the articles and comments are germain to this study, so are quoted here:

> There remains the tremendous task of educating the public to the acceptance and understanding of SI units. The major part of this task will be done through our existing teaching staffs in schools from primary grades through vocational institutions and the universities.[24]

> The number of metric workshops for teachers is increasing steadily throughout the nation. So many are taking place that it is impossible to report individually on these. The number of workshops appears to be greater in those states where the state education departments have taken positive action to encourage the teaching of SI units in their schools or where public awareness programs have been underway.[25]

> ...virtually every state has underway some type of statewide activity relating to teaching metric...it is encouraging that the schools are keeping pace with industry's change to metric.[26]

> Prof. Raymond Hollub, who is director of continuing engineering education in Alabama.....has been named director of the newly formed Metric Institute which is funded with a grant from the Alabama Board of Education. The primary goal of the institute will be to train teachers in the use of metric units and to develop metric training programs.[27]

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[24] U.S. Metric Association Newsletter. Vol. 10. No. 1, February 1975. p. 3.

[25] Ibid., p. 2.

[26] Ibid., p. 7.

[27] U.S. Metric Association Newsletter, Vol. 9. No. 3, August 1974, p. 4.

> Vermont metric council formed - The Greater Burlington Metric Council has been formed to act as an advisory group on metric matters. The council consists of participants from local industry, an officer of the Small Business Administration, a home economist, and a professor of Manufactruing Engineering.[28]

> The Regents of the University of Minnesota approved a proposal to establish a Minnesota Metric Center in the Institute of Technology. The purpose of the center is to promote and assist in the introduction of SI into the educational, commercial, and governmental activities in the state.[29]

> The Department of Elementary Education at Kent State University in Kent, Ohio has announced the opening of a Metric Assistance Center. The major objective for this project is to aid the citizens of northeastern Ohio in an orderly transition to metric.....The center will serve as a clearinghouse for information and materials including both hardware and software. The personnel will provide inservice and consultant help to educators in area schools. The staff will also train key personnel as facilitators in metric. Workshops will be offered to the general public in that area.[30]

> Various aspects of metrication are being covered in the Los Angeles area via a weekly prime-time television show, Moving into Metrics, which is aired for one hour each Tuesday at 19:30 (7:30 P.M.) on KVST, Channel 68...[31]

The state of Hawaii has the distinction of being the first of the fifty states to commit its schools to the metric system. In a

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[28] Ibid., p. 4.

[29] U.S. Metric Association Newsletter, Vol. 9, No. 2, May 1974, p. 4.

[30] U.S. Metric Association Newsletter, Vol. 9, No. 4, November 1974, p. 3.

[31] Ibid., p. 2.

resolution passed by the House of Representatives of the Sixth Legislature of the State of Hawaii, in regular session of 1972, it was resolved that:

> the College of Education of the University of Hawaii be requested to develop a pilot program for teaching metric in the schools of Hawaii as the primary language of measurement.[32]

Following the recommendations contained in the U.S. Metric Study Interim Report on Education, Mr. Irv King and Ms. Nancy Whitman initiated two experimental programs in order to investigate the Metric Study recommendations in greater detail. Their findings were:

1. A twelve hour workshop, which actively involves teachers in estimation and measuring activities, can adequately prepare teachers for the task of teaching the metric system.

2. The children thoroughly enjoy measurement activities and are gradually discovering the properties of the metric system.

3. The program is not as easy to install as originally hoped. The entire program is based upon activities and our teachers are hard pressed to prepare activities on a daily basis. This leads us to believe that it might be unwise to adopt a substantially revised program at the same time that we attempt a conversion to the metric system. The teachers will have their hands full with metrication, and to introduce a totally revised curriculum at the same time might very well create chaos.[33]

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[32] Irv King and Nancy Whitman, Going Metric in Hawaii, The Arithmetic Teacher, April 1973, p. 258.

[33] Ibid., p. 259.

Mr. Fred Helgren of the Metric Association has lived with the problems of metric conversion for a number of years. His article in the Arithmetic Teacher of April 1973 lists six recommendations concerning what should be done in the field of education to go metric; they are;

1. Teach the metric system by itself so that teachers and pupils learn to think in this language of measure. Do not try to learn or teach the metric system through conversion problems, and do not try to learn conversion factors. Learn the metric system by itself. Think Metric.

2. Change mathematics and science text books so that only metric units of measure are used.

3. Before textbooks are changed, get metric workbooks for each teacher and each pupil. Then the system can be learned with very little individual effort.

4. Select one faculty member to be the metric authority for the school. He can get the information and materials necessary to enable the school to go metric.

5. Encourage teachers to become members of an organization that will send them literature that explains the metric system, provides information on sources of educational aids, and publishes a newsletter that will keep them alert to metric progress and developments in the teaching of units of measure and their use.

6. Teach the metric system to all prospective teachers, for the change to the new system of measure is not just a mathematics or science project.[34]

Rupert N. Evans from the University of Illinios wrote an article for School Shop in April 1974. Many of his suggestions

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[34]Fred J. Helgren, Schools are Going Metric, The Arithmetic Teacher, April 1973, p. 266.

have been voiced by others but Evans has digested these into one prescriptive listing. The following actions may deserve consideration by industrial teacher educators:

1. Institution of programs on teaching metrics at national, regional, and state conventions of professionas associations (e.g. AIAA, ATEA), designed for subject matter specialists and administrators who work in local education agencies and in teacher education institutions. Such programs will be needed each year for at least five years.

2. Establishment of curriculum development projects designed to produce transparencies, texts, exercises, projects, and tests which teachers of industrial education can use in familiarizing youth and adults with SI metrics. The Center for Metric Education would be a logical hub for such activity.

3. Design and production of metric conversion units for equipment commonly used in industrial teacher education.

4. Development of a correspondence course in SI metrics designed for currently employed teachers and teacher educators.....which does not require an instructor to be present.

5. Development of short courses for currently employed teachers and teacher educators.....designed to communicate knowledge of SI metrics and of how to teach the relevant concepts in each type of industrial-education course.

6. Designation of one staff member in each subject field in each teacher-education institution as the person responsible for acquiring knowledge of SI metrics and for proposing course changes to teach this knowledge to pre-service teachers...

7. Designation of one industrial-education teacher in each local education agency as the person responsible for acquiring information about SI metrics and about the availability of in-service teacher-education programs on the subject.

8. Development of a metric advisory committee for each state department, large school and university, with representation from research and development units which are managing the metric changeover in progressive business and industry.

9. Development of a departmental timetable for familiarization with SI metrics for each industrial-education teacher, and a related timetable for introduction of these concepts into each industrial-education course for youth, for adults, for prospective teachers and for in-service teachers.

10. Purchase of metric tools and conversion of some equipment to metric standards, according to the schedule set by your departmental timetable.[35]

Another viewpoint concerning education of teachers was expressed by Orville Nelson of Stout State University at Menomonie, Wisconsin. Mr. Nelson further tackled the problem asked by so many educators; how much will it cost?

> Teachers will also need additional training in metric measurement. Almost 40 per cent of industrial arts teachers have no formal training related to the metric system according to survey statistics. Most of those who have formal training acquired it in math and science classes. Some have used the metric system in industry. A very few have worked on foreign-made equipment with metric specifications and dimensions.
>
> It is apparent that educational programs will have to be developed for these men. The single exception are the electronics teachers...[36]

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[35]Rupert N. Evans, Three Approaches to Metrication for Teacher Trainers, School Shop, April 1974, pp. 91, 100.

[36]Orville Nelson, Is Metric A Measure of Pain?, Industrial Arts and Vocational Education, February 1972, p. 22.

> The U.S. Metric Study staff, basing its report on the input from industrial arts and vocational teachers, estimated that most shops and labs could be converted to the metric system for less than 5% of the original cost of tools and equipment. And even in the labs requiring the most extensive modifications and new equipment, the estimate was less than 10%.[37]

The following chart from the U.S. Metric Study Interim Report: Education, is dated July 1971. The latest inflationary figures should be used as a factor in determining current prices.

The greatest conversion costs will be experienced in the Tool and Die Shop and Machine Shop, while the least conversion costs will be experienced in Electronics.

Table 1. Estimated Costs for Converting Selected Labs to Metric[38]

Area	Number of Stations	Total Cost ($)
Auto Body	12	400
Auto Mechanics	16	4,400
Carpentry and Cabinet Making	20	1,250
Drafting and Design	20	300
Electronics	20	100
Graphic Arts	15	1,000
Machine Shop	15	18,300
Small Engine Repair	15	500
Tool and Die	15	20,000
Welding	16	3,300

From U.S. Metric Study Interim Report: Education, National Bureau of Standards Special Publication 345-6, July, 1971 ($1.75)

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[37] Ibid., p. 23.

[38] U.S. Metric Study Interim Report: Education, National Bureau of Standards Special Publication 345-6, U.S. Department of of Commerce, July 1971.

The cost of hand tools is another expressed concern, and is the focal point of most union opposition to the metric system. It has not yet been determined who will pay for the metric tools needed by the worker. Since the automotive mechanic will require extensive re-tooling, the following article tends to clarify the issue:

> "There is one little-recognized fact about the metric system as it applies to hand tools: while bolt head sizes are expressed in millimeters, socket drivers such as speed handles and ratchets are based on inch measurements throughout the world; that is, the drive end of a socket is always made for a U.S. Customary 1/4 inch, 3/8 inch, or 1/2 inch drive. Thus, the service technician had only to add new metric-size sockets to the toolbox; the handles and ratchets that were already owned fit both metric and inch-size sockets".[39]

Utah educators have been actively participating in a number of metric activities in the past, including the Interstate Consortium on Metric Education which was held in San Mateo, California, July 21 - 25, 1974.[40] The Consortium was attended by representatives from 26 States and U.S. Territories. Those States and Territories having statewide adoption of textbooks were invited to attend the Consortium as contributing and voting participants.

The Utah Education Association has given high priority to teaching metrics, according to Deloy Spencer, President Elect of

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[39] William H. Crouse and Donald L. Anglin, The Impact of Metrication on Automotive Education, Technical Education News, March-April 1975, p. 3.

[40] American Metric Journal, California Directs Interstate Consortium on Metric Education, September/October 1974, pp. 6-13

the UEA Department of Classroom Teachers. According to Spencer;

> ...present plans call for a series of workshops around the state aimed at helping teachers teach metrics.[41]

Utah State University Conference and Institute Division sponsored a metric workshop during the period 9-13 June 1975, under the direction of Antone H. Bringhurst, assistant professor of Mathematics at Utah State University. Professor Bringhurst commented that;

> "Rather than thinking in the traditional system and then converting to the metric, we will begin working directly with the metric measure - we will think metric"[42]

Opposition to metric conversion

Not all of the literature cited is supportive of a National conversion to the Metric System, nor should conversion be considered a panacea. The major opposition to previous metrication bills has come from organized labor, primarily the International Brotherhood of Electrical Workers, the United Brotherhood of Carpenters and Joiners of America and the International Association of Machinists and Aerospace Workers. The National Federation of Independent Business also opposed a Federal metrication bill. The Metric News of March/April 1974 reprinted a letter

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[41] UEA Action, May 1975, p. 5.

[42] Herald Journal, May 28, 1975, p. 4.

sent to Congress by the IBEW, UBCJA and the IAMAW.[43] Portions of that letter follow:

> It is extremely important to understand that there is no cheap method of converting to the metric system. The estimates of costs range from 45 to 100 billion dollars and it is important to note that these costs will be in competition with other pressing national priorities. We are convinced that, regardless what action Congress takes on metric conversion, the U.S. and the world will have a dual system of measurement for at least the next 50 to 100 years.....We strongly object to the method of implementation of the plan and the omission of government assistance for those individuals and organizations adversely affected by metric conversion, especially the American workers.....
>
> More directly, we are afraid that thousands of jobs will be lost as a result of increased imports from metric countries.....All workers would require additional training, which would cost companies, contractors and unions millions of dollars. Many mechanics would have to purchase new tools. They would need two sets of tools and assume the burden of maintaining, storing and transporting them.

In the U.S. Commerce Department Report to Congress on the U.S. Metric Study, the various advantages and disadvantages of the conversion to metric were listed. Under the headings of Pro-Customary and Pro-Metric, various comments that had been made to the Metric Study Committee, were listed. The opponents to metric conversion commented as follows:

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[43] David Mathieu, Metric News, March/April 1974. p. 27.

Let's not risk our industrial success with a measurement system promoted by countries that have not done as well technologically as the U.S.

Going metric would open the way to imports from countries that do not now make products to Customary specifications.

Within our borders the Customary system works all right. Foreign considerations do not warrant disrupting our trillion dollar economy.

If we decide to go metric, we are likely to pick the wrong time. No one can guarantee what the economic conditions will be throughout the transition period. The measurement conversion might complicate all our problems.

Even in good times the nation is faced with complex problems. Why add to them a troublesome change in measurement.

Many companies would have to carry double inventories of spare parts during the transition period.

People would have to be retrained. And during the retraining period they would be deprived of invaluable experience - the intuitive feel for measurements on which craftsmen, mechanics, and engineers depend. The result would be a temporary loss of productivity.

Conversion might be easy enough for big firms with engineering staffs and foreign trade departments. But small businesses would find it very difficult.[44]

The above comments are but a few of the concerns of the persons opposed to metric conversion, and the pro-metric groups agree with many of the identified problems. It seems to be a question of whether the advantages out weigh the disadvantages or whether in fact, we can afford not to go metric.

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[44] Maurice H. Stans, A Metric America - A Decision Whose Time Has Come, U.S. Dept. of Commerce July 1971, pp. 43-50

Summary

The United States has been embroiled in the Metric System controversy for over 150 years with periodic eras of support and opposition. Education and science have historically supported the conversion to the Metric System in the United States while industry has provided an opposing point of view. Congress legalized the use of the metric weights and measures in 1866 but did not make it mandatory. Since Congress had never officially approved the Anglo-Saxon system of measurement in the United States, the customary system we used was not law, but merely tradition.

The controversy continued un-abated until 1957 when Russia launched Sputnik. A renewed interest in scientific endeavor, including scientific measurement, immediately occured. Pressure was again brought to bear on Congress to pass some type of metric legislation, but it was to fail once more.

When Great Britain announced in 1968, its intention of changing from the Anglo-Saxon or Customary system of measurement, the United States found itself the only large industrialized nation of the world using the Customary System of Weights and Measures. Industry was not idle however, and had been moving toward metrication for years. The same pressures that had forced the metric decision in Great Britain were forcing it here; the world market was being conducted in metric and the industries

of Great Britain and the United States were finding it more difficult to compete using the Customary System.

At the completion of a three year metric study in 1971, the secretary of Commerce recommended a nine point metric conversion plan to Congress. As a result of that report a number of metric conversion bills were submitted to Congress over the next few years. All failed to become law due to opposition by labor and small business concerning the responsibility for the incurred conversion costs. Congress amended the Elementary and Secondary Education Act in August 1974, thereby making funds available for education of the nation's youth in the Metric System.

The passage of a compromise metrication bill seems possible during the 94th Congress, which would make the Metric System of Measurement the legal system in the United States. This action would effectively change the United States to the predominate, though not exclusive, use of the International System of Measurement (SI) over a prescribed period of time.

Education in the United States has long been a supporter of the Metric System, and had actively supported the conversion for many years. Most states had developed metric education programs, primarily in-service workshop activities for teachers. Although these activities were taking place, most efforts were not coordinated, except through the organization support of the major

education groups such as the National Education Association, American Vocational Association and other large teacher organizations.

CHAPTER III

PRESENTATION OF THE DATA

Introduction

The purposes of this study were: 1. to obtain information from industrial education teachers in Utah concerning their feelings and attitudes toward conversion to the Metric System in the United States; 2. to determine their present familiarity with that system; and 3. to identify potential problem areas which would tend to influence educational programs on the Metric System for industrial education teachers in Utah.

The population of the study

A random sample of Industrial Education Teachers in Utah was used as the population for this study. This random sample was obtained from the October 1974 issue of the Utah Industrial Education Journal directory. Every other name in the directory was selected without regard to grade level or teaching subject.

Those who were directly identified as administrators or other non-teaching personnel were eliminated from the population.

From the 846 names appearing in the directory, 423 were selected for the study. Questionnaires, cover letters, and return envelopes were prepared and mailed to this random sample of industrial education teachers in Utah. The mailing was completed on May 10, 1975.

The returns

The questionnaire returns were received during a five week period commencing May 21, 1975 and ending June 25, 1975. As of the ending date, 302 questionnaires (71.4%) were received. Five returns were not usable for the following reasons:

1. Three questionnaires were returned with the notation N.A. written across the face. No other information was indicated.
2. One questionnaire was returned from a respondent who indicated that he was not teaching now.
3. One returned letter in lieu of questionnaire.

All other questionnaire returns (297) were usable, although some items on the questionnaire were not properly marked. This will account for the difference in totals for some questionnaire items.

Tabulation criteria

The questionnaire returns were examined for completeness as they were tabulated. It was determined that many teaching areas were given different names on the basis of emphasis or tradition. For this reason, the returns were tabulated according to the following criteria:

1. Only the primary teaching responsibility was considered for this study. Where more than one subject was listed as primary, the first listed subject was used.

2. All identified teaching areas numbering five or less were considered as one group under the miscellaneous category. (See Table 2).
3. Drafting, Mechanical Drafting, and Architectural Drafting were considered in the Drafting category.
4. Construction, Home Building, and Woods were considered in the Woods category.
5. Power, Heavy Duty Diesel, and Trucks were considered in the Diesel category.
6. Electricity and Electronics were considered in the Electronics category.
7. All other categories were clearly identified.

Tabulation method

The questionnaire returns were tabulated in the following manner:

1. All of the returns (297) were tabulated as a single group of Industrial Education teachers (Comparison Group Teachers), according to each questionnaire item.
2. Each occupation category (10 identified categories) was tabulated separately, according to each questionnaire item.

3. Twenty-one occupational areas were compiled under the Miscellaneous category as shown in Table 2. No further tabulations were made for this category.

Results

Considering the above criteria, Table 2 represents the Comparison Group Teacher distribution of this study.

Table 2. Primary Teaching Responsibilities of Utah Industrial Education Teachers of all Grades Responding to the Study.

Category	Number	Percentage
Woods	66	22.2
Auto	41	13.8
Metals	40	13.5
Drafting	30	10.1
Machine Shop	22	7.4
Electronics	20	6.7
Welding	12	4.0
Diesel	8	2.7
Graphics	8	2.7
Plastics	7	2.4
*Miscellaneous	43	14.5
	297	100.0

*The remaining occupational areas reported under the Miscellaneous category are:

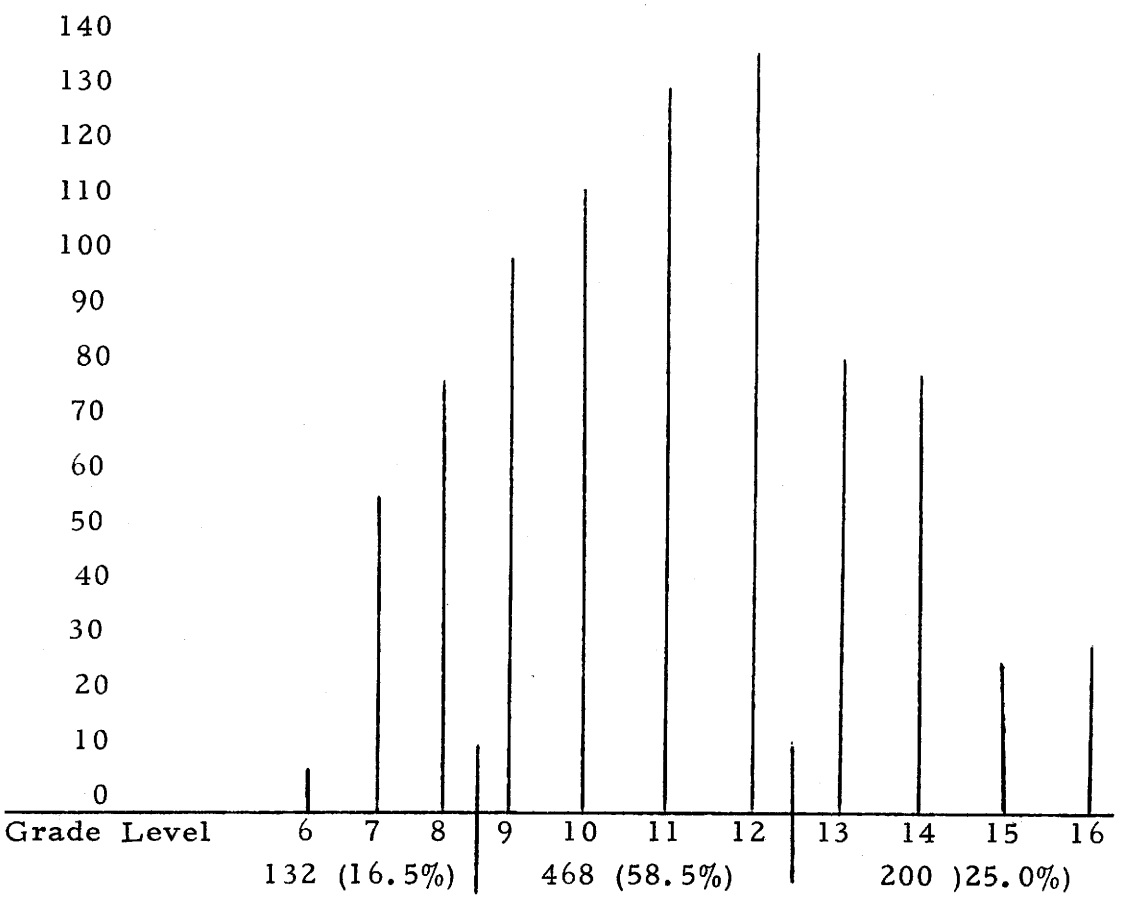
Aeronautics	4	General Shop	4
Agricultural Mechanics	2	IACP	3
Agricultural Science	2	Industrial Engineering	1
Architecture	1	ISP	3
Art	3	Manufacturing	1
Auto Body	4	Masonry	1
Business Machine Repair	1	Photography	1
Clothing	1	Police Science	1
Cosmetology	2	Refrigeration	2
Crafts	2	World of Manufacturing	2
Electrical Trades	2	Total	43

Section I

Industrial Education Teachers

Two hundred eighty three (95.3 per cent) respondents reported that they taught more than one grade level. One hundred fifty five (59.9 per cent) teachers had the responsibility for three or more grades. The tabulation for grade level (Table 3) indicates that 16.5 percent of the respondents had teaching responsibility in junior high school, 58.5 per cent were from high school programs and the remaining 25.0 per cent were from post-secondary institutions.

Table 3. Grade Level Distribution for Industrial Education Teachers Responding to the Survey



One of the major concerns of this study was to determine the attitudes of Comparison Group teachers in Utah toward the conversion to the predominate use of the Metric System in the United States. Table 4 shows the response to question number 1. Nearly 70 per cent agree with the conversion, while less than 10 per cent oppose it.

Table 4. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States?

Answer	Number	Percentage
I Strongly Agree	95	31.9
I Agree	112	37.7
I am Undecided	63	21.2
I Disagree	17	5.7
I Strongly Disagree	10	3.3
Total	297	100

The teacher was asked to express the degree of his familiarity with the base units of the Metric System. Although the Liter is not a base unit, its common usage warranted inclusion with the seven base units of the Metric System, (see Table 5).

Seven teachers indicated that they used millimeters rather than meters in their classes. Their responses were considered

as though millimeter and meter required identical skill. Nearly 25 per cent of the respondents indicated that they were not familiar with the Second.

Table 5. How Familiar Are You With the Following Units of the Metric System?

Unit	Totally Familiar								Not Familiar		
	4	%	3	%	2	%	1	%	0	%	Total
Meter	107	36.3	89	30.2	61	20.7	14	4.7	24	8.1	295
Liter	71	23.9	74	25.0	79	26.7	36	12.2	36	12.2	296
Kilogram	77	26.1	62	21.0	79	26.7	34	11.5	43	14.6	295
Ampere	126	42.8	55	18.7	43	14.6	20	6.8	50	17.0	294
Mole	19	6.5	19	6.5	42	14.4	49	16.8	163	55.8	292
Celsius	44	15.0	27	9.2	35	11.9	40	13.6	145	49.5	293
Candela	15	5.1	18	6.2	33	11.3	34	11.6	192	65.7	292
Second	127	43.6	36	12.4	36	12.4	20	6.8	72	24.7	291

Question number 3 attempted to determine the present status of metric education in the various industrial education programs of Utah, specifically those programs requiring student proficiency with the metric system. Table 6 indicates the present status of metric education as of approximately 1 June 1975. As indicated in Table 5, the Second (our familiar unit of time) appears to require little proficiency in the classroom.

Table 6. AT PRESENT, Students in my Class Require Proficiency in the Use of the Following Metric Units.

Unit or Category	Number*	Per Cent of 297*
Meter	158	53.2
Liter	62	20.8
Kilogram	63	21.2
Ampere	110	37.0
Mole	12	4.0
Celsius	41	13.8
Candela	11	3.7
Second	87	29.3
I teach classes that do not require the use of metric measurement	149	50.2
Not applicable	63	21.2

*Since the respondent may have indicated more than one metric unit or category, totals are not appropriate for this section.

Question 4 determined the future requirements for metric measurement in industrial education classes. One Hundred Five teachers (35.3 per cent) were of the opinion that their classes could not require the use of metric measurement in the future. Table 7 indicates the anticipated future status of metric education in industrial education classes.

Table 7. IN THE FUTURE, Students in my Class Will Require Proficiency in the Use of the Following Metric Units.

Unit or Category	Number*	Per Cent of 297*
Meter	277	93.3
Liter	153	51.5
Kilogram	163	54.9
Ampere	161	54.2
Mole	26	8.7
Celsius	108	36.4
Candela	31	10.4
Second	122	41.1
I teach classes that do not require the use of metric measurement.	105	35.3

*Since the respondent may have indicated more than one metric unit or category, totals are not appropriate for this section.

A comparison of the present status with the future needs is indicated in Table 8. It appears that all eight units of the metric system will be used more in the future, while the number of classes that do not require metric measurement will decrease.

Table 8. A Comparison of Present and Future Use of the Metric System in Industrial Education Programs in Utah.

Unit or Category	Present No.	Future No.	No Difference	Present %	Future %	% Increase = + Decrease = -
Meter	158	277	+119	53.2	93.3	+40.1
Liter	62	153	+ 91	20.8	51.5	+30.7
Kilogram	63	163	+100	21.2	54.9	+33.7
Ampere	110	161	+ 51	37.0	54.2	+17.2
Mole	12	26	+ 14	4.0	8.7	+ 4.7
Celsius	41	108	+ 67	13.8	36.4	+22.6
Candela	11	31	+ 20	3.7	10.4	+ 6.7
Second	87	122	+ 35	29.3	41.1	+11.8
I teach classes that do no require the use of metric measurement	149	105	- 44	50.2	35.3	-14.9

The review of literature indicated that a number of educational programs throughout the United States are involved with metric education programs. Over one third of the respondents indicated that they were already teaching some metric measurement in their classes. Of equal importance is the fact that nearly another one third of the teachers are undecided about introducing the metric system in their classes.

Table 9. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start?

Category	Number	Percent
I already teach metric measurement	99	33.3
During the school year starting in September 1975	44	14.8
During the school year starting in September 1976	27	9.1
Sometime after 1976	24	8.1
Undecided	103	34.7
Total	297	100

This study determined the value of various sources of metric information to the Comparison Group teacher. These sources were divided into. 1. Metric Teaching Information and 2. General Metric Information. Tables 10 and 11 indicates the results of questionnaire item 6. In both categories, newspapers were not significantly important, nor were curriculum guides. Government publications and metric system reference books rated highest in both categories as the overwhelming value item. Those teachers expressing no opinion are generally those who have had little or no exposure to teaching metrics.

Table 10. As a Source of Metric Teaching Information

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	3	13	56	60	157	289
Professional Education Journals	28	62	70	26	101	287
Business and Industry Journals	28	50	59	39	112	288
Industrial Conferences	25	43	44	42	132	286
Industrial Sponsored Workshops	23	29	38	39	156	285
Educational In-Service Workshops	23	36	32	50	146	287
Government Publications	45	49	57	27	109	287
Subject Area Textbooks	34	53	41	48	111	286
Metric System Reference Books	71	70	37	20	94	292
Curriculum Guides	6	19	30	55	178	288
Other	0	0	0	0	0	0

Table 11. As a Source of General Metric Information.

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	19	38	64	43	126	290
Professional Education Journals	37	70	66	27	90	290
Business and Industry Journals	33	52	62	36	104	287
Industrial Conferences	27	48	49	36	129	289
Industrial Sponsored Workshops	21	33	40	46	148	288
Educational In-Service Workshops	21	35	35	52	144	287
Government Publications	69	51	47	26	95	289
Subject Area Textbooks	42	43	48	58	96	288
Metric System Reference Books	92	59	32	24	80	287
Curriculum Guides	5	20	33	68	161	287
Other	0	0	0	0	0	0

Questionnaire item 7 identified potential problem areas that might influence metric conversion. Cost of equipment, materials, and tools presented the greatest number of problems, while opposition from parents, students, administrators, teachers, and industry would create the least number of problems. Lack of text books, guidance from the state, and a lack of knowledge of the metric system ranked near the top as overwhelming problem areas to the teachers.

Table 12. Factors Influencing Metric Conversion in Educational Program.

Factor	Overwhelming Problem	Serious Problem	Problem	Minimal Problem	Not a Problem	No Opinion	Total
Cost of new equipment	34	81	69	49	35	26	294
Cost of converting existing equipment	32	86	67	44	36	27	292
Cost of materials and supplies	24	52	65	71	53	26	291
Cost of tools	33	73	80	44	37	24	291
Opposition from parents	1	14	28	58	129	61	291
Opposition from administrators	2	9	20	55	154	49	289
Opposition from students	7	15	50	72	111	36	291
Opposition from teachers	2	12	37	66	137	37	291
Opposition from industry	4	8	24	44	157	55	292
Opposition from Advisory Committee	5	13	11	39	152	69	289
Lack of text books in metric units	21	67	77	57	40	29	291
Lack of guidance from state department	25	59	55	47	59	44	289
Lack of knowledge of the metric system	25	45	85	53	56	25	289

Summary - industrial education teachers

Most of the respondents indicated that they taught more than one grade level; in some cases, four or more. The grade level distribution was presented in Table 3, indicating a majority of those responding to the questionnaire were High School teachers.

Over 69 per cent of the respondents agree with the metric conversion while 10 per cent disagree and 21 per cent are uncertain. Most respondents reported some familiarity with the units of the metric system but indicated little knowledge of the Mole or Candela. Nearly 25 per cent of the respondents indicated that they were not familiar with the Second.

A comparison was made between the present and future use of the Metric System in Industrial Education programs in Utah. In every subject category, metric instruction will be increased in the future. Over 33 per cent of the teachers indicated they were already including metric instruction in their programs, but nearly 35 per cent were undecided about introducing the metric system.

Government publications and metric reference books have been of greatest value to Industrial Education teachers as sources of general and teaching information, while curriculum guides and newspapers have been of little assistance. Industrial Education teachers as a group have indicated that the cost of equipment,

material and tools present the greatest problem with metric conversion while opposition from parents, students, administration, teachers, industry, and advisory committees will present the least problems.

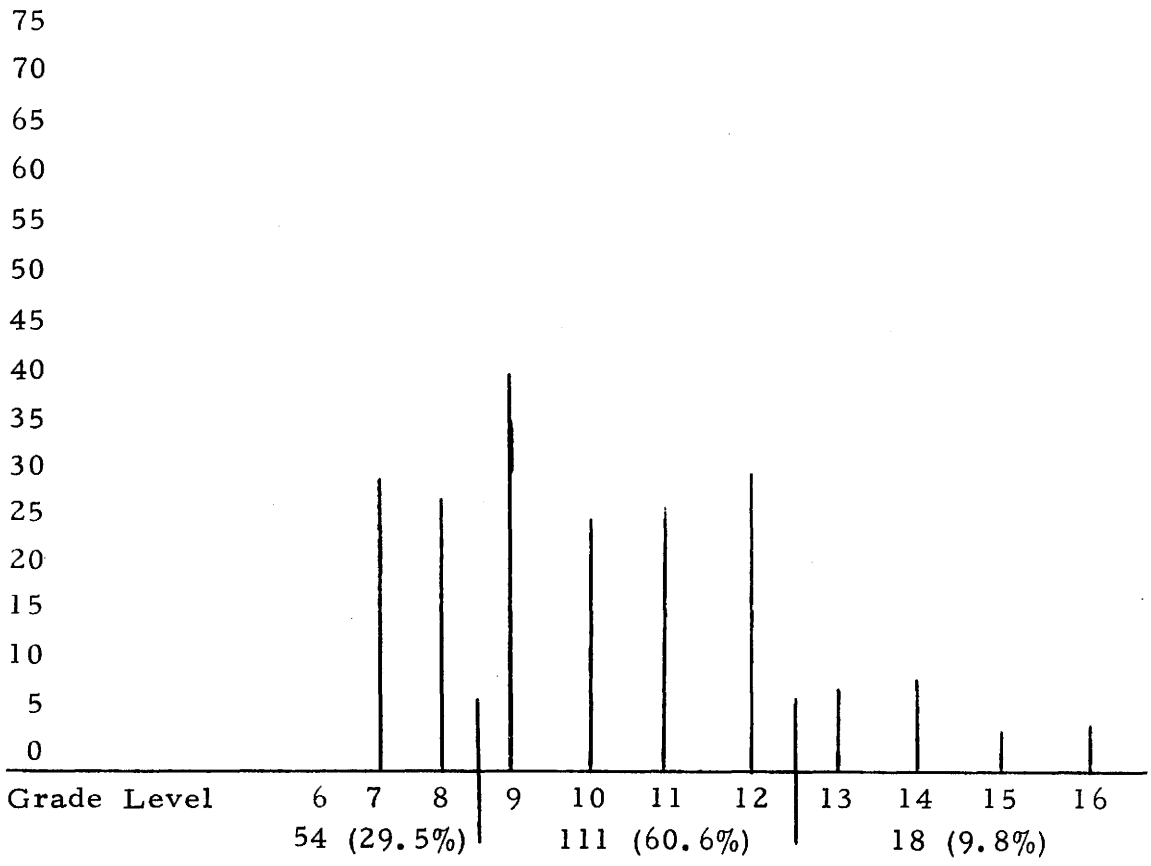
Lack of text books in metric units, lack of state guidance, and the teacher's lack of knowledge of the metric system were also listed as serious problem areas.

Section II

Woods

The greatest number of respondents taught classes in the Woods category which also included home building and construction. Nearly 30 per cent of the Woods teachers taught classes in junior high school as compared to 16.5 per cent for the Comparison Group teachers in the survey. Nearly 61 per cent of the Woods teachers taught classes in high school as compared to 58.5 per cent for the Comparison Group teachers. Only 9.8 per cent of the Woods teachers are represented in postsecondary institutions as compared to 25 per cent for all Industrial Education teachers. Table 13 indicates this grade level distribution.

Table 13. Grade Level Distribution of WOODS



Nearly 14 per cent of the Woods teachers responding to this survey disagreed or strongly disagreed with the conversion to the predominate use of the Metric System in the United States, while only 9.0 per cent of The Comparison Group teachers responding to the survey were opposed to the conversion. Table 14 indicates the responses from Woods teachers to questionnaire item 1.

Table 14. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (WOODS)

Answer	Number	Percent
I Strongly Agree	8	12.1
I Agree	30	45.5
I am Undecided	19	28.8
I Disagree	5	7.6
I Strongly Disagree	4	6.0
Total	66	100.0

Table 15 indicates the results of questionaire item 2 for Woods teachers. Table 15 indicates that Woods teachers are less familiar with the units of the metric system than the Comparison Group teachers responding to the survey.

Table 15. How familiar are you With the Following Units of the Metric System? (WOODS)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	16	24.6	17	26.2	19	29.2	6	9.2	7	10.7	65
Liter	11	16.9	15	23.1	19	29.2	12	18.5	8	12.3	65
Kilogram	9	13.8	11	16.9	22	33.8	14	21.5	9	13.8	65
Ampere	21	32.3	9	13.8	15	23.1	8	12.3	12	18.5	65
Mole	1	1.5	1	1.5	10	15.4	13	20.0	40	61.5	65
Celsius	2	3.0	4	6.1	8	12.2	8	12.2	44	66.6	66
Candela	1	1.5	1	1.5	7	10.7	10	15.4	46	70.7	65
Second	17	26.1	8	12.3	13	20.0	7	10.7	20	30.8	65

Table 16 indicates the results of questionaire item 3 for Woods teachers. Over 57 per cent of the Woods teachers responding to the survey indicated that they taught classes that did not require the use of metric measurement; nearly 8 per cent higher than the comparison group of Industrial Education teachers.

Table 16. AT PRESENT, Students in my Class Require Proficiency in the Use of the Following Metric Units. (WOODS)

Unit or Category	Number	Percent
Meter	6	9.1
Liter	1	1.5
Kilogram	1	1.5
Ampere	5	7.5
Mole	1	1.5
Celsius	1	1.5
Candela	1	1.5
Second	3	4.5
I teach classes that do not require the use of metric measurement	38	57.6
Not applicable	15	22.7

Table 17 indicates the results of questionnaire item 4 for Woods teachers. Although every metric unit will increase in usage in the future, 53 per cent of the Woods teachers indicated that their classes would not require the use of metric measurement in the future; nearly 20 per cent higher than the comparison group of Industrial Education teachers.

Table 17. IN THE FUTURE, Students in my Class Will Require Proficiency in the Use of the Following Metric Units. (WOODS)

Unit or Category	Number	Percent
Meter	29	44.0
Liter	11	16.6
Kilogram	13	19.7
Ampere	11	16.6
Mole	5	7.5
Celsius	3	4.5
Candela	3	4.5
Second	4	6.1
I teach classes that do not require the use of metric measurement	35	53.0

Table 18 indicates the results of questionnaire item 5 for Woods teachers. Nearly 70 per cent of all Woods teachers responding to the survey indicated that they were undecided about when to teach metric measurement in their classes. The comparison group of Industrial Education teachers indicated nearly 34.7 per cent for this category.

Table 18. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (WOODS)

Category	Number	Percent
I already teach metric measurement	4	6.1
During the school year starting in September 1975	6	9.1
During the school year starting in September 1976	3	4.5
Sometime after 1976	7	10.6
Undecided	46	69.7
Total	66	100.0

Table 19 indicates the results of questionnaire item 6 concerning the value of metric teaching information to Woods teachers. The results indicate that government publications and Metric System reference books were of greatest value, while newspapers and curriculum guides have been of least value.

Table 19. As a Source of Metric Teaching Information (WOODS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	0	1	9	13	42	65
Professional Education Journals	5	13	12	6	28	64
Business and Industry Journals	3	4	16	7	34	64
Industrial Conferences	2	12	11	8	33	66
Industrial Sponsored Workshops	3	4	12	4	42	65
Educational In-Service Workshops	4	5	11	7	39	66
Government Publications	7	7	11	8	33	66
Subject Area Textbooks	3	8	10	9	34	64
Metric System Reference Books	11	14	4	7	30	66
Curriculum Guides	1	2	6	12	44	65
Other: (Foreign Travel)	1	0	0	0	0	1

Table 20 indicates the results of questionnaire item 6 concerning the value of various sources of general metric information to Woods teachers. The results indicate that government publications and Metric System reference books were of greatest value while newspapers and curriculum guides were of least value. Nearly 50 per cent of the Woods teachers indicated no opinion concerning the various sources of information on the Metric System.

Table 21 indicates the results of questionnaire item 7 concerning the various factors influencing metric conversion in Woods programs. The cost of new equipment, cost of converting existing equipment, cost of materials and supplies, and cost of tools represented the greatest problems to Woods teachers, while opposition from various groups represented the least problems. Lack of text books in metric units, lack of guidance from the state department of education and a lack of knowledge of the metric system were also rated as overwhelming or servious problems.

Table 20. As a source of General Metric Information (WOODS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	2	4	13	12	35	66
Professional Education Journals	7	13	13	6	26	65
Business and Industry Journals	3	8	9	13	33	66
Industrial Conferences	2	8	13	7	34	64
Industrial Sponsored Workshops	3	6	11	6	40	66
Educational In-service Workshops	4	6	8	9	39	66
Government Publications	10	5	9	8	33	65
Subject Area Textbooks	4	6	4	14	38	66
Metric System Reference Books	16	8	7	7	27	65
Curriculum Guides	2	3	3	15	42	65
Other: (Foreign Travel)	1	0	0	0	0	1

Table 21. Factors Influencing Metric Conversion in Educational Programs . (WOODS)

Factor	Overwhelming Problem	Serious Problem	Problem	Minimal Problem	Not a Problem	No Opinion	Total
Cost of new equipment	6	19	17	11	4	9	66
Cost of converting existing equipment	6	19	19	10	5	7	66
Cost of materials and supplies	6	13	17	14	8	8	66
Cost of tools	9	21	16	5	8	7	66
Opposition from parents	0	4	8	16	22	16	66
Opposition from administrators	0	2	6	14	30	12	64
Opposition from students	1	5	17	15	17	11	66
Opposition from teachers	0	3	13	13	24	11	64
Opposition from industry	1	0	10	11	32	10	64
Opposition from Advisory Committee	0	2	4	9	31	18	64
Lack of text books in metric units	6	15	18	12	6	9	66
Lack of guidance from state department	4	11	12	11	16	10	64
Lack of knowledge of the metric system	8	12	16	12	11	5	64

Section III

Auto

Table 22 indicates the results of the grade level distribution for 41 Auto teachers. Only 2.5 per cent indicated teaching responsibility in junior high school compared with 14 per cent for Comparison Group teachers in the survey. Nearly 64 per cent of the Auto teachers are in high school programs compared to 60 per cent for the Comparison Group teachers. Nearly 34 per cent of the Auto teacher respondents are in post-secondary institutions as compared to 26 per cent for all Industrial Education teachers in the survey.

Table 22. Grade Level Distribution (AUTO)

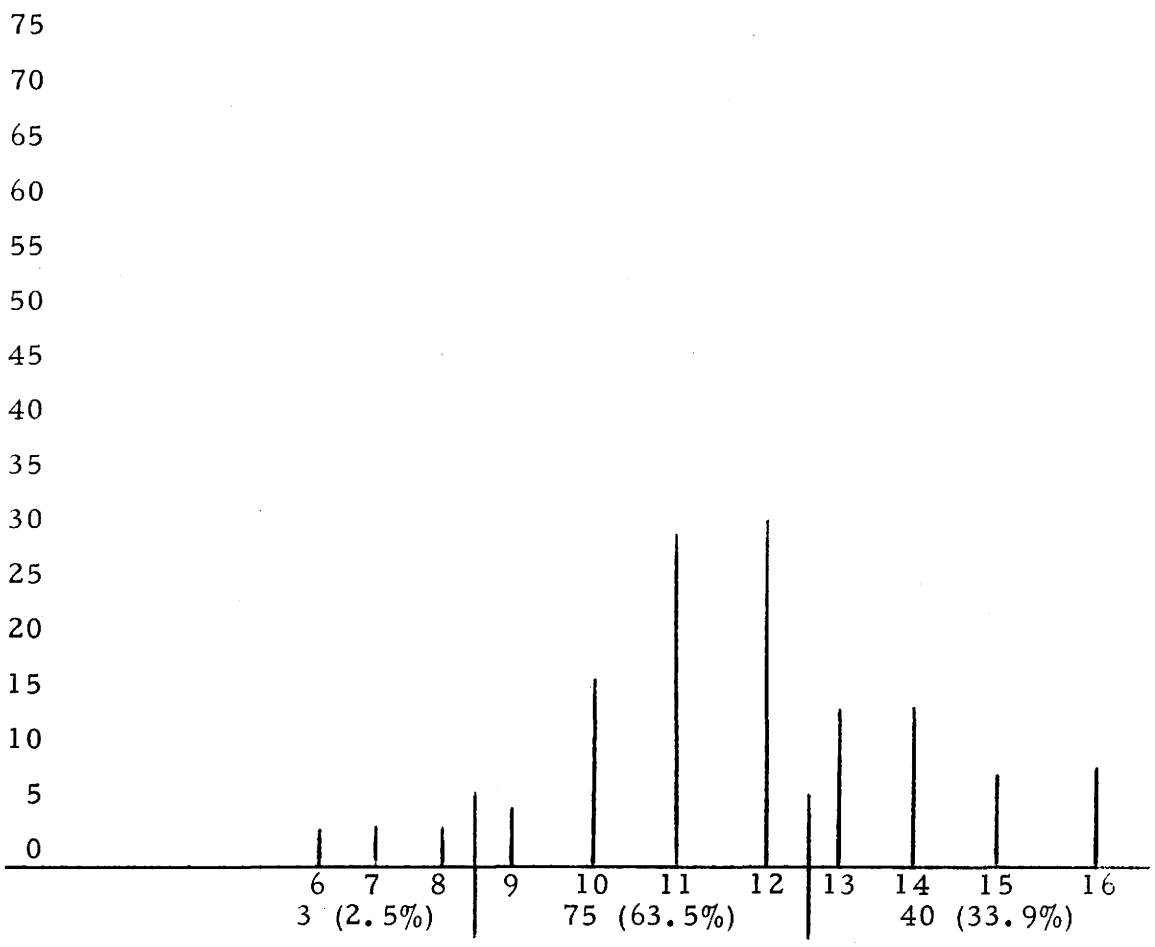


Table 23 indicates the results of questionnaire item 1 for Auto teachers. Nearly 25 per cent of the Auto teachers responding to the survey disagreed or strongly disagreed with the conversion to the metric system in the United States, compared to 10 per cent for the Comparison Group teachers.

Table 23. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (AUTO)

Answer	Number	Percent
I Strongly Agree	13	31.7
I Agree	14	34.1
I am Undecided	4	9.7
I Disagree	7	17.1
I Strongly Disagree	3	7.3
Total	41	99.9

Table 24 indicates the results of questionnaire item 2 for Auto teachers. Nearly 71 per cent of the Auto teachers surveyed were not familiar with Candela and over 50 per cent were not familiar with the Mole and Celsius; a finding very similar to all Industrial Education teachers surveyed.

Table 24. How Familiar are you With the Following Units of the Metric System? (AUTO)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	14	34.1	10	24.4	10	24.4	2	4.8	5	12.2	41
Liter	11	26.8	8	19.5	13	31.7	2	4.8	7	17.1	41
Kilogram	9	21.9	6	14.6	15	36.6	3	7.3	8	19.5	41
Ampere	16	39.0	9	21.9	4	9.7	4	9.7	8	19.5	41
Mole	2	4.8	1	2.4	8	19.5	8	19.5	22	53.6	41
Celsius	5	12.2	2	4.8	5	12.2	8	19.5	21	51.2	41
Candela	0	0	0	0	8	19.5	4	9.7	29	70.7	41
Second	16	39.0	3	7.3	6	14.6	5	12.2	11	26.8	41

Table 25 indicates the results of questionnaire item 3 for Auto teachers. Only 21.9 per cent of the Auto teachers indicated that they taught classes that did not require the use of metric measurement as compared to 48.7 per cent for all Industrial Education teachers surveyed. All other metric unit comparisons for Auto teachers were very similar to the total population of the study.

Table 25. AT PRESENT, Students in my Class Require Proficiency in the Use of the Following Metric Units. (AUTO)

Unit or Category	Number	Percent
Meter	22	53.6
Liter	13	31.7
Kilogram	5	12.2
Ampere	18	43.9
Mole	2	4.8
Celsius	4	9.7
Candela	1	2.4
Second	12	29.3
I teach classes that do not require the use of metric measurement	9	21.9
Not applicable	5	12.2

Table 26 indicates the results of questionnaire item 4 for Auto teachers. All units of the metric system will increase in usage in the future. The percentage of increase is nearly twice that of the present usage, while the number of Auto teachers indicating that metric measurement will not be required, has decreased to 14.6 per cent.

Table 26. IN THE FUTURE, Students in my Class Will Require Proficiency in the Use of the Following Metric Units. (AUTO)

Unit or Category	Number	Percent
Meter	31	75.6
Liter	27	65.8
Kilogram	20	48.8
Ampere	26	63.4
Mole	5	12.2
Celsius	15	36.6
Candela	5	12.2
Second	14	34.1
I teach classes that do not require the use of metric measurement.	6	14.6

Table 27 indicates the results of questionnaire item 5 for Auto teachers. Although over 25 per cent of the Auto teachers are already teaching metric measurement, this response is 10 per cent lower than the results for the Comparison Group teachers in the survey. Nearly 50 per cent of the Auto teachers surveyed were undecided about when to start teaching metric measurement in their classes.

Table 27. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (AUTO)

Category	Number	Percent
I already teach metric measurement	11	26.8
During the school year starting in September 1975	5	12.2
During the school year starting in September 1976	1	2.4
Sometime after 1976	4	9.7
Undecided	20	48.8
Total	41	99.9

Table 28 indicates the results of questionnaire item 6 for Auto teachers concerning the value of various sources of information for teaching the metric system. Newspapers and curriculum guides were of the least value while industrial conferences, Government publications and metric system references books were of the greatest value.

Table 28. As a Source of Metric Teaching Information. (AUTO)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	1	2	7	12	19	41
Professional Education Journals	6	10	10	3	12	41
Business and Industry Journals	6	10	10	8	7	41
Industrial Conferences	9	5	6	6	15	41
Industrial Sponsored Workshops	6	8	3	7	16	40
Educational In-Service Workshops	7	7	4	8	15	41
Government Publications	8	6	14	3	10	41
Subject Area Textbooks	6	9	10	5	11	41
Metric System Reference Books	14	14	7	3	2	40
Curriculum Guides	0	1	11	10	19	41
Other	0	0	0	0	0	0

Table 29 indicates the results of questionnaire item 6 for Auto teachers concerning the value of various sources of general metric information. Government publications, industrial conferences, subject area text books and metric system reference books were of greatest valu to Auto teachers, while newspapers and curriculum guides were of least value.

Table 29. As a Source of General Metric Information. (AUTO)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	3	7	12	9	10	41
Professional Education Journals	9	9	10	2	11	41
Business and Industry Journals	9	12	8	6	6	41
Industrial Conferences	10	5	8	3	15	41
Industrial Sponsored Workshops	7	4	7	8	15	41
Educational In-Service Workshops	9	5	3	8	16	41
Government Publications	15	7	4	3	12	41
Subject Area Textbooks	10	3	13	6	9	41
Metric System Reference Books	13	13	7	2	5	40
Curriculum Guides	0	3	7	10	20	40
Other	0	0	0	0	0	0

Table 30 indicates the various factors which would influence metric conversion in the Auto programs in Utah. Equipment, material, and tool costs as well as lack of guidance from the state were listed as the most serious problems by Auto teachers. Opposition from parents, administrators, students, teachers, industry and advisory committees were considered the least problems.

Table 30. Factors Influencing Metric Conversion in Educational Programs (AUTO)

Factor	Overwhelming Problem	Serious Problem	Problem	Minimal Problem	Not a Problem	No Opinion	Total
Cost of new equipment	6	11	6	13	4	1	41
Cost of converting existing equipment	7	10	9	9	5	1	41
Cost of materials and supplies	3	9	7	12	9	1	41
Cost of tools	8	9	14	4	6	0	41
Opposition from parents	2	1	5	5	20	8	41
Opposition from administrators	1	3	3	7	24	3	41
Opposition from students	2	1	9	12	13	4	41
Opposition from teachers	2	1	8	7	21	1	40
Opposition from industry	1	2	2	7	28	1	41
Opposition from Advisory Committee	1	0	2	4	28	6	41
Lack of text books in metric units	1	8	9	12	9	2	41
Lack of guidance from state department	5	4	6	7	12	7	41
Lack of knowledge of the metric system	2	6	16	7	10	0	41

Section IV

Metals

Table 31 indicates the grade level distribution for Metals teachers responding to the survey. Over 35 per cent of Metals teachers teach classes in junior high school. The percentage of junior high school teachers for all Industrial Education programs reporting is only 16.5 per cent.

Table 31. Grade Level Distribution (METALS)

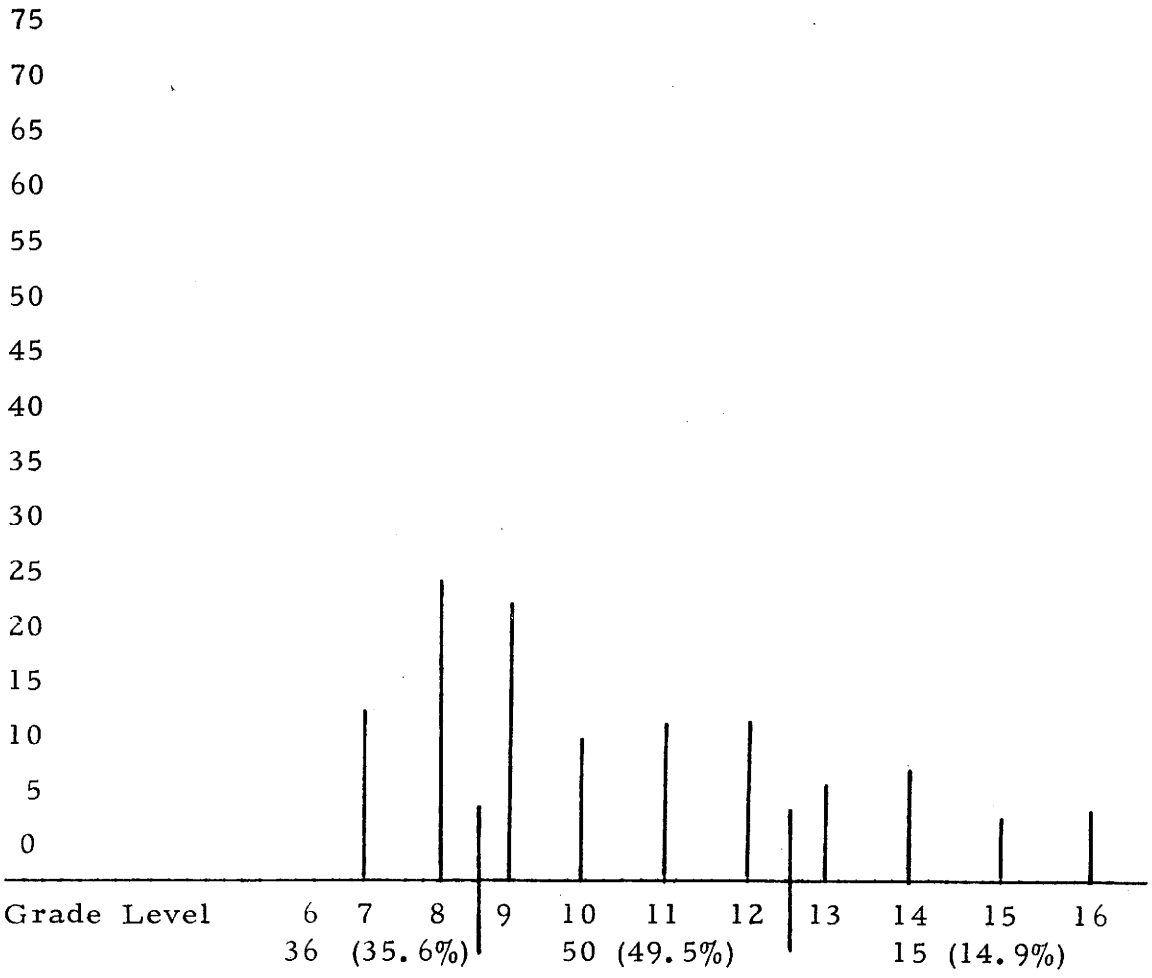


Table 32 indicates the results of questionnaire item 1 from Metals teachers. Not one Metals teacher responding to the survey disagreed with the conversion to the Metric System in the United States.

Table 32. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (METALS)

Answer	Number	Percent
I Stongly Agree	14	35.0
I Agree	20	50.0
I am Undecided	6	15.0
I Disagree	0	0
I Strongly Disagree	0	0
Total	40	100.0

Table 33 indicates the results of questionnaire item 2 for Metals teachers. The Mole, Celsius and Candela are the least familiar units of the Metric System, while the Meter, Ampere and the Second are the most familiar units to Metals teachers.

Table 33. How Familiar are You With the Following Units of the Metric System? (METALS)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	8	20.0	17	42.5	8	20.0	3	7.5	4	10.0	40
Liter	6	15.0	11	27.5	11	27.5	6	15.0	6	15.0	40
Kilogram	6	15.0	10	25.0	11	27.5	6	15.0	7	17.5	40
Ampere	17	42.5	7	17.5	6	15.0	1	2.5	9	22.5	40
Mole	2	5.0	2	5.0	7	17.5	7	17.5	22	55.0	40
Celsius	4	10.0	4	10.0	5	12.5	6	15.0	21	52.5	40
Candela	0	0	2	5.0	5	12.5	5	12.5	28	70.0	40
Second	14	35.0	8	20.0	8	20.0	2	5.0	8	20.0	40

Tables 34 and 35 indicate the results of questionnaire items 3 and 4 for Metals teachers. Over 50 per cent of the Metals teachers responding to the survey presently do not require the use of metric measurement in their classes. In the future, this percentage will drop to 22.5 per cent.

Table 34. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (METALS)

Unit or Category	Number	Percent
Meter	14	35.0
Liter	5	12.5
Kilogram	7	17.5
Ampere	13	32.5
Mole	2	5.0
Celsius	4	10.0
Candela	1	2.5
Second	7	17.5
I teach classes that do not require the use of metric measurement	20	50.0
Not applicable	3	7.5

Table 35. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (METALS)

Unit or Category	Number	Percent
Meter	30	75.0
Liter	12	30.0
Kilogram	17	42.5
Ampere	19	47.5
Mole	4	10.0
Celsius	10	25.0
Candela	2	5.0
Second	11	27.5
I teach classes that do not require the use of metric measurement	9	22.5

Table 36 indicates the results of questionnaire item 5 for Metals teachers. Although 5 Metals teachers (12.5 per cent) are currently teaching metric measurement in their classes, 20 Metals teachers (50.0 per cent) are undecided about starting metric measurement in their classes.

Table 36. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (METALS)

Category	Number	Percent
I already teach metric measurement	5	12.5
During the school year starting in September 1975	7	17.5
During the school year starting in September 1976	5	12.5
Sometime after 1976	3	7.5
Undecided	20	50.0
Total	40	100.0

Tables 37 and 38 indicate the results of questionnaire item 6 for Metals teachers. Government publications, metric system reference books and curriculum guides were of the greatest value to Metals teachers as sources of metric teaching information. Curriculum guides were not as valuable as sources of general metric information, although government publications, and metric

Table 37. As a Source of General Metric Information (Metals).

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of no Value	No Opinion	Total
Newspapers	0	3	4	10	22	39
Professional Education Journals	4	10	11	2	12	39
Business and Industry Journals	4	6	6	7	17	40
Industrial Conferences	4	10	5	2	18	39
Industrial Sponsored Workshops	3	8	3	0	25	39
Educational In-service Workshops	1	9	2	0	26	38
Government Publications	5	9	7	4	13	38
Subject Area Textbooks	2	12	9	0	16	39
Metric System Reference Books	8	7	7	0	15	37
Curriculum Guides	7	5	2	3	23	40
Other:	0	0	0	0	0	0

Table 38. As a Source of General Metric Information. (METALS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	2	7	7	3	20	39
Professional Education Journals	5	8	9	2	15	39
Business and Industry Journals	1	4	13	2	19	39
Industrial Conferences	4	6	8	2	17	39
Industrial Sponsored Workshops	2	3	5	3	23	36
Educational In-service Workshops	1	4	4	3	25	37
Government Publications	9	7	5	3	15	39
Subject Area Textbooks	3	6	8	2	18	37
Metric System Reference Books	10	9	4	3	14	40
Curriculum Guides	1	3	5	4	25	38
Other	0	0	0	0	0	0

system reference books were of greatest value to Metals teachers in this category.

Metals teachers responding to questionnaire item 7 indicated that cost of equipment, materials, and tools were the most serious problems influencing metric conversion. Lack of text books, guidance from the state, and a lack of their own knowledge of the metric system ranked second as problem areas. Table 39 indicates the results of questionnaire item 7.

Table 39, Factors Influencing Metric Conversion in Educational Programs (METALS)

Factor	Overwhelming Problem	Serious Problem	Problem	Minimal Problem	Not a Problem	No Opinion	Total
Cost of new equipment	6	16	10	2	5	1	40
Cost of converting existing equipment	5	16	11	4	3	1	40
Cost of materials and supplies	2	10	15	4	7	2	40
Cost of tools	2	15	13	3	4	2	39
Opposition from parents	0	1	6	11	17	5	40
Opposition from administrators	1	0	5	7	23	4	40
Opposition from students	1	2	9	11	15	1	39
Opposition from students	1	1	4	13	19	2	40
Oppisition from industry	0	3	5	7	20	4	39
Opposition from Advisory Committee	0	0	2	6	23	9	40
Lack of text books in metric units	1	9	12	9	5	3	39
Lack of guidance from state department	3	10	13	6	3	5	40
Lack of knowledge of the metric system	4	9	16	6	3	1	39

Section V

Drafting

The majority of Drafting teachers are concentrated in the high school Industrial Education programs. Over 78 per cent of the respondents in Drafting indicated this grade level distribution, as compared to 58.5 per cent for the Comparison Group teachers responding to this survey. Only 4.2 per cent of the Drafting teachers are in the junior high school program and 17.7 per cent in post-secondary institutions.

Table 40 indicates the grade level distribution for Drafting teachers.

Table 40. Grade Level Distribution (DRAFTING).

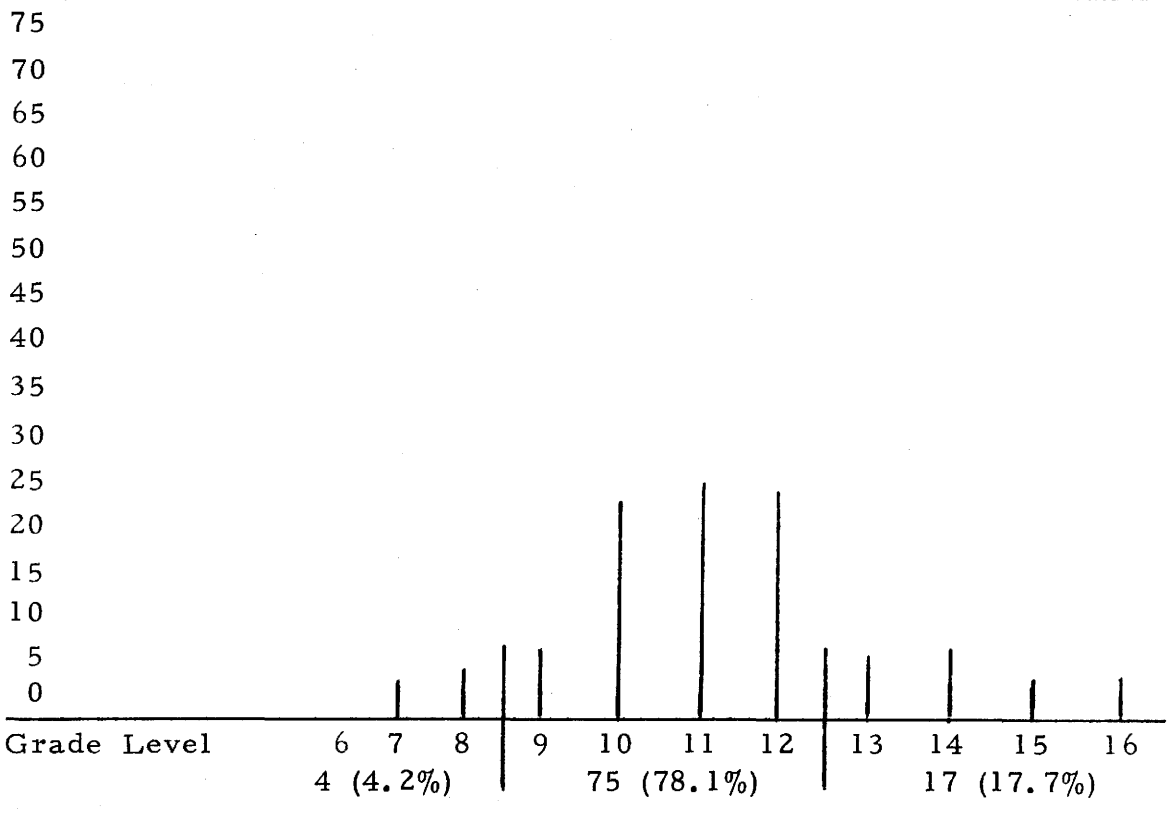


Table 41 indicates the responses for questionnaire item 1 for Drafting teachers. Over 86 per cent agree with the conversion to the metric system in the United States compared to 69.6 per cent for the Comparison Group teachers responding to the survey.

Other than Electronics teachers, Drafting teachers responding to the survey are more familiar with the units of the Metric System when compared to the Comparison Group teachers responses, but indicated a general lack of familiarity with the Mole, Celsius, and Candela. Table 42 indicates the results of questionnaire item 2 for Drafting teachers.

Table 41. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (DRAFTING)

Answer	Number	Percent
I Strongly Agree	13	43.3
I Agree	13	43.3
I am Undecided	3	10.0
I Disagree	0	0
I Strongly Disagree	1	3.3
Total	30	99.9

Table 42. How Familiar are You With the Following Units of the Metric System? (DRAFTING)

Unit	Totally Familiar							Not Familiar			
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	18	60.0	8	26.6	4	13.3	0	0	0	0	30
Liter	12	40.0	8	26.6	8	26.6	2	6.6	0	0	30
Kilogram	10	33.3	7	23.3	12	40.0	1	3.3	0	0	30
Ampere	17	56.6	6	20.0	2	6.6	4	13.3	1	3.3	30
Mole	1	3.3	2	6.6	12	40.0	4	13.3	11	36.6	30
Celsius	8	26.6	7	23.3	4	13.3	13	43.3	8	26.6	30
Candela	4	13.3	3	10.0	5	16.6	2	6.6	16	53.3	30
Second	14	46.6	5	16.6	5	16.6	3	10.0	3	10.0	30

Tables 43 and 44 indicate the results of questionnaire items 3 and 4 for Drafting teachers. Eleven Drafting teachers (36.6 per cent) indicated that they presently taught classes that did not require the use of metric measurement. This compares to 50.2 per cent for the Comparison Group teachers responding to the survey.

Five Drafting teachers (16.6 per cent) indicated that metric measurement would not be required in the future compared to 35.3 per cent for the Comparison Group teachers.

Table 43. AT PRESENT, Stidents in My Class Require Proficiency in the Use of the Following Metric Units. (DRAFTING)

Unit or Category	Number	Percent
Meter	15	50.0
Liter	6	20.0
Kilogram	6	20.0
Ampere	6	20.0
Mole	0	0
Celsius	1	3.3
Candela	0	0
Second	4	13.3
I teach classes that do not require the use of metric measurement	11	36.6
Not applicable	3	10.0

Table 44. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (DRAFTING)

Unit or Category	Number	Percent
Meter	25	83.3
Liter	13	43.3
Kilogram	13	43.3
Ampere	11	36.6
Mole	1	3.3
Celsius	8	26.6
Candela	3	13.3
Second	8	26.6
I teach classes that do not require the use of metric measurement	5	16.6

Over 43 per cent of the Drafting teachers responding to the survey indicated that they were presently teaching metric measurement in their classes, compared to 33.3 per cent for all Industrial Education teachers. Table 45 indicates the results of questionnaire item 5.

Table 45. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (DRAFTING)

Category	Number	Percent
I already teach metric measurement	13	43.3
During the school year starting in September 1975	1	3.3
During the school year starting in September 1976	4	13.3
Sometime after 1976	1	3.3
Undecided	11	36.6
Total	30	99.8

Government publications and metric system reference books were the most valuable sources of general and teaching metric information to Drafting teachers. Newspapers, industrial conferences, and curriculum guides were of least value in both categories. Tables 46 and 47 indicate the results of questionnaire item 6.

Table 46. As a Source of Metric Teaching Information. (DRAFTING)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	2	6	10	12	30
Professional Education Journals	5	9	7	1	8	30
Business and Industry Journals	3	8	9	2	8	30
Industrial Conferences	1	4	8	4	13	30
Industrial Sponsored Workshops	4	1	6	6	13	30
Educational In-Service Workshops	4	4	4	6	11	29
Government Publications	6	5	8	1	10	30
Subject Area Textbooks	3	7	7	7	6	30
Metric System Reference Books	10	11	5	1	3	30
Curriculum Guides	2	2	5	9	12	30
Other	0	0	0	0	0	0

Table 47. As a Source of General Metric Information. (DRAFTING)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	1	7	9	4	9	30
Professional Education Journals	5	9	9	1	6	30
Business and Industry Journals	5	8	9	2	4	28
Industrial Conferences	2	6	8	2	12	30
Industrial Sponsored Workshops	3	7	6	3	11	30
Educational In-Service Workshops	3	5	6	4	12	30
Government Publications	9	5	8	1	7	30
Subject Area Textbooks	3	7	7	9	4	30
Metric System Reference Books	10	9	5	1	5	30
Curriculum Guides	1	2	5	10	12	30
Other	0	0	0	0	0	0

Drafting teachers responding to the survey considered costs of equipment, materials, and tools to be problem areas but not overwhelming ones. Lack of text books in metric units, lack of guidance from the state were also considered problem areas. Opposition from parents, administrators, students, teachers, industry, and advisory committees were not considered a problem by over 50 per cent of the Drafting teachers responding to the survey. Table 48 indicates the results of questionnaire item 7 for Drafting teachers.

Table 48. Factors Influencing Metric Conversion in Educational Program. (DRAFTING)

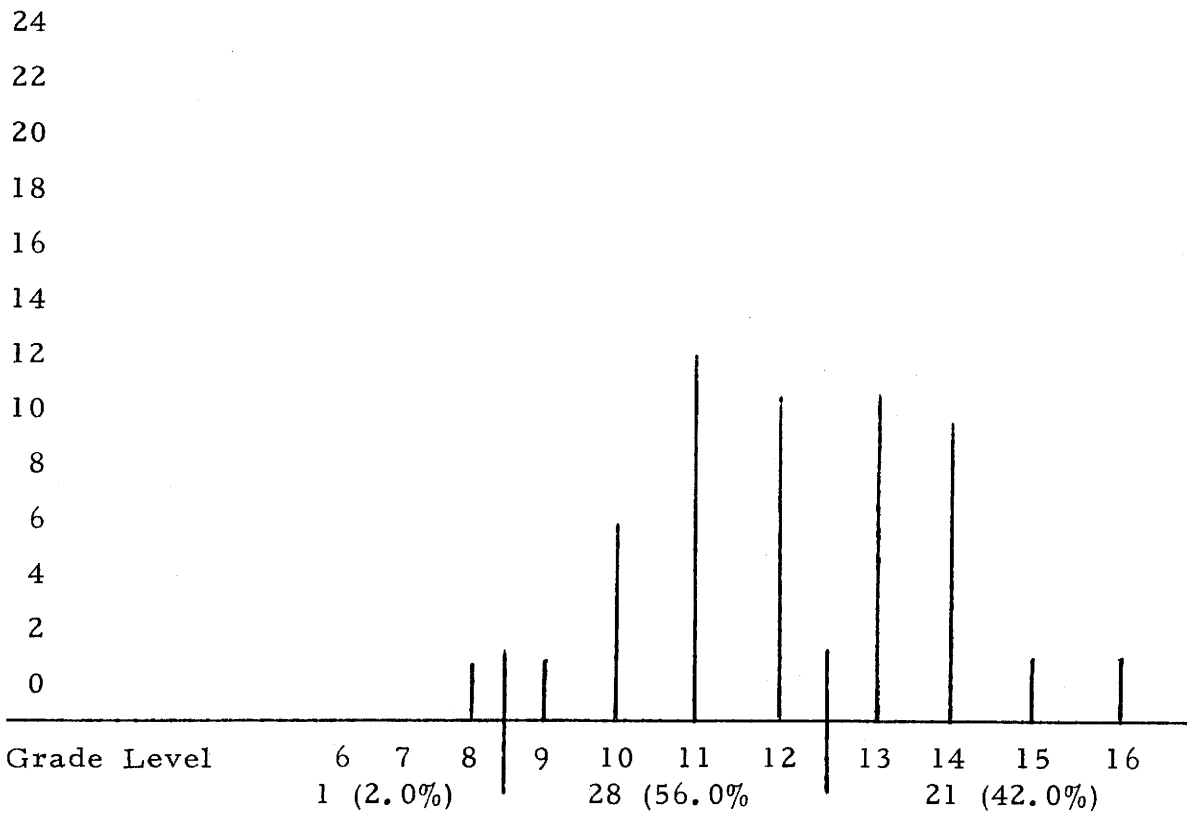
Factor	Overwhelming Problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	2	6	9	8	3	2	30
Cost of converting existing equipment	1	6	7	9	5	2	30
Cost of materials and supplies	1	4	5	11	7	2	30
Cost of tools	1	5	5	12	5	2	30
Opposition from parents	0	4	1	4	15	6	30
Opposition from administrators	0	2	2	4	18	4	30
Opposition from students	0	5	1	7	14	3	30
Opposition from teachers	0	2	3	3	16	6	30
Opposition from industry	2	1	1	3	14	9	30
Opposition from Advisory Committee	2	2	0	1	17	7	29
Lack of text books in metric units	2	12	11	3	1	1	30
Lack of guidance from state department	2	6	7	6	3	6	30
Lack of knowledge of the metric system	1	4	9	6	8	2	30

Section VI

Machine Shop

Over 42 per cent of the Machine Shop teachers responding to this survey teach in post-secondary institutions as compared to only 26 per cent for the Comparison Group teachers. Only one respondent teaches machine shop in junior high school compared to 14 per cent for the Comparison Group teachers. Table 49 illustrates the grade level distribution for Machine Shop teachers.

Table 49. Grade Level Distribution (MACHINE SHOP)



Nearly 46 per cent of the Machine Shop teachers surveyed strongly agreed with metric conversion in the United States compared with 33 per cent for the Comparison Group teachers surveyed. Only one Machine Shop teacher (4.5 per cent) disagreed with Metric conversion. Table 50 indicates the results of questionnaire item 1.

Table 50. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (MACHINE SHOP)

Answer	Number	Percent
I Strongly Agree	10	45.4
I Agree	8	36.4
I am Undecided	3	13.6
I Disagree	0	0
I Strongly Disagree	1	4.5
Total	22	99.9

Table 51 illustrates the results of questionnaire item 2 for Machine Shop teachers. Nearly one-third of the Machine Shop teachers were totally familiar with the Meter, Kilogram, and Ampere while over 77 per cent were completely unfamiliar with Mole and Candela.

Table 51. How Familiar Are You With the Following Units of the Metric System? (MACHINE SHOP)

	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	7	31.8	10	45.4	4	18.2	0	0	1	4.5	22
Liter	7	13.6	5	22.7	8	36.4	2	9.1	4	18.2	22
Kilogram	6	27.3	5	22.7	6	27.3	3	13.6	2	9.1	22
Ampere	7	33.3	4	19.0	5	23.8	1	4.7	4	19.0	21
Mole	1	4.5	1	4.5	1	4.5	2	9.1	17	77.3	22
Celsius	2	9.1	1	4.5	5	22.7	2	9.1	12	54.5	22
Candela	0	0	2	9.1	1	4.5	2	9.1	17	77.3	22
Second	13	59.1	2	9.1	1	4.5	1	4.5	5	22.7	22

Table 52 illustrates the results of questionnaire item 3 for Machine Shop teachers. Although some metric proficiency is required, over 54 per cent of the Machine Shop teachers do not require the use of metric measurement in their classes, compared to 49 per cent for the Comparison Group teachers in the survey.

Table 52. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (MACHINE SHOP)

Unit or Category	Number	Percent
Meter	10	45.4
Liter	2	9.1
Kilogram	7	31.8
Ampere	0	0
Mole	0	0
Celsius	4	18.2
Candela	1	4.5
Second	5	22.7
I teach classes that do not require the use of metric measurement	12	54.5
Not applicable	1	4.5

Table 53 illustrates the results of questionnaire item 4 for Machine Shop teachers. The Liter, Mole, and Candela will not experience increased use in the future, although the use of the Meter will double.

Table 53. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (MACHINE SHOP)

Unit or Category	Number	Percent
Meter	19	86.4
Liter	2	9.1
Kilogram	8	36.4
Ampere	3	13.6
Mole	0	0
Celsius	6	27.3
Candela	1	4.5
Second	7	31.8
I teach classes that do not require the use of metric measurement	3	13.6

Nearly one-half (45.5 per cent) of the Machine Shop teachers are already teaching metric measurement in their classes compared to only 36 per cent for the Comparison Group teachers. Table 54 indicates the results of questionnaire item 5 for Machine Shop teachers.

Table 54. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (MACHINE SHOP)

Category	Number	Percent
I already teach metric measurement	10	45.5
During the school year starting in September 1975	4	18.2
During the school year starting in September 1976	3	13.6
Sometime after 1976	1	4.5
Undecided	4	18.2
Total	22	100.0

Tables 55 and 56 indicate the results of questionnaire item 6 for Machine Shop teachers. Nearly 50 per cent of all Machine Shop teachers expressed no opinion concerning the various sources of metric information.

Table 57 indicates the results of questionnaire item 7 for Machine Shop teachers. Cost factors for equipment, tools, and materials as well as lack of text books, guidance from the state department and lack of knowledge of the Metric System were considered overwhelming problems in converting to the Metric System.

Table 55. As a Source of Metric Teaching Information. (MACHINE SHOP)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	1	3	4	14	22
Professional Education Journals	1	6	5	1	9	22
Business and Industry Journals	0	5	5	0	12	22
Industrial Conferences	2	5	2	2	11	22
Industrial Sponsored Workshops	1	1	2	2	15	21
Educational In-Service Workshops	1	2	3	2	14	22
Government Publications	0	6	7	0	9	22
Subject Area Textbooks	3	3	3	3	10	22
Metric System Reference Books	2	6	4	1	9	22
Curriculum Guides	1	2	2	2	15	22
Other	0	0	0	0	0	0

Table 56. As a Source of General Metric Information. (MACHINE SHOP)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	3	1	5	2	11	22
Professional Education Journals	3	6	4	1	8	22
Business and Industry Journals	3	3	4	0	12	22
Industrial Conferences	2	2	4	2	12	22
Industrial Sponsored Workshops	0	1	2	4	15	22
Educational In-Service Workshops	0	0	4	4	14	22
Government Publications	3	4	6	0	9	22
Subject Area Textbooks	2	2	5	4	9	22
Metric System Reference Books	5	5	3	0	9	22
Curriculum Guides	0	0	4	4	14	22
Other	0	0	0	0	0	0

Table 57. Factors Influencing Metric Conversion in Educational Program. (MACHINE SHOP)

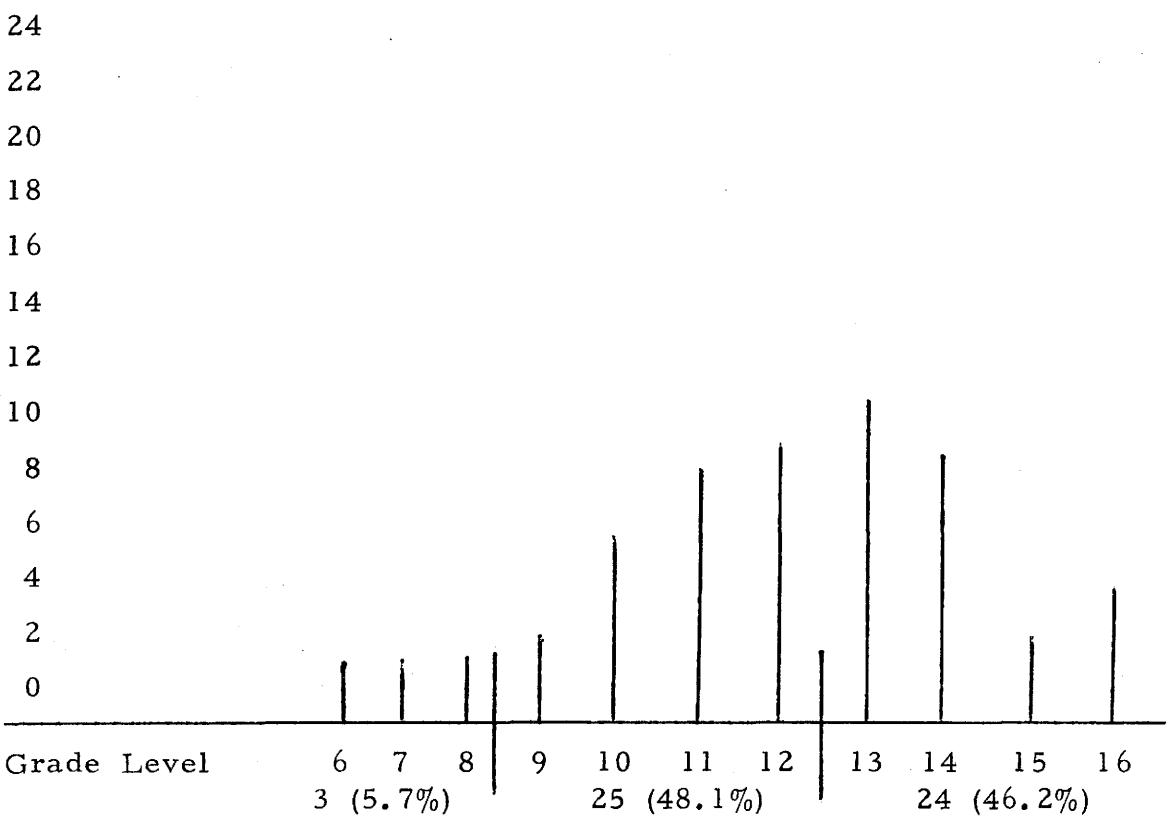
Factor	Overwhelming Problem	Serious problem	Problem	Minimal Problem	Not a problem	No Opinion	Total
Cost of new equipment	8	6	2	3	2	1	22
Cost of converting existing equipment	3	11	1	4	1	2	22
Cost of materials and supplies	2	3	4	6	5	2	22
Cost of tools	4	6	7	2	2	1	22
Opposition from parents	0	1	0	6	11	4	22
Opposition from administrators	1	0	0	4	13	4	22
Opposition from students	1	0	1	6	12	2	22
Opposition from teachers	0	2	1	4	12	3	22
Opposition from industry	1	0	1	3	14	3	22
Opposition from Advisory Committee	0	1	2	3	13	3	22
Lack of text books in metric units	3	4	5	4	4	2	22
Lack of guidance from state department	4	4	4	5	2	3	22
Lack of knowledge of the metric system	2	5	4	4	4	2	21

Section VII

Electronics

Twenty Electricity and Electronics teachers responded to this survey. Nearly 6 per cent of the respondents teach classes in junior high school, 48 per cent in high school and the remaining 46 per cent of the teachers are in post-secondary institutions. Table 58 indicates this grade level distribution.

Table 58. Grade Level Distribution (ELECTRONICS)



Of the twenty Electronics teachers responding to this survey, seventeen (85.0 per cent) agreed with the conversion to the Metric System in the United States. Table 59 indicates the responses to questionnaire item 1.

Table 59. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (ELECTRONICS)

Answer	Number	Percent
I Strongly Agree	13	65.0
I Agree	4	20.0
I am Undecided	3	15.0
I Disagree	0	0
I Strongly Disagree	0	0
Total	20	100.0

Table 60 indicates the results of questionnaire item 2 for Electronics teachers. Twice as many Electronics teachers indicated total familiarity with the Metric System as did the total of all Industrial Education teachers.

Table 60. How Familiar Are You With the Following Units of the Metric System?

Unit	Totally Familiar							Not Familiar			
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	16	80.0	2	10.0	2	10.0	0	0	0	0	20
Liter	11	55.0	4	20.0	3	15.0	1	5.0	1	5.0	20
Kilogram	14	70.0	3	15.0	2	10.0	1	5.0	0	0	20
Ampere	17	85.0	3	15.0	0	0	0	0	0	0	20
Mole	6	30.0	6	30.0	1	5.0	2	10.0	5	25.0	20
Celsius	11	55.0	4	20.0	1	5.0	2	10.0	2	10.0	20
Candela	6	30.0	3	15.0	4	20.0	2	10.0	5	25.0	20
Second	18	90.0	2	10.2	0	0	0	0	0	0	20

Tables 61 and 62 indicate the results of questionnaire items 3 and 4 for Electronics teachers. All twenty (100 per cent) of the Electronics teachers indicated that students in their classes required proficiency in the use of the Ampere, eighteen (90 per cent) required proficiency with the Second, and sixteen (80 per cent) required proficiency with the Meter. These three metric units will require the same proficiency in the future, and the use of all other metric units will increase in the future.

Table 61. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (ELECTRONICS)

Unit of Category	Number	Percent
Meter	16	80.0
Liter	5	25.0
Kilogram	8	40.0
Ampere	20	100.0
Mole	1	5.0
Celsius	9	45.0
Candela	5	25.0
Second	18	90.0
I teach classes that do not require the use of metric measurement	0	0
Not applicable	0	0

Table 62. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (ELECTRONICS)

Unit or Category	Number	Percent
Meter	16	80.0
Liter	8	40.0
Kilogram	12	60.0
Ampere	20	100.0
Mole	3	15.0
Celsius	13	65.0
Candela	6	30.0
Second	18	90.0
I teach classes that do not require the use of metric measurement	0	0

Table 63 indicates the responses to questionnaire item 5 for Electronics teachers. Eighty per cent of the Electronics teachers are presently teaching metric measurement in their classes. Three Electronics teachers (15 per cent) are undecided about the time to start teaching metric measurement in their classes.

Table 63. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (ELECTRONICS)

Category	Number	Percent
I already teach metric measurement	16	80.0
During the school year starting in September 1975	1	5.0
During the school year starting in September 1976	0	0
Sometime after 1976	0	0
Undecided	3	15
Total	20	100.0

Tables 64 and 65 indicate the responses to questionnaire item 6 for Electronics teachers. Government publications, subject area text books, and metric system reference books were of major value as sources of metric information.

Table 66 indicates the responses to questionnaire item 7 from Electronics teachers. Over fifty per cent of the respondents indicated that every factor was a minimal problem or no problem concerning metric conversion.

Table 64. As a Source of Metric Teaching Information. (ELECTRONICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	1	6	3	10	20
Professional Education Journals	2	2	5	4	7	20
Business and Industry Journals	3	4	3	3	7	20
Industrial Conferences	2	1	3	4	10	20
Industrial Sponsored Workshops	2	3	1	4	10	20
Educational In-Service Workshops	2	2	0	7	9	20
Government Publications	5	2	2	2	9	20
Subject Area Textbooks	8	3	3	1	5	20
Metric System Reference Books	10	1	1	1	7	20
Curriculum Guides	2	1	3	3	11	20
Other	0	0	0	0	0	0

Table 65. As a Source of General Metric Information. (ELECTRONICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	3	1	4	4	8	20
Professional Education Journals	2	5	4	4	5	20
Business and Industry Journals	3	5	4	3	5	20
Industrial Conferences	2	1	5	3	9	20
Industrial Sponsored Workshops	2	2	3	4	9	20
Educational In-Service Workshops	1	3	1	6	9	20
Government Publications	5	3	3	2	7	20
Subject Area Textbooks	9	4	2	2	3	20
Metric System Reference Books	10	1	0	2	7	20
Curriculum Guides	1	1	3	6	9	20
Other	0	0	0	0	0	0

Table 66. Factors Influencing Metric Conversion in Educational Program. (ELECTRONICS)

Factor	Overwhelming Problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	0	2	5	4	8	1	20
Cost of converting existing equipment	0	1	6	5	8	0	20
Cost of materials and supplies	0	1	5	5	8	1	20
Cost of tools	0	3	6	3	7	1	20
Opposition from parents	0	2	2	1	11	4	20
Opposition from administrators	0	0	0	5	12	3	20
Opposition from students	1	1	5	5	7	1	20
Opposition from teachers	0	0	2	5	12	1	20
Opposition from industry	0	1	4	1	12	2	20
Opposition from Advisory Committee	0	0	2	1	14	3	20
Lack of text books in metric units	0	1	3	6	9	1	20
Lack of guidance from state department	1	0	2	2	12	2	19
Lack of knowledge of the metric system	1	1	1	4	11	2	20

Section VIII

Welding

The twelve Welding teachers responding to the survey were primarily from high school programs (65.7 per cent). Only one Welding teacher (2.8 per cent) indicated that he taught in junior high school. The remaining 31.5 per cent of the Welding teachers responding to the survey taught classes in post-secondary institutions. Table 67 indicates the grade level distribution for Welding teachers in Utah.

Table 67. Grade Level Distribution (WELDING)

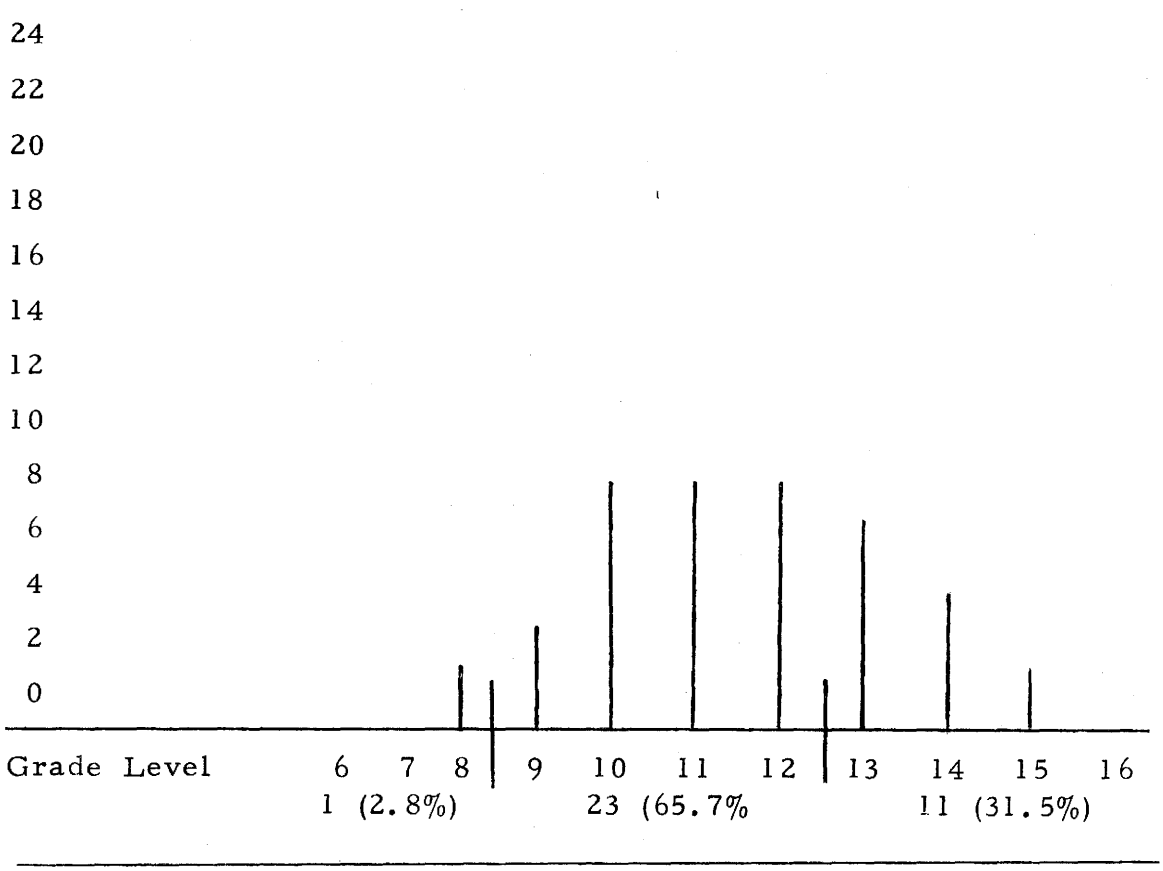


Table 68 indicates the results of questionnaire item 1 for Welding teachers. Not one Welding teachers responding to the survey disagreed with the conversion to the Metric System in the United States.

Table 68. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (WELDING)

Answer	Number	Percent
I Strongly Agree	0	0
I Agree	8	66.6
I am Undecided	4	33.3
I Disagree	0	0
I Strongly Disagree	0	0
Total	12	99.9

Welding teachers responding to the survey were generally familiar with the Ampere and the Second, but indicated a general lack of knowledge of the Mole, Celsius, and Candela. Table 69 indicates the results of questionnaire item 2.

Table 69. How Familiar Are You With the Following Units of the Metric System? (WELDING)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	3	25.0	5	41.6	1	8.3	1	8.3	2	16.6	12
Liter	2	16.6	1	8.3	4	33.3	3	25.0	2	16.6	12
Kilogram	2	16.6	3	25.0	2	16.6	2	16.6	3	25.0	12
Ampere	7	58.3	2	16.6	0	0	1	8.3	2	16.6	12
Mole	0	0	0	0	1	8.3	4	33.3	7	58.3	12
Celsius	1	8.3	1	8.3	2	16.6	4	33.3	4	33.3	12
Candela	0	0	2	16.6	0	0	2	16.6	8	66.6	12
Second	8	66.6	0	0	0	0	1	8.3	3	25.0	12

Tables 70 and 71 illustrate the results of questionnaire items 3 and 4 for Welding teachers. Welding teachers are presently less familiar with all units of the Metric System than the Comparison Group teachers. Six Welding teachers (50.0 per cent) indicated that they taught classes that did not require the use of metric measurement at the present time. Metric measurement will be used to a greater extent by Welding teachers in the future. All units of the Metric System, except Mole and Candela, will be increased in Welding programs in the future.

Table 70. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (WELDING)

Unit or Cetegory	Number	Percent
Meter	5	41.6
Liter	0	0
Kilogram	2	16.6
Ampere	3	25.0
Mole	0	0
Celsius	1	8.3
Candela	0	0
Second	2	16.6
I teach classes that do not require the use of metric measurement	6	50.0
Not applicable	0	0

Table 71. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Units. (WELDING)

Unit or Category	Number	Percent
Meter	8	66.6
Liter	2	16.6
Kilogram	7	58.3
Ampere	7	58.3
Mole	0	0
Celsius	5	41.6
Candela	0	0
Second	6	50.0
I teach classes that do not require the use of metric measurement	3	25.0

Nearly 60 per cent of the Welding teachers responding to the survey are already teaching metric measurement or have plans to do so within the next year. Five Welding teachers (41.6 per cent) are undecided about starting metric measurement in their classes. Table 72 indicates the responses to questionnaire item 5 for Welding teachers.

Table 72. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (WELDING)

Category	Number	Percent
I already teach metric measurement	2	16.6
During the school year starting in September 1975	2	16.6
During the school year starting in September 1976	3	25.0
Sometime after 1976	0	0
Undecided	5	41.6
Total	12	99.8

Government publications, subject area textbooks, and metric system reference books were of greatest value to Welding teachers as sources of metric teaching information. However, professional conferences and journals were also listed as valuable sources of general metric information by Welding teachers. Tables 73 and 74 indicate the responses to questionnaire item 6.

Table 73. As a Source of Metric Teaching Information. (WELDING)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	0	2	2	8	12
Professional Education Journals	0	3	3	2	4	12
Business and Industry Journals	0	3	3	2	4	12
Industrial Conferences	1	1	2	3	5	12
Industrial Sponsored Workshops	0	1	2	4	5	12
Educational In-Service Workshops	0	2	1	6	3	12
Government Publications	3	4	1	1	3	12
Subject Area Textbooks	2	1	1	5	3	12
Metric System Reference	3	6	0	0	3	12
Curriculum Guides	0	1	1	4	6	12
Other	0	0	0	0	0	0

Table 74. As a Source of General Metric Information. (WELDING)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	1	2	0	1	8	12
Professional Education Journals	2	5	0	1	4	12
Business and Industry Journals	3	3	1	1	4	12
Industrial Conferences	3	1	1	2	5	12
Industrial Sponsored Workshops	0	2	2	3	5	12
Educational In-Service Workshops	0	2	1	6	3	12
Government Publications	6	2	0	1	3	12
Subject Area Textbooks	2	2	0	5	3	12
Metric System Reference Books	6	3	0	0	3	12
Curriculum Guides	0	1	1	5	5	12
Other	0	0	0	0	0	0

Welding teachers responding to the survey did not generally consider the factors in questionnaire item 7 to be overwhelming problems, although costs of equipment, materials, and tools were listed as generally serious. Lack of text books in metric units was considered one of the more serious problems by the Welding teachers. Table 75 indicates the results of questionnaire item 7 for Welding teachers.

Table 75. Factors Influencing Metric Conversion in Educational Program. (WELDING)

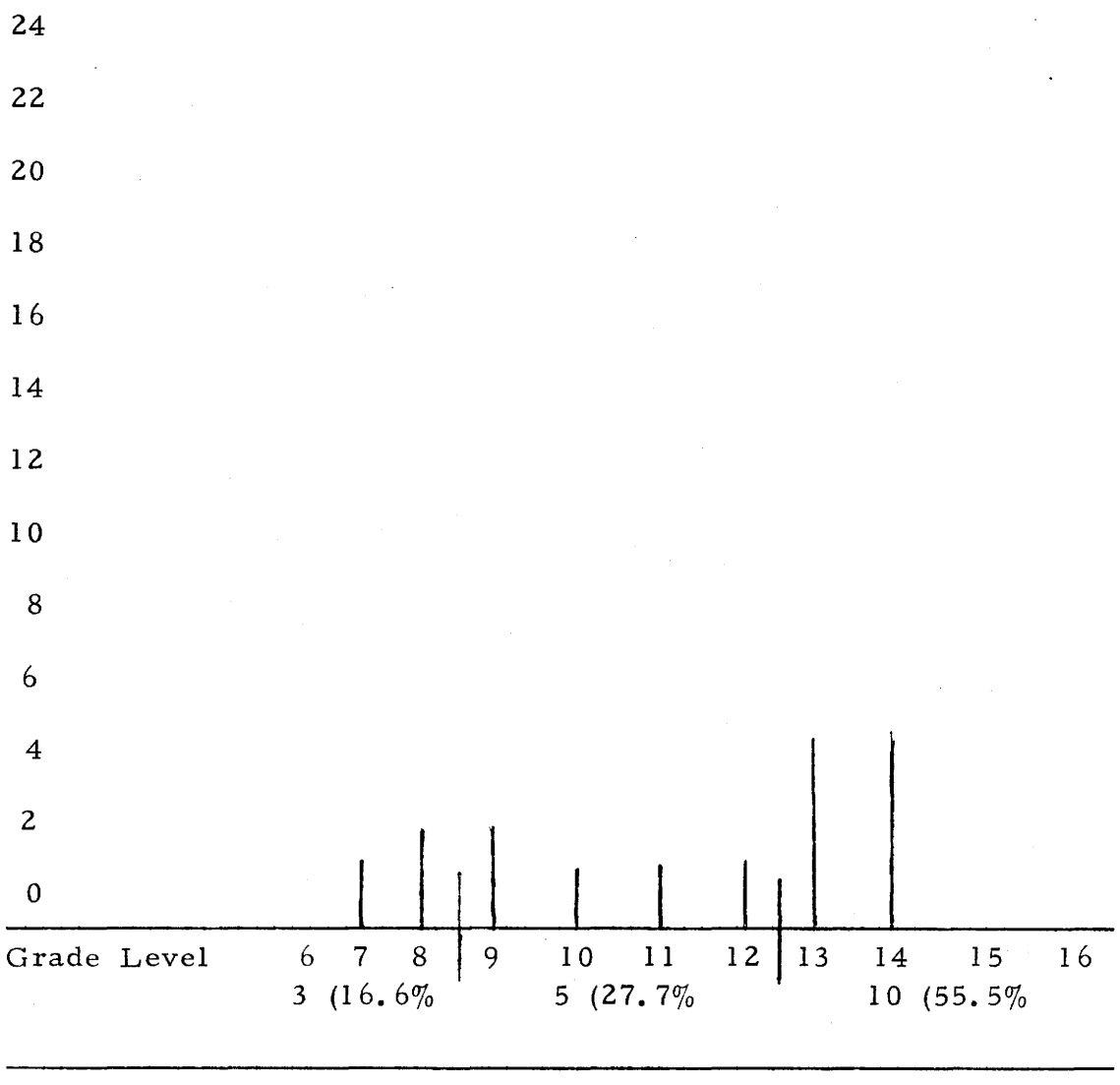
Factor	Overwhelming Problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	0	3	5	2	1	1	12
Cost of converting existing equipment	0	2	6	2	1	1	12
Cost of materials and supplies	1	3	0	6	1	1	12
Cost of tools	1	3	4	1	2	1	12
Opposition from parents	0	0	0	4	4	4	12
Opposition from administrators	0	0	0	3	5	4	12
Opposition from students	0	0	2	4	3	3	12
Opposition from teachers	0	0	1	4	4	3	12
Opposition from industry	0	0	0	4	4	4	12
Opposition from Advisory Committee	0	0	0	3	5	4	12
Lack of text books in metric units	2	2	4	2	0	2	12
Lack of guidance from state department	0	5	0	2	1	4	12
Lack of knowledge of the metric system	0	1	4	4	1	2	12

Section IX

Diesel

Over 50 per cent of the Diesel teachers responding to the survey teach in post-secondary institutions. Table 76 indicates the results of the grade level distribution for Diesel teachers.

Table 76. Grade Level Distribution (DIESEL)



Two Diesel teachers (25.0 per cent) disagreed with the conversion to the Metric System in the United States compared to 9.0 per cent for the Comparison Group teachers responding to the survey. Table 77 indicates the results of questionnaire item 1 for Diesel teachers.

Table 77. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States?

Answer	Number	Percent
I Strongly Agree	1	12.5
I Agree	2	25.0
I am Undecided	3	37.5
I Disagree	2	25.0
I Strongly Disagree	0	0
Total	8	100.0

Seventy-five per cent of the Diesel teachers responding to the survey are not familiar with the Mole and 62.5 per cent are not familiar with Celsius and Candela. Table 78 indicates the results of questionnaire item 2 for Diesel teachers.

Table 78. How Familiar Are You With the Following Units of the Metric System? (DIESEL)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	3	42.8	2	28.5	1	14.3	0	0	1	14.3	7
Liter	3	37.5	2	25.0	1	12.5	1	12.5	1	12.5	8
Kilogram	3	37.5	2	25.0	0	0	2	25.0	1	12.5	8
Ampere	3	37.5	1	12.5	2	25.0	1	12.5	1	12.5	8
Mole	1	12.5	0	0	1	12.5	0	0	6	75.0	8
Celsius	2	25.0	1	12.5	0	0	0	0	5	62.5	8
Candela	1	12.5	0	0	1	12.5	1	12.5	5	62.5	8
Second	3	37.5	1	12.5	1	12.5	0	0	3	37.5	8

One hundred per cent of the Diesel teachers responding to the survey are not presently teaching metric measurement in their classes. In the future, only 37.5 per cent of the Diesel teachers will not teach metric measurement in their classes. Tables 79 and 80 indicate the results of questionnaire items 3 and 4 for Diesel teachers.

Table 79. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (DIESEL)

Unit or Category	Number	Percent
Meter	0	0
Liter	0	0
Kilogram	0	0
Ampere	0	0
Mole	0	0
Celsius	0	0
Candela	0	0
Second	0	0
I teach classes that do not require the use of metric measurement	8	100
Not applicable		

Table 80. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (DIESEL)

Unit or Category	Number	Percent
Meter	5	62.5
Liter	5	62.5
Kilogram	5	62.5
Ampere	4	50.0
Mole	0	0
Celsius	3	37.5
Candela	0	0
Second	1	12.5
I teach classes that do not require the use of metric measurement	3	37.5

Sixty Two point five per cent of the Diesel teachers responding to the survey are undecided when to start teaching metric measurement in their classes. Table 81 indicates the results of questionnaire item 5 for Diesel teachers.

Table 81. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (DIESEL)

Category	Number	Percent
I already teach metric measurement	1	12.5
During the school year starting in September 1975	1	12.5
During the school year starting in September 1976	1	12.5
Sometime after 1976	0	0
Undecided	5	62.5
Total	8	100.0

Diesel teachers indicated that business and industry journals, government publications, subject area text books, and metric system reference books were the most valuable sources of general and metric teaching information. Tables 82 and 83 indicate the results of questionnaire item 6 for Diesel teachers.

Table 82. As a Source of Metric Teaching Information. (DIESEL)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	0	2	1	5	8
Professional Education Journals	0	1	2	0	5	8
Business and Industry Journals	2	0	1	0	5	8
Industrial Conferences	0	1	0	0	7	8
Industrial Sponsored Workshops	0	0	0	0	8	8
Educational In-Service Workshops	0	1	0	0	7	8
Government Publications	1	1	2	0	4	8
Subject Area Textbooks	2	0	0	1	5	8
Metric System Reference Books	2	0	1	0	5	8
Curriculum Guides	0	0	0	1	7	8
Other: European Manual and Service Manual	2	0	1	0	0	3

Table 83. As a Source of General Metric Information. (DIESEL)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Vlaue	Of No Value	No Opinion	Total
Newspapers	0	2	2	0	4	8
Professional Education Journals	0	2	2	1	3	8
Business and Industry Journals	2	0	1	2	3	8
Industrial Conferences	0	1	0	1	6	8
Industrial Sponsored Workshops	0	1	0	2	5	8
Educational In-Service Workshops	0	2	0	2	4	8
Government Publications	3	1	1	1	2	8
Subject Area Textbooks	1	1	1	3	2	8
Metric System Reference Books	4	0	0	1	3	8
Curriculum Guides	0	0	0	2	6	8
Other: Manuals	2	0	1	0	0	3

Cost of new equipment, cost of converting existing equipment, cost of materials and supplies, and cost of tools were the factors recognized by Diesel teachers as being the most serious problems influencing metric conversion in their programs. Lack of text books in metric units, lack of guidance from the state and a lack of knowledge of the metric system were also identified as serious and overwhelming problems. Table 84 indicates the results of questionnaire item 7 for Diesel teachers.

Table 84. Factors Influencing Metric Conversion in Educational Program. (DIESEL)

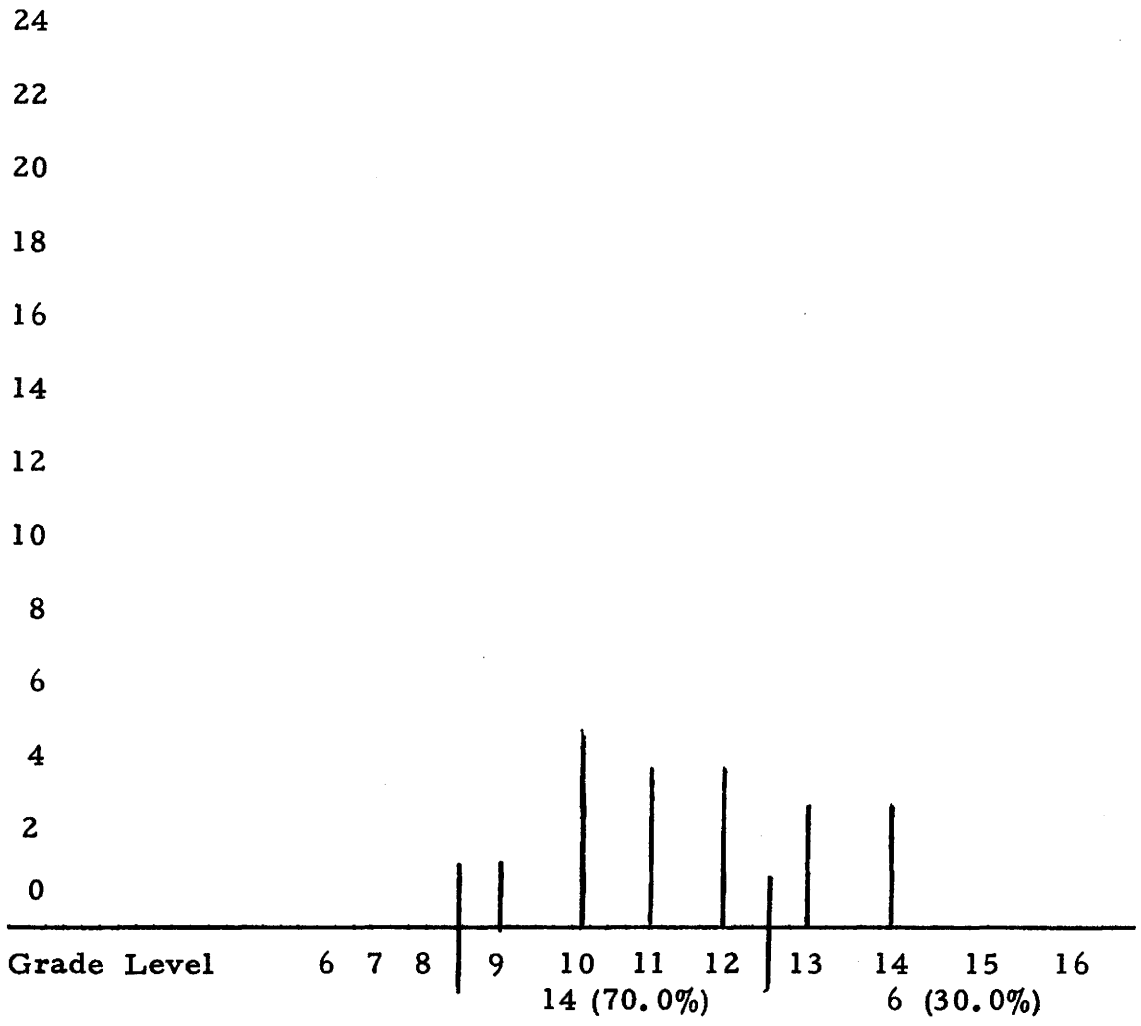
Factor	Overwhelming Problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	3	2	2	0	0	1	8
Cost of converting existing equipment	2	4	0	0	0	2	8
Cost of materials and supplies	0	3	2	1	0	2	8
Cost of tools	2	3	1	0	1	1	8
Opposition from parents	0	0	2	2	1	3	8
Opposition from administrators	0	0	1	2	2	3	8
Opposition from students	1	1	1	1	2	2	8
Opposition from teachers	0	1	2	2	2	1	8
Opposition from industry	0	0	1	3	2	2	8
Opposition from Advisory Committee	0	0	1	1	3	3	8
Lack of text books in metric units	2	2	0	2	0	2	8
Lack of guidance from state department	1	3	2	0	0	2	8
Lack of knowledge of the metric system	1	2	1	2	0	2	8

Section X

Graphics

Seventy per cent of the Graphics teachers responding to the survey teach classes in high school with the remaining 30 per cent in post-secondary institutions. There were no reported Graphics programs in junior high schools. Table 85 indicates the grade level distribution for Graphics teachers.

Table 85. Grade Level Distribution (GRAPHICS)



Seven Graphics teachers (87.5 per cent) agree or strongly agree with the conversion to the Metric System in the United States compared to 69.6 per cent for the Comparison Group teachers responding to the survey. Table 86 indicates the results of questionnaire item 1 for Graphics teachers.

Table 86. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (GRAPHICS)

Answer	Number	Percent
I Strongly Agree	6	75.0
I Agree	1	12.5
I am Undecided	1	12.5
I Disagree	0	0
I Strongly Disagree	0	0
Total	8	100.0

Fifty per cent of the Graphics teachers are unfamiliar with the Mole and Candela and 37.5 per cent are unfamiliar with Celsius. Table 87 indicates the results of questionnaire item 2 for Graphics teachers.

Table 87. How Familiar Are You With the Following Units of the Metric System? (GRAPHICS)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	4	50.0	2	25.0	1	12.5	1	12.5	0	0	8
Liter	3	37.5	1	12.5	2	25.0	1	12.5	1	12.5	8
Kilogram	3	37.5	1	12.5	1	12.5	1	12.5	2	25.0	8
Ampere	3	37.5	1	12.5	2	25.0	0	0	2	25.0	8
Mole	3	0	2	25.0	1	12.5	1	12.5	4	50.0	8
Celsius	2	25.0	2	25.0	0	12.5	1	12.5	3	37.5	8
Candela	0	0	3	37.5	0	12.5	1	12.5	4	50.0	8
Second	3	37.5	2	25.0	1	0	0	0	2	25.0	8

Only one Graphics teacher (12.5 per cent) reported that metric measurement will not be required in his classes at present or in the future. The Ampere and the Mole will not be required at present or in the future by any Graphics teacher. Tables 88 and 89 indicate the results of questionnaire items 3 and 4 for Graphics teachers.

Table 88. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (GRAPHICS)

Unit or Category	Number	Percent
Meter	4	50.0
Liter	5	62.5
Kilogram	4	50.0
Ampere	0	0
Mole	0	0
Celsius	4	50.0
Candela	1	12.5
Second	2	25.0
I teach classes that do not require the use of metric measurement	1	12.5
Not applicable		

Table 89. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units. (GRAPHICS)

Unit or Category	Number	Percent
Meter	7	87.5
Liter	5	62.5
Kilogram	4	50.0
Ampere	0	0
Mole	0	0
Celsius	4	50.0
Candela	1	12.5
Second	2	25.0
I teach classes that do not require the use of metric measurement	1	12.5

Fifty per cent of the Graphics teachers reported that they were undecided about when they plan to teach metric measurement in their classes. Only two Graphics teachers are presently teaching metric measurement in their classes. Table 90 indicates the results of questionnaire item 5 for Graphics teachers.

Table 90. If You Plan To Teach Metric Measurement in Your Classes, When Would You Start? (GRAPHICS)

Category	Number	Percent
I already teach metric measurement	2	25.0
During the school year starting in September 1975	0	0
During the school year starting in September 1976	2	25.0
Sometime after 1976	0	0
Undecided	4	50.0
Total	8	100.0

Graphics Teachers reported that government publications were of greatest value as sources of general metric information, with metric system reference books and professional and business journals nearly as valuable. Tables 91 and 92 indicate the results of questionnaire item 6 for Graphics teachers.

Table 91. As a Source of General Metric Information. (GRAPHICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	1	3	1	3	8
Professional Education Journals	2	1	2	0	3	8
Business and Industry Journals	2	2	1	1	2	8
Industrial Conferences	0	2	0	2	4	8
Industrial Sponsored Workshops	1	1	1	0	5	8
Educational In-Service Workshops	0	2	0	2	4	8
Government Publications	2	2	1	0	3	8
Subject Area Textbooks	2	1	0	2	3	8
Metric System Reference Books	2	2	2	0	2	8
Curriculum Guides	0	0	0	3	5	8
Other	0	0	0	0	0	0

Table 92. As a Source of General Metric Information. (GRAPHICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	1	3	3	0	1	8
Professional Education Journals	2	2	2	0	2	8
Business and Industry Journals	2	3	1	1	1	8
Industrial Conferences	0	1	1	2	4	8
Industrial Sponsored Workshops	1	1	1	0	5	8
Educational In-Service Workshops	0	1	1	0	6	8
Government Publications	4	2	0	0	2	8
Subject Area Textbooks	1	1	1	2	3	8
Metric System Reference Books	3	2	1	0	2	8
Curriculum Guides	0	0	0	3	5	8
Other	0	0	0	0	0	0

Costs of new equipment, converting existing equipment, materials and supplies, and tools were shown to be serious and overwhelming problems influencing metric conversion. Lack of text books in metric units and guidance from the state were reported as serious problems by Graphics teachers. Table 93 indicates the results of questionnaire item 7 for Graphics teachers.

Table 93. Factors Influencing Metric Conversion in Educational Program. (GRAPHICS)

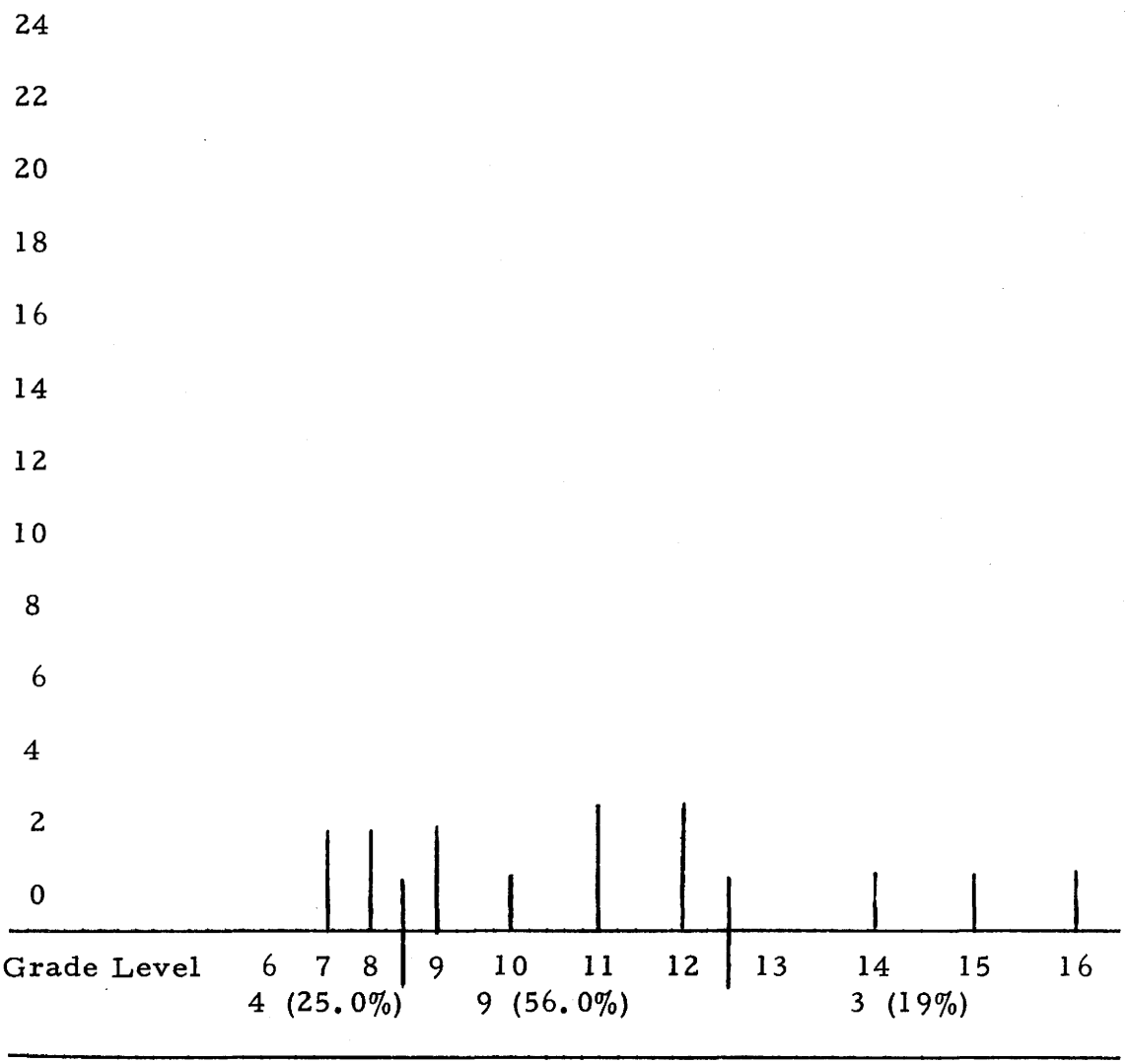
Factor	Overwhelming problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	1	3	1	1	2	0	8
Cost of converting existing equipment	2	3	0	1	2	0	8
Cost of materials and supplies	2	2	0	1	3	0	8
Cost of tools	1	2	0	1	4	0	8
Opposition from parents	0	0	0	3	4	1	8
Opposition from administrators	0	0	0	3	4	1	8
Opposition from students	0	0	1	5	2	0	8
Opposition from teachers	0	0	0	3	4	1	8
Opposition from industry	0	0	0	2	5	1	8
Opposition from Advisory Committee	0	0	0	2	5	1	8
Lack of text books in metric units	0	3	0	3	2	0	8
Lack of guidance from state department	1	3	3	1	0	0	8
Lack of knowledge of the metric system	0	1	3	1	3	0	8

Section XI

Plastics

Seven teachers of Plactics have been identified in this survey, with 25 per cent in junior high school, 56 per cent in high school and the remaining 19 per cent in post-secondary institutions. Table 94 indicates the grade level distribution for Plastics.

Table 94. Grade Level Distribution (PLASTICS)



The Metric System conversion received strong support from Plastics teachers responding to the survey. Five teachers (71.3 per cent) agree with the conversion while one teacher disagrees with the conversion. Table 95 indicates the results of questionnaire item 1 for Plastics teachers responding to the survey.

Table 95. What is Your Opinion Concerning the Conversion to the Predominate Use of the Metric System in the United States? (PLASTICS)

Answer	Number	Percent
I Strongly Agree	3	42.8
I Agree	2	28.5
I am Undecided	1	14.3
I Disagree	1	14.3
I Strongly Disagree	0	0
Total	7	99.9

Table 96 indicates the results of questionnaire item 2 for Plastics teachers. Five teachers (71.4 per cent) were not familiar with the Candela, four (57.1 per cent) were not familiar with the Mole and three (42.8 per cent) were not familiar with Celsius. Plastics teachers indicated greatest familiarity with the Meter, Kilogram and Second.

Table 96. How Familiar Are You With the Following Units of the Metric System? (PLASTICS)

Unit	Totally Familiar								Not Familiar		
	4	(%)	3	(%)	2	(%)	1	(%)	0	(%)	Total
Meter	4	57.1	2	28.5	0	0	0	0	1	14.3	7
Liter	2	28.5	3	42.8	1	14.3	0	0	1	14.3	7
Kilogram	5	71.4	1	14.3	0	0	0	0	1	14.3	7
Ampere	3	42.8	1	14.3	0	0	1	14.3	2	28.5	7
Mole	2	28.5	0	0	1	14.3	0	0	4	57.1	7
Celsius	1	14.3	1	14.3	1	14.3	1	14.3	3	42.8	7
Candela	1	14.3	0	0	1	14.3	0	0	5	71.4	7
Second	6	85.7	0	0	0	0	0	0	1	14.3	7

Tables 97 and 98 indicate the results of questionnaire items 3 and 4 for Plastics teachers. Only the Liter and Kilogram will require added proficiency in the future; all other units will be utilized as they are at present.

Table 97. AT PRESENT, Students in My Class Require Proficiency in the Use of the Following Metric Units. (PLASTICS)

Unit or Category	Number	Percent
Meter	3	42.8
Liter	0	0
Kilogram	2	28.5
Ampere	2	28.5
Mole	0	0
Celsius	2	28.5
Candela	0	0
Second	2	28.5
I teach classes that do not require the use of metric measurement	3	42.8
Not applicable	0	0

Table 98. IN THE FUTURE, Students in My Class Will Require Proficiency in the Use of the Following Metric Units.

Unit or Category	Number	Percent
Meter	3	42.8
Liter	2	28.5
Kilogram	3	42.8
Ampere	2	28.5
Mole	0	0
Celsius	2	28.5
Candela	0	0
Second	3	42.8
I teach classes that do not require the use of metric measurement	3	42.8

Only one Plastics teacher is presently teaching metric measurement while four (57.1 per cent) are undecided when to start teaching metric measurement. Table 99 indicates the results of questionnaire item 5 for Plastics teachers responding to the survey.

Table 99. If You Plan to Teach Metric Measurement in Your Classes, When Would You Start? (PLASTICS)

Category	Number	Percent
I already teach metric measurement	1	14.3
During the school year starting in September 1975	1	14.3
During the school year starting in September 1976	0	0
Sometime after 1976	1	14.3
Undecided	4	57.1
Total	7	100.0

Tables 100 and 101 indicate the results of questionnaire item 6 for Plastics teachers. The majority of Plastics teachers considered the various sources of metric information to be of little or no value to them, although government publications and metric reference books were considered valuable.

Table 100. As a Source of Metric Teaching Information. (PLASTICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	0	0	4	1	2	7
Professional Education Journals	0	2	2	2	1	7
Business and Industry Journals	0	1	0	3	3	7
Industrial Conferences	0	1	2	2	2	7
Industrial Sponsored Workshops	0	0	1	3	3	7
Educational In-Service Workshops	0	0	0	3	4	7
Government Publications	1	3	2	0	1	7
Subject Area Textbooks	0	1	0	4	2	7
Metric System Reference Books	2	1	0	4	0	7
Curriculum Guides	0	0	0	3	4	7
Other	0	0	0	0	0	0

Table 101. As a Source of General Metric Information. (PLASTICS)

Source	Overwhelming Value	Quite a Bit of Value	Minimal Value	Of No Value	No Opinion	Total
Newspapers	2	1	1	0	3	7
Professional Education Journals	1	3	2	0	1	7
Business and Industry Journals	0	3	2	1	1	7
Industrial Conferences	0	1	1	3	2	7
Industrial Sponsored Workshops	0	0	1	3	3	7
Educational In-service Workshops	0	0	1	3	3	7
Government Publications	3	2	1	0	1	7
Subject Area Textbooks	0	0	0	4	3	7
Metric System Reference Books	3	1	2	0	1	7
Curriculum Guides	0	0	1	3	3	7
Other	0	0	0	0	0	0

Plastics teachers considered the cost of equipment, materials, and tools to be a serious, but not overwhelming, problem. Five teachers (71.5 per cent) indicated their own lack of knowledge of the metric system to be a problem area. Table 102 indicates the results of questionnaire item 7 for Plastics teachers responding to the survey.

Table 102. Factors Influencing Metric Conversion in Educational Program. (PLASTICS)

Factor	Overwhelming Problem	Serious problem	Problem	Minimal problem	Not a problem	No Opinion	Total
Cost of new equipment	0	3	4	0	0	0	7
Cost of converting existing equipment	0	5	1	1	0	0	7
Cost of materials and supplies	0	3	4	0	0	0	7
Cost of tools	0	4	2	1	0	0	7
Opposition from parents	0	0	1	2	3	1	7
Opposition from administrators	0	1	0	2	3	1	7
Opposition from students	0	1	1	3	2	0	7
Opposition from teachers	0	1	0	1	5	0	7
Opposition from industry	0	1	0	1	2	3	7
Opposition from Advisory Committee	0	1	0	1	2	3	7
Lack of text books in metric units	1	1	1	2	2	0	7
Lack of guidance from state department	1	0	3	0	1	2	7
Lack of knowledge of the metric system	3	1	1	2	0	0	7

Unsolicited comments

A number of respondents assisted this study by providing comments on the metric system controversy. These comments reflect on the variety of problems to be faced in developing metric education programs in Utah. Although there were but 22 written comments (7.9 per cent), they point to some of the concerns shared by Industrial Education teachers and must be recognized as genuine concerns and apprehensions.

Five of the respondents expressed concerns that are politically based and reflect some of the strong opposition to conversion to the metric system. Each of the following comments also indicate the subject area of the respondent.

> Why should we follow the leftist? Why not have them follow us? (Building Construction)

> I think it's just another step toward world control. (Woods)

> I feel that metrics is a waste in too large an area to be of value. We U.S.A. people valued fractions since America began. A wise move, why screw up everything just because Europe and Asia want to infiltrate U.S.A. (Auto)

> I believe that all this noise of changing to metrics is a group of No Bodies just getting their names in the newspapers. As for benefiting the average American, it will not. I guess if European Countries want an 8 day week, we in the west will have to change to an 8 day week also. (Drafting)

> I am opposed to the conversion although I realize it is inevitable and I'll have to do it. If we are gradually

being pushed to a one world government under the U.N., and evidence is strong in support of that move, then metric conversion must be made. On the other hand, if we resist the conversion it would frustrate that move. America has obviously been un-hampered in her progress on the system now used. (Machine Tool)

Two of the comments were opposed to metric conversion at this time since they felt that industry should take the first steps toward metric conversion. These two comments were:

> The cry for Metrics is being overemphasized. We spent a whole summer workshop on it and then what? Nothing. I teach at_____, I teach the apprentice program for_____Company. I talked to them about metrics and they just laugh. They don't use metrics. Until our local industries use metrics heavily there is really no need for metrics. (Machine Shop)

> As soon as industry starts using it to a degree to justify teaching it. (Mechanical Drafting)

Five other respondents indicated their opposition to metric conversion until such time as a National Law is passed or until they are forced to teach metric. These comments were:

> When the state or district will pay to qualify me. (Metals)

> When the U.S. Changes over by law. Until then, most students won't see the need. (Woods)

> Not until I have to. (Agricultural Mechanics)

> When required. (Power Mechanics)

> I'll teach it I suppose, when I'm told I must. (Machine Shop)

Five other respondents indicated they were not teaching metric conversion for other reasons. Four were in favor of

metric conversion but were not involved. The fifth respondent could see no reason for the change.

> I know nothing about the metric system or to what extent it will influence our program. (Cosmetology)

> I really don't know enough about metrics to answer the questions. (Refrigeration)

> Graphics has its own system of measurement; points and pica system. (Graphics)

> Don't teach it because of difficulty obtaining teaching aids from metric supply companies. (Woods)

> America doesn't need it, why change? Could change but I'm against it. (Woods)

The remaining six respondents were supportive of the metric system conversion in general and offered the following comments:

> All engineering type drafting next year will be completely metric. The scales in the drafting machines will be millimeter scale. (Drafting)

> We should start switching and teaching metric as soon as possible, both from text book to job learning opportunities. (Auto)

> Metric is used but proficiency is not yet required. (Graphics)

> As books, equipment, and tools become common in usage, it will be easy to adjust to. Looking forward to it. (Welding)

> Many of my students already know metrics because they were born or lived in metric standard countries. I learned metrics by living in two different metric standard countries. I believe you should teach metrics by use, not by converting English to Metric, very similar to learning a language. I have not seen an effective metric instruction program except those that force a student to use metrics as they are, without all the conversion nonsense. (Machine Tool)

CHAPTER IV

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND DISCUSSION

Summary

The chapter includes a summary of the introduction to the problem, problem statement, purpose of the study, the review of literature, and the findings.

Introduction

The United States is currently the only large industrialized nation of the world not officially committed to converting to the Metric System of weights and measures. Great Britain made the decision to convert to the Metric System in 1968 and is closely approaching the ten year target date for the complete changeover. Since 1968 there has been increased pressure from industry for U.S. Congress to formulate and pass a National Metrication Bill. A number of such bills have been introduced but all have failed to become law; opposition from small business and labor has blocked passage of metric legislation. With increased pressure for a compromise bill, it is likely that legislation will be passed in the near future which will provide national guidelines for conversion to the predominate use of the Metric System in the United States.

The question of when the United States will eventually convert to the Metric System and how this conversion will take place has enormous implication for education. Since metric instruction will need to be introduced into the curriculum of all levels of education at about the same time, the implications seem apparent; metric measurement must become a part of existing educational programs as soon as possible. To wait until federal legislation has been passed and until the various states formulate their own guidelines and programs, could deprive our students of the skills they need now.

The Metric System controversy is not a new one; it has raged in the United States for over 200 years. Thomas Jefferson, Benjamin Franklin and John Quincy Adams were strong supporters of a metric measurement system for the United States but were unable to convince Congress of the need to change from the Anglo-Saxon system, brought to this country from England. Although the Congress has never officially adopted the Anglo-Saxon system of measurement that we use today, its use has become traditional rather than official, even though our familiar yard and pound are legally defined in metric units.

With the decision by Great Britain in 1968 to convert to the Metric System, a United States Metric Study was authorized by Congress in the same year. The report of that study was

submitted to Congress in 1971 by the U.S. Department of Commerce. In that report, the Secretary of Commerce, Maurice H. Stans, recommended that the United States change to the Metric System through a coordinated national program over a period of ten years and that the Government make a firm commitment to this goal.

Although there is still opposition to converting to the Metric System in the United States and many problems remain to be solved, support for the conversion has been mounting steadily during the past years. Many governmental agencies such as the Department of Defense, Department of the Interior, Department of Commerce, Department of Agriculture, United States Patent Office and others have developed plans to convert to the Metric System.

Education, which has historically supported the conversion to the Metric System, has taken an active role and presently includes support from organizations such as the National Education Association, American Vocational Association, The Associalion of American Colleges, The American Home Economics Association, The U.S. Office of Education, and The American Industrial Arts Association.

Regardless of occupation or interest, metric conversion will affect each and every citizen in some way. Road signs, paper

sizes, grocery store merchandise, clothing and shoe sizes as well as all other weights and measures will be a part of our metric world. Students in our Industrial Education programs today will be working and living in a metric world in the near future. In many industries, metric proficiency will be a condition of employment. Industrial Education programs will be among the first to be affected by a conversion to the Metric System in the United States.

Problem Statement

The effect of all the metric conversion bills before Congress will be to convert to the predominate use of the SI Metric System in the United States over a planned period of time. At the time of this study it was not known if industrial education teachers in Utah were prepared to incorporate metric measurement in their educational programs nor what their feelings and attitudes were toward metric conversion.

Purpose of the study

This study was designed to obtain information from industrial education teachers in Utah concerning their feelings and attitudes toward conversion to the Metric System in the United States, to determine their present familiarity with that system, and to identify potential problem areas which would tend to influence educational programs on the Metric System. Specifically, this

study attempted to answer five questions:

1. How familiar are industrial education teachers in Utah with the base units of the Metric System?
2. Which subject area teachers have the least understanding of the base units of the Metric System?
3. Which sources of Metric System information have been of greatest value to industrial education teachers.
4. What types of educational programs would be appropriate for familiarizing industrial education teachers with the Metric System?
5. Which types of metric information are currently being used by industrial education teachers in Utah?

Review of literature

Three specific areas were investigated in the review of pertinent literature; 1. the history of the metric controversy in the United States, 2. the Metric System and Education, and 3. present opposition to the Metric System conversion. All of the literature cited was restricted to material dated 1967 to 1975.

The United States has been involved in the Metric System controversy for over 150 years, during which time there have been eras of support and opposition. Education and science have historically supported conversion to the Metric System while industry has opposed it on economic grounds. Congress legalized the use of the metric weights and measures in 1866 but did not

make it the mandatory system of weights and measures for the United States. Since Congress has not officially approved or legalized the Anglo-Saxon system of measurement for the United States, our familiar Customary System is not law, but merely traditional.

When Russia launched Sputnik in 1957, a renewed interest in scientific endeavors was launched in this country. Pressure was again brought to bear on Congress to pass some type of metric legislation, but all efforts to provide a national metrication program failed once more.

When in 1968, Great Britain announced its intention of changing from the Anglo-Saxon System or Customary system of measurement to the Metric System, the United States became the only large industrialized nation of the world still committed to the Customary system of weights and measures. At an ever increasing rate, world commerce was being conducted in the Metric System and Great Britain found it increasingly difficult to compete, using the Anglo-Saxon measurement system, especially in the European Common Market.

Congress acted in 1968 by approving a United States Metric Study to be conducted by the Department of Commerce. In 1971, Maurice H. Stans, Secretary of Commerce submitted the results of that study to Congress. In the report, Secretary Stans recommended that the United States change to the International Metric

System deliberately and carefully, through a coordinated national program over a period of ten years and that there be a firm government commitment to that goal.

Since 1971 there have been a number of conversion bills submitted to Congress but all have failed due primarily to the opposition from small business and organized labor, over concern for provisions for small business loans and subsidies for purchase of metric tools for workers. There are strong indications that a compromise metric conversion bill will become law before the end of 1975.

In August 1974, Congress amended the Elementary and Secondary Education Act and approved the expenditure of ten million dollars during each of three fiscal years to encourage educational agencies and institutions to prepare students to use the Metric System. At the time of this study, the specific guidelines of this amendment were not available.

Education in the United States has long been a supporter of the Metric System. Many of the leading educational organizations such as the National Education Association, American Vocational Association, and the American Industrial Arts Association publically stated their support for metric conversion. Many states have developed metric education programs, primarily in-service activities for teachers.

Alabama, Vermont, Minnesota, Ohio, California, Michigan, Arizona and Hawaii are a few of the states where metric education has been strongly supported. Hawaii is the first of the fifty states to commit its schools to the metric system as the primary language of measurement. The Center for Metric Education in Michigan, a Metric Institute in Alabama, and the Metric Center in Minnesota are but a few of the educational activities taking place throughout the United States. Federal funds have been provided to the Vocational Education Resource Center at Ohio State University for the purpose of developing educational materials.

Utah educators have participated in metric activities over the past years including the Interstate Consortium on Metric Education held in California in 1974. According to the President Elect of the Utah Education Association Department of Classroom Teachers, a series of workshops are planned in the state to help teachers learn the skills of teaching metrics.

Not all of the literature reviewed was supportive of metric conversion in the United States. The National Federation of Independent Business, the International Brotherhood of Electrical Workers, the United Brotherhood of Carpenters and Joiners of America, and the International Association of Machinists and Aerospace Workers in a letter to Congress indicated their opposition. Specifically they fear that jobs will be lost, the

conversion costs will be prohibitive, and there will be no government assistance for those individuals and organizations adversely affected by the conversion.

Findings

A select sample of 423 Industrial Education teachers in Utah was used as the population for this study. The survey questionnaire was mailed on May 10, 1975 and 302 returns (71.4 per cent) were received during a five week period. Five returns were not usable and the remaining 297 questionnaires were tabulated in the following manner:

1. All 297 returns were tabulated as a single group of Industrial Education teachers (Comparison Group).
2. Each of the 10 occupational categories was tabulated separately.
3. All identified occupational areas numbering 5 or less were compiled into one miscellaneous category but the data from this group was not tabulated separately.

Each of the questionnaire items was tabulated for the Comparison Group and for each of the individual occupational categories. The findings for this study are based upon the significant responses obtained from the Comparison Group and from each of the ten occupational categories.

Woods teachers represent the largest single number of respondents to this survey. Sixty-six Woods teachers (22.2 per cent) returned usable questionnaires. The Miscellaneous category, representing 21 different occupational areas, numbered 43 teachers (14.5 per cent), and was the second largest category. Auto teachers, numbering 41 (13.8 per cent) were the third largest category, followed by Metals with 40 teachers, Drafting with 30 teachers, and Machine Shop with 22 teachers.

Two hundred eighty three (95.3 per cent) of the Comparison Group had teaching responsibilities in more than one grade level, while 155 teachers (59.9 per cent) taught classes at three or more grade levels.

Within the Comparison Group, 16.5 per cent of the teachers taught classes in junior high school, 58.5 per cent in high school and the remaining 25.0 per cent taught classes in post-secondary institutions.

The majority of Comparison Group teachers, (69.6 per cent) strongly agree or agree with the conversion to the predominate used of the Metric System in the United States. (21.2 per cent) are undecided about the conversion and the remaining teachers (9.0 per cent) either disagree or strongly disagree with the con version.

Comparison Group teachers are most familiar with the Meter (36.3 per cent), Ampere (42.8 per cent) and the Second

(43.6 per cent) but indicated they were not familiar with the Mole (55.8 per cent), Celsius (49.5 per cent) and Candela (65.7 per cent).

At the present time 149 Comparison Group teachers (50.2 per cent) teach classes that do not require the use of metric measurement. An additional 63 teachers (21.2 per cent) indicated that the question was not applicable to them. Eighty-seven Comparison Group teachers (29.3 per cent) presently require student proficiency with the Second (our familiar unit of time).

In the future, the number of Comparison Group teachers not requiring the use of metric measurement in their classes will decrease to 105 (35.3 per cent). All units of the Metric System will require greater proficiency in the future. With the exceptions of the Mole which will increase 4.7 per cent in the future, and the Candela 7.0 per cent, all other units will increase in usage by an average of 26 per cent.

Ninety-nine Comparison Group teachers (33.3 per cent) are presently teaching metric measurement in their classes and 103 (34.7 per cent) are undecided about teaching metric measurement.

Comparison Group teachers indicated that Metric System reference books were of greatest value to them as sources of metric teaching information, while newspapers and curriculum guides were of least value. Metric System reference books and Government publications were of greatest value as sources of general

metric information. Curriculum guides and newspapers were again of least value as sources of general metric information.

Comparison Group teachers indicated that the cost of new equipment and the cost of converting existing equipment represented the most serious and overwhelming problems influencing metric conversion in educational programs. Cost of new and replacement tools were considered the third most serious or overwhelming problem, while lack of text books in metric units was fourth.

Opposition from parents, administrators, students, teachers, industry and advisory committees were considered the least serious problems influencing metric conversion by Comparison Group teachers.

Nine of the Woods teachers (13.6 per cent) disagree or strongly disagree with the conversion to the predominate use of the Metric System in the United States, compared to 9.0 per cent for the Comparison Group teachers.

Woods teachers are less familiar with the units of the Metric System than the Comparison Group teachers. Forty Woods teachers (61.5 per cent) are not familiar with the Mole, 44 (66.6 per cent) are not familiar with Celsius and 46 (70.7 per cent) are not familiar with Candela.

At present, 38 Woods teachers (57.6 per cent) do not require the use of metric measurement in their classes. In the

future, 35 Woods teachers (53.0 per cent) indicated that metric measurement would not be used in their classes.

Although 4 Woods teachers (6.1 per cent) presently teach metric measurement in their classes, 46 (69.7 per cent) are undecided about teaching metric measurement in their classes.

Metric system reference books were of greatest value to Woods teachers as sources of general and teaching information and professional education journals were the second greatest source. Curriculum guides and newspapers were of least value to Woods teachers as sources of metric information.

Cost of tools , cost of new equipment, cost of converting existing equipment, and cost of materials and supplies were listed as the most serious and overwhelming factors influencing metric conversion in educational programs by Woods teachers.

Only 1 Auto teacher (2.5 per cent) responding to the survey taught automotive classes in junior high school. Seventy-five Auto teachers (63.5 per cent) teach classes in high school programs.

Ten Auto teachers (24.4 per cent) disagree or strongly disagree with the conversion to the predominate use of the Metric System in the United States.

At present, 11 Auto teachers (26.8 per cent) are teaching metric measurement in their classes. Twenty Auto teachers

(48.8 per cent) are undecided about when to start teaching metric measurement in their classes.

Metric System reference books were of the greatest value to Auto teachers as sources of general and metric teaching information. Business and industry journals and Government publications were shown to be the second most important sources of metric information to Auto teachers.

Cost of new equipment, cost of converting existing equipment, cost of materials and supplies, and cost of tools were all listed as the most serious problems influencing metric conversion in automotive programs in Utah.

A high percentage of Metals teachers reported that they taught classes in junior high school; 35.6 per cent as compared to 16.5 per cent for the Comparison Group teachers.

Eighty-five per cent of the Metals teachers responding to the survey agree or strongly agree with the conversion to the predominate use of the Metric System in the United States. Not one Metals teacher disagreed with that conversion.

At present, 20 Metals teachers (50.0 per cent) do not require the use of metric measurement in their classes. In the future, only 9 Metals teachers (22.5 per cent) will not require the use of metric measurement in their classes.

Metric system reference books and Government publications have been of greatest value to Metals teachers as sources of

teaching and general metric information. Professional education journals have also been of great value. Curriculum guides were listed as valuable sources of metric teaching information by Metals teachers.

Metals teachers indicated that cost of new equipment and cost of converting existing equipment were the two most serious problems influencing metric conversion in their metals programs. The Metals teachers' own lack of knowledge of the Metric System was also listed as a serious problem.

Over 78 per cent of the Drafting teachers responding to the survey teach classes in high school, compared to 58.5 per cent for the Comparison Group teachers.

Only 1 Drafting teacher (3.3 per cent) responding to the survey strongly disagrees with the conversion to the metric system in the United States. Over 86 per cent agree or stongly agree with that conversion.

Five Drafting teachers (16.6 per cent) indicated that in the future, their classes would not require the use of metric measurement, compared to 35.3 per cent for the Comparison Group teachers.

Although 13 Drafting teachers (43.3 per cent) already teach metric measurement in their classes, 11 (36.6 per cent) are undecided about when to start teaching metric measurement.

Drafting teachers indicated that metric system reference books were of greatest value as sources of general and metric teaching information, while newspapers and curriculum guides were of least value to them.

Cost of new equipment and lack of guidance from the state department were listed as serious problems by Drafting teachers, while lack of text books in metric units was listed as the most serious problem influencing metric conversion in their programs.

Only 1 Machine Shop teacher (4.5 per cent) disagrees with the conversion to the predominate use of the Metric System in the United States, while 81.8 per cent agree or totally agree with that conversion.

At present, 12 Machine Shop teachers (54.5 per cent) teach classes that do not require the use of metric measurement. In the future only 3 Machine Shop teachers will not require metric measurement in their classes.

Professional education journals, Government publications, and Metric System reference books have been of greatest value to Machine Shop teachers as sources of general and metric teaching information.

Machine Shop teachers indicated that cost of equipment and cost of converting existing equipment to be the two greatest problems influencing metric conversion in their programs. Lack

of text books and lack of guidance from the state were also listed as serious problems.

Eighty-five per cent of the Electronics teachers agree or strongly agree with the conversion to the predominate use of the Metric System in the United States. Not one Electronics teacher disagreed with the conversion.

Electronics teachers are more familiar with every unit of the Metric System than the Comparison Group teachers. Eighty per cent of the Electronics teachers surveyed are totally familiar with the Meter, 85.0 per cent with the Ampere, and 90.0 per cent with the Second.

Not one Electronics teacher reported that they taught classes that did not require the use of metric measurement, although only 80.0 per cent indicated that they were presently teaching metric measurement in their classes.

Subject area text books were listed as the most valuable source of metric teaching and general metric information by Electronics teachers responding to the survey.

Eight Welding teachers (66.6 per cent) agree with the conversion to the predominate use of the metric system and 4 (33.3 per cent) were undecided about the conversion. Not one Welding teacher was opposed to that conversion.

Government publications and subject area text books were of greatest value to Welding teachers as sources of metric teaching and general metric information.

Lack of guidance from the state department was listed as the most serious problem influencing metric conversion in welding programs in Utah.

At present, 100 per cent of the Diesel teachers responding to the survey do not require the use of metric measurement in their classes. In the future this percentage will drop to 37.5 per cent.

Diesel teachers indicated that the cost of new equipment and the cost of converting existing equipment represented the most serious problems influencing metric conversion in their programs.

Not one Graphics teacher disagreed with the conversion to the predominate use of the Metric System in the United States.

Graphics teachers indicated that Government publications and Metric System reference books were of greatest value to them as sources of general metric information.

Plastics teachers indicated that costs of new equipment, cost of converting existing equipment, cost of materials and supplies and cost of tools were the most serious problems influencing metric conversion in their educational programs.

Conclusions

The analysis of the data and the basic findings of the study warrant the following conclusions:

1. Industrial Education teachers in Utah are generally familiar with the Meter, Liter, Kilogram, and Ampere, but are mostly unfamiliar with the Mole, Candela, and Celsius. Further, Industrial Education teachers in Utah appear to be unaware that the Second, our familiar unit of time, is part of the Metric System of measurement. It is concluded that Industrial Education teachers in Utah need instruction in the use and structure of the Metric System of measurement.
2. Electronics teachers in Utah are already using the Metric System as part of the electronics curriculum and do not, as a group, need additional instruction in Metric System measurement.
3. Woods teachers do not see the necessity for metric measurement in their occupation, nor do they see economic advantages in the conversion for the construction and wood industries.
4. Curriculum guides as sources of metric information have been of little use to Industrial Education teachers in Utah, with the exception of Electronics teachers.

5. Subject area textbooks, with the exception of electronics texts, are of little value as sources of metric information to Industrial Education teachers in Utah since they do not utilize metric measurement as the primary instructional method.
6. Industrial Education teachers perceive that the Utah State Board of Education has not provided sufficient guidance on the Metric System of measurement.
7. General informational programs on the Metric System as well as specific instruction on the use and application of the Metric System of measurement are needed by Industrial Education teachers in Utah.

Recommendations

This study provided sufficient data to make the following recommendations.

1. Curriculum guides for Industrial Education programs should be changed to reflect the use and application of the Metric System.
2. A state-wide Metrics Committee should be established as soon as possible, representing education, industry, consumers, and every segment of the population in Utah. This committee should be tasked with the responsibility of coordinating educational programs and

dissemination of metric information.

3. A Metric System information center should be established in Utah for the purpose of gathering and disseminating appropriate metric references, training aids, films, and other media. This center should be under the administrative control of the Utah Metrics Committee, since the material from the center should be made available to all segments of the population in the state.
4. Since many Industrial Education teachers are not familiar with the Metric System and since the Metric system will affect each occupational area in a different way, two types of in-service activities will need to be conducted; one which will introduce Industrial Education teachers to the history, structure, rationale, and use of the Metric System while the second activity will be specifically tailored to a given occupational area. Since Electronics instruction is taught in predominately metric terms already, there will be little impact in this field. Drafting will be greatly affected by the conversion and will require the greatest curriculum effort. All other occupational areas will have differing degrees of conversion problems.

5. A coordinated state-wide effort should be made immediately to provide in-service workshop activities on the history, purpose, and application of the Metric System in Industrial Education programs in Utah.

Discussion

In view of the nature of this study and a belief that it can be of some value in planning and developing educational programs for Industrial Education teachers in Utah, the following topics of discussion appear to be in order:

1. Do not teach students to convert from one system of measurement to another; teach only metric measurement. The process of having to memorize conversion factors is time consuming, confusing, frightening, and unnecessary.
2. Provide simple measurement instruments to students, such as tape measures and rulers in metric units, Celsius thermometers, metric micrometers, and kilogram scales so that students are forced to make familiar measurements with metric scaled instruments.
3. In the future, metric education will start in the elementary grades, but until metric education has been a fact of life for a number of years, Industrial Education teachers will need to provide many students the necessary

instruction in the Metric System.

4. A Metric System information program should be prepared for television broadcast, in order to aquaint the general public with the Metric System and its implications.

5. Advantage should be taken of the effort that has been made by other states, educational systems, and private organizations in metric conversion. Most groups and agencies are willing to share what has been done in metric education; of course, this sharing must also occur within Utah as well. Duplication will be time-consuming and extremely expensive. The coordination of such metric conversion activities should be the responsibility of a Utah Metric Committee, with representation from education, industry, business, and the general public. This committee should be tasked with the responsibility for coordinating all metric conversion activity in Utah, development of a state metric resources center, and provide technical direction and assistance to all sectors of the state concerning metric conversion.

6. Most textbooks used by Industrial Education programs are written in Anglo-Saxon or Customary units of measurement. Until textbooks are eventually modified

to the Metric System of measurement, Industrial Education teachers can and should work collectively with their specialty counterparts in developing units of instruction for their discipline.

7. The transition from the Anglo-Saxon system of measurement to the Metric System must be well planned, professionally coordinated, and adequately financed.

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APPENDIX

Appendix A

Questionnaire Sent to Industrial Education Teachers

Your name:_____
(Optional: to be used for follow-up information only)

GRADE LEVEL/S THAT YOU TEACH: 6 7 8 9 10 11 12 13 14 15 16 _____ Other
(Circle one or more levels)

SUBJECTS THAT YOU TEACH: Primary Teaching Responsibility:_____
(Woods, Plastics, Auto etc.)
Other Teaching Responsibility:_____

DIRECTIONS:

For items No. 6 and No. 7, place a check mark in the appropriate boxes.

For all other items, please circle the appropriate letter or letters.

Place the completed questionnaire in the self-addressed envelope provided and return it immediately. THANK YOU.

---

1. What is your opinion concerning the conversion to the predominant use of the metric system in the United States?
   - A. I strongly agree with the conversion.
   - B. I agree with the conversion.
   - C. I am undecided about the conversion.
   - D. I disagree with the conversion.
   - E. I strongly disagree with the conversion.

---

2. How familiar are you with the following units of the metric system? (Please circle the most appropriate number for each unit).

A. Meter	4	3	2	1	0
B. Liter	4	3	2	1	0
C. Kilogram	4	3	2	1	0
D. Ampere	4	3	2	1	0
E. Mole	4	3	2	1	0
F. Celsius	4	3	2	1	0
G. Candela	4	3	2	1	0
H. Second	4	3	2	1	0

4 = Totally familiar
0 = Not familiar

---

3. AT PRESENT, Students in my class require proficiency in the use of the following metric units. (Please circle one or more letters).
   - A. Meter
   - B. Liter
   - C. Kilogram
   - D. Ampere
   - E. Mole
   - F. Celsius
   - G. Candela
   - H. Second
   - I. I teach classes that do not require the use of metric measurement.
   - J. Not applicable

---

4. IN THE FUTURE, Students in my class will require proficiency in the use of the following metric units. (Please circle one or more letters).
   - A. Meter
   - B. Liter
   - C. Kilogram
   - D. Ampere
   - E. Mole
   - F. Celsius
   - G. Candela
   - H. Second
   - I. I teach classes that do not require the use of metric measurement.

---

5. If you plan to teach metric measurement in your classes, when would you start?
   - A. I already teach metric measurement.
   - B. During the school year starting in September 1975.
   - C. During the school year starting in September 1976.
   - D. Sometime after 1976.
   - E. Undecided.

---

6. Which of the following sources of metric information have been of value to you? (Please respond to both categories for each of the sources indicated below).

SOURCE	As a Source of Metric Teaching Information					As a Source of General Metric Information				
	4	3	2	1	0	4	3	2	1	0
Newspapers										
Professional Education Journals										
Business and Industry Journals										
Industrial Conferences										
Industrial Sponsored Workshops										
Educational In-service Workshops										
Government Publications										
Subject Area Textbooks										
Metric System Reference Books										
Curriculum Guides										
Other:_____										

4 = Overwhelming Value
3 = Quite a bit of Value
2 = Minimal Value
1 = Of no Value
0 = No Opinion

7. Please indicate the influence of each of the following factors on metric conversion in your educational program: (Please check the appropriate response).

	Overwhelming Problem	Serious Problem	Problem	Minimal Problem	Not a Problem	No Opinion
Cost of new equipment						
Cost of converting existing equipment						
Cost of materials and supplies						
Cost of tools						
Opposition from parents						
Opposition from administrators						
Opposition from students						
Opposition from teachers						
Opposition from industry						
Opposition from advisory committee						
Lack of text books in metric units						
Lack of guidance from state dept. of education						
Lack of knowledge of the metric system						
OTHER:_____						

Appendix B

Questionnaire Cover Letter

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322

COLLEGE OF ENGINEERING

DEPARTMENT OF
INDUSTRIAL AND
CHNICAL EDUCATION

May 12, 1975

Dear Colleague:

The enclosed questionnaire is part of a state-wide effort to determine the status of metric education in Industrial Education Programs in Utah and to identify problem areas which might inhibit or prevent a coordinated educational effort. We would appreciate you immediate response to this survey so that planning for in-service or other educational activities might commence before the end of this school year. Your individual responses are necessary for program planning, so please return the completed questionnaire in the self addressed envelope prior to 20 May 1975.

Thank you in advance for your assistance and cooperation.

Sincerely,

Austin G. Loveless
Professor

Thomas J. Brames
Graduate Assistant

Enclosure

Appendix C

Remarks by Wilson Riles;

California Superintendent

of Public Instruction

CALIFORNIA STATE DEPARTMENT OF EDUCATION
721 Capitol Mall, Sacramento, CA 95814

No. 54

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LOS ANGELES.....

This week marks the beginning of school in most districts throughout California and the nation.

The start of each school year is always a time of both reflection and anticipation for me. Above all, it is a time when I consider the prospects of the child who is beginning school for the first time, the five-year old who is entering kindergarten.

As an educator and as an elected state official, it is my duty to try to break away from the pressures and problems of each day to take a long view, to look ahead. As I visualize each new kindergarten student, I am concerned, of course, that he should have a good teacher right now, that his classroom should be well-equipped right now, that his school building is safe and spacious right now. But I also contemplate larger questions. What kind of individual will that child be thirteen years from now, as he graduates from high school? Will he be a truly educated individual, with the skills and knowledge to make it in a job or in college? Most important, will he be prepared to face confidently the society into which he will be thrust?

It is difficult for me or for anyone to visualize clearly how this nation and society will be changed in thirteen years. We cannot peer that far into the future and know precisely the patterns and problems of the nation's economy, its politics, its needs for different skills.

But I am sure of one change. In thirteen years, I am convinced this nation will have gone metric.

The child entering kindergarten this week must be prepared for a metric America. We in the schools must accelerate our efforts, our planning and our action <u>now</u> to assure that the

educational system will offer effective instruction in metrics.

If we do not, the schools will be caught short, and the child will be the big loser. As a citizen in the future, he will be unprepared or even incompetent to function in a metric America.

If education evades the need to change over to metrics, if the schools lag behind the general movement toward metrics in America, one consequence is inevitable.

Thirteen years from now, we will be seeing newspaper headlines about "The Failure of the Schools." And I have no doubt that a book will emerge as a bestseller with the title: "WHY JOHNNY CAN'T MEASURE."

I am personally committed to an educational system that will fully prepare Johnny and Suzy for a metric America.

As State Superintendent of Public Instruction in California, I am seeking a changeover to metric instruction in the schools, with all the careful planning that is necessary, but also as quickly as possible.

The reasons for my commitment and effort are abundant, and compelling.

First--whether anybody likes it or not--metrication is inevitable in the United States. The evidence of coming conversion is overwhelming.

The United States is now the only major industrial nation clinging to the obsolete, customary system of measurements. We are in the company of only a handful of other non-metric nations, such as Barbados, Gambia, Muscat, Southern Yemen and Tonga. American industry recognizes the reality of the metric movement. Major segments of industry have already converted, and many more corporations are adopting metric measurements each year. The Federal administration supports metrics, and Congress is moving toward favorable action on legislation to make it official.

The second major reason for my commitment to metrics is that it is a more efficient system than the one we use now. I believe it's high time that we rid ourselves of a system of measurements which originated, in part, on the basis of the distance--called a "yard"--from the nose to the tip of the thumb of England's King Henry the First. Instead of the intricate maze of units in

the customary system of measurements, the metric system has three basic units--meter, liter and gram--and is based on the decimal system.

The third major reason for my commitment is the benefit the children, the students will reap from the metric system. Because if is more efficient as a system of measurements, metrics is easier to learn. I liked this limerick, written by a teacher:

> "There once was a student named Peter
> Who asked, 'Why use meter and liter?'
> But when he found out
> He let out a shout,
> 'Cause meter and liter are neater!'"

I also feel strongly that the schools must lead--and not lag--in the movement toward metrication. The process of conversion is much more smooth and much less costly when education changes over early. In England, the schools got off to a slow start in metrics instruction; that country's transition encountered many problems and much confusion as a result. By contrast, Australia's schools were in the forefront of the conversion to metrics; the result is a much more orderly and successful transition in that country.

While the United States is lagging far behind the rest of the world in the metrication movement, California is regarded as being ahead of most other states within the nation.

Last April, after working closely with the California Metric Committee for more than a year, I publicly announced my commitment to metrication and my recommendations to prepare the state's schools and teachers for metric instruction.

The reaction was interesting--and encouraging. Despite the warnings of some advisers to me, there was no ground swell of opposition to metrics from teachers, parents or the public at large. Almost all of the newspapers expressing editorial opinion on the subject strongly endorsed our recommendations for metric instruction in the schools. The mail we received in the Department of Education was overwhelmingly favorable to metrication.

The letters did, of course, reveal a wide range of viewpoints. Some of the supporting letter writers, I must admit, overreacted to my public announcement, assuming that Wilson Riles

had made a unilateral decision, snapped his fingers and instantly established metric instruction in all the schools. One supporter, in fact, so optimistically interpreted my remarks and involvement that he wrote to order a copy of a book titled, "Metric System for Vocational Students by Wilson Riles"--which is non-existent.

At the other end of the spectrum of opinion, a woman wrote to deplore my recommendations for conversion to metrics. This was, she wrote, "a part of a conspiracy to brainwash the children to favor Communism." Fortunately, her view and other opposition was a minuscule minority of the citizens who expressed themselves on the subject of metrics.

Educational organizations are almost unanimous in their support of metrication, both nationally and within California. Here is just a very partial listing of organization support:

The California Teachers Association, the California Inter-Science Council, the California Mathematics Council, the National Education Association, the National Association of Secondary School Principals, the National Council of Teachers of Mathematics, the Council for Exceptional Children, the Association of American Colleges, the Association of Classroom Teachers, the National Science Teachers Association the American Society for Engineering Education, the Association for Educational Communications and Technology, the National Congress of Parents and Teachers.

The support is impressive, but we must be realistic and practical about some of the barriers on the road to metrication.

More than 400 years ago Niccolo Machiavelli wrote that nothing is more difficult than to change an established system. It seems to be a part of human nature to cling to habit, to resist change.

I do not expect significant opposition to metric instruction in the schools. But we must realize that there may be an inclination to procrastinate on the planning, to delay action, to wait for others to take the lead.

I believe that California should take the lead toward metrication in America. I believe that the schools should be in the forefront of the metrication movement.

That is why I made these recommendations to the State Board of Education in the spring:

First, endorsement of pending legislation to provide funds to train teams of teacher-trainers in metrics.

Second, action by the State Curriculum and Supplemental Materials Commission to plan for metrics textbooks by 1976.

Third, support for colleges and universities to move to metrics in the training and education of new teachers.

There is another area of effort I have also emphasized. I am not worried about the ability of children to learn metrics with ease. But those of us who are older--parents and citizens--will face a tougher adjustment. Our adult education system and the communications media will have to be involved in the effort to help the public learn to "think metric."

It is true that there has been no significant, outright opposition to these recommendations. What concerns me is the lack of response by some groups and the tentative skepticism expressed by some individuals about metrics.

The State Board of Education did refer the matter of textbook conversion to the State Curriculum Commission, and that group will take up the issue at its meeting next month.

But the State Legislature defeated the bill to provide in-service training funds for teachers in metrics.

The Department of Education is working to develop plans for such training through its existing staff and resources. We will also pursue other, related projects. Vocational education and home economics classes, in particular, will need special help which we will provide.

All of us must be alert to the human resistance to change and to the latent skepticism of some citizens toward metrication.

The skeptic is likely to say that California and its schools should wait until Congress acts on legislation establishing the policy that metrics should be the predominant system of measurement within ten years.

My response is that all reliable reports indicate Congress will act on the legislation soon. Also, American industry has not waited for Congress to act, nor should California and its schools.

The skeptic is inclined to say that we--and the students--will be stuck out on a limb if education moves to metrics now and the nation does not keep moving to metrics in coming years.

My response is that California and its students will be out of it--period--if we do not plan carefully and act urgently now to prepare for inevitable metrication.

The skeptic might say that there is no "proof" that the metric movement is strong and gaining momentum. One man argued to me that everybody was excited about the new language of Esperanto thirty years ago and that if we'd converted to Esperanto in the schools, our graduates would be stuck with it today.

My response is the Esperanto was never firmly established anywhere in the world, and that metrics is now the dominant system of measurement in all but a few small nations and the United States.

I conclude by commending the sponsors of this conference and all of you in attendance here. This meeting is a step in the right direction in our effort to prepare the nation, California--and Johnny--for a metric world.

I pledge that I will continue my commitment to take all the steps necessary to assure that the children who began school this week will be well prepared for a metric America by the time they are graduated from high school.

We can't let them down.

Thank you.

VITA

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Biographical Information:

Personal Data: Born at Cincinnati, Ohio, April 12, 1931, son of Howard J. and Alice Kalmeyer Brames; married Marilyn Ivey Brames from Bisbee, Arizona; two children--Carolmarie and Walter.

Education: Attended elementary and high school in Cincinnati, Ohio; received the Associate of Arts Degree from the College of San Mateo in 1967; completed the Bachelor of Vocational Education degree at San Francisco State College in 1969; completed the Master of Science degree, specializing in Industrial and Technical Education, at Utah State University in 1971; completed the Doctor of Education degree, specializing in Industrial and Technical Education, at Utah State University in 1975.

Professional Experience: 1964 to present, instructor in Electronics and Manufacturing Technology at the College of San Mateo, with one year leave of absence in 1974-75 and in 1969-70 to attend Utah State University; 1962-64, Manufacturing Superintendent, ITT Kellogg, Mountain View, California; 1961-62, Electronics Methods Engineer at Dalmo Victor Company, Belmont, California; 1959-61, Assistant Foreman, Varian Associates, Palo Alto, California; 1958-59, Leadman, Electronics Assembly, Ampex Corporation, Redwood City, California. 1948-58, Served in United States Navy aboard nuclear submarines. Presently hold rank of Lieutenant Commander in the United States Naval Reserve.