PROCESSES IN IMPLEMENTING THE METRIC SYSTEM IN EIGHT LOCAL PUBLIC SCHOOL DISTRICTS

Dissertation for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
JAMES RICHARD LAWSON
1977

This is to certify that the

thesis entitled

PROCESSES IN IMPLEMENTING THE METRIC SYSTEM
IN EIGHT LOCAL PUBLIC SCHOOL DISTRICTS

presented by

JAMES RICHARD LAWSON

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Secondary Ed. & Curriculum

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Date 4/21/77

ABSTRACT

PROCESSES IN IMPLEMENTING THE METRIC SYSTEM
IN EIGHT LOCAL PUBLIC SCHOOL DISTRICTS

By

James Richard Lawson

The purpose of the study was to describe the initiation and implementation stages in the diffusion of the metric system in eight local public school districts (K-6) in San Diego County, California. The study further sought to determine whether a paradigm for metric transition in local public school districts (K-6) was feasible and, if so, to make recommendations for developing such a paradigm. Specifically, the objectives of the study were:

1. To describe the heuristics and change strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric transition in eight selected public school districts (K-6) in San Diego County, California.

2. To describe specified characteristics of the eight selected public school districts under investigation.

3. To describe the execution of district plans as they relate to the installation of metric education in the districts under study.

4. To describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study.

5. To describe metric cognitive and affective changes on a population of each district's organizational members and metric cognitive changes on a population of pupils in each of the eight school districts under study.

6. To analyze the findings of the study to determine whether a paradigm for metric transition in local public school districts is feasible and, if so, make recommendations for developing such a paradigm.

The basic method of the study was descriptive in nature. The description of Centre heuristics and strategies and the description of district characteristics were based upon content analyses of documents and records and published data sources. The description of the execution of district plans and the description of organizational members' perceptions of the innovation, metric system, were based on surveys made on populations of districts' metric specialists, metric multipliers, and teachers. A quasi-experimental approach was used to gather data to describe cognitive and affective changes on districts' multipliers, experimental teachers, and control teachers. A quasi-experimental approach was also used to gather data to describe metric cognitive changes on a population of districts' multiplier pupils, experimental teacher pupils, and control teacher pupils.

Five strategies were identified and described at the initiation stage of the diffusion process: (1) commitment, (2) district plans, (3) a multiplier approach, (4) seed money, and (5) on-site support. District characteristics described were district type, size, special personnel resources, district economic factors, pupil background factors, and pupil performance factors. All districts in the study used a "multiplier approach" in the execution of their district metric implementation plans. Multiplier selection, training, and disperson were described as well as teacher selection and training. Organizational members' perceptions of school based parent and community metric education programs and perception of the metric system were also described.

Significant differences in favor of treatment groups were found between districts' multipliers, experimental teachers, and control teachers in cognitive and affective domains. Significant differences in favor of treatment groups were also found between districts' multiplier pupils and experimental teacher pupils and control teacher pupils at the first, third, fourth, fifth, and sixth grade levels. No significant differences were found between groups at the kindergarten or first grade levels.

Among other conclusions, the study concluded that:

1. A regional metric resource centre can be an effective outside change agent in initiating the diffusion of metric education in local public school districts (K-6)

when: (a) obtaining strong district commitment to metric transition, (b) requiring districtwide metric implementation plans, (c) requiring a multiplier approach to metric inservice training, (d) providing seed money, and (5) providing on-site support for district metric program implementation.

2. A significant change can be made in teacher metric cognitive and affective growth and pupil metric cognitive growth when: (a) strong district commitment to metric transition is made, (b) districtwide metric implementation plans are developed, (c) a multiplier approach to metric inservice training is used, (d) funds are provided for the purchase or development of metric instructional materials, and (e) on-site support is provided for district metric program implementation.

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

College of Education
Area of Instructional Development and Technology

1977

ACKNOWLEDGMENTS

The debt of gratitude that I have contracted toward so many people to complete this dissertation can never be adequately repaid. Those recognized below are but a few who have provided unselfish support and made personal contributions to the successful completion of the study.

First, I wish to thank the many people who have acted on my committee over the years.

Dr. James L. Page for his continuing encouragement, good counsel, and long distance assistance;

Dr. George Myers, Dr. Castelle Gentry, Dr. Bruce Miles, Dr. Wilfred L. Veenendahl, and Dr. Elwood Miller who provided the necessary advice and took the necessary actions at the right times and in the right places;

Dr. Andrew Papageorge and Dr. Paul E. Erzen who acted as my cognate advisors at the United States International University.

Second, I am deeply indebted to Dr. Dale G. Hamreus and Dr. Thomas L. Haines at the United States International University whose local encouragement and personnel contributions were so essential, so many times, over so many years. To them I owe a special thanks.

Third, I am grateful to the many administrators,

metric specialists, multipliers, teachers, and pupils who helped me in the school districts under study.

Finally, I would like to express my fond appreciation to Dr. Paul W. F. Witt whom I consider my Mentor and whose faith in me gave me the courage to pick up where I left off and the perseverance to complete the task.

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INTRODUCTION

Time, distance, and space have been foreshortened by man's technology. McLuhan, Fiore, and Agel stated, "Ours is a brand-new world of allatonceness. 'Time' has ceased, 'space' has vanished. We now live in a global village."[1] If technology has brought "allatonceness," it too has brought "altogetherness," for global man has been forced to establish new relationships.

Today, there is an increasing multifarious interdependence among the world's societies, especially in trade, commerce, and in scientific research, which has brought about a compelling need for a universal system of weights and measures. The evolution of measurement systems parallels that of civilization itself. The global village moves rapidly toward a universal language of weights and measures: Le Systeme International d'Unites (SI), a universal international system of metric weights and measures:

> Rapidly, we approach the final phase of the extensions of man--the technological simulation of consciousness, when the creative process of knowing will be collectively and

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[1]Marshall McLuhan, Quentin Fiore, and Jerome Agel, The Medium Is the Message (New York: Random House, 1967), p. 63.

> corporately extended to the whole of human society. . . .[2]

This study will be concerned with the metric transition in education in the United States, the last major industrial nation to accept and adopt the international system of metric weights and measures.

BACKGROUND OF THE PROBLEM

Presently, 92 per cent of the people in the world live in countries that officially recognize the metric system as the national standard for weights and measures. Today, Brunei, the People's Democratic Republic of Yemen, the Yemen Arab Republic, and the United States of America are the only countries in the world that predominantly use some system of measurement other than the metric system.[3]

As an island in a metric world, the United States is at a disadvantage in world trade and commerce. "American manufacturers are now experiencing rejection of 'inch' products overseas and the barriers increasingly are being raised."[4] The European Common Market countries have given

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[2]Marshall McLuhan, Understanding Media: The Extensions of Man (New York: McGraw-Hill Book Company, 1964), pp. 3-4.

[3]California State Department of Education, Inservice Guide for Teaching Measurement: An Introduction to the SI Metric System (Sacramento: Bureau of Publications, California State Department of Education, 1975), p. 8.

[4]Metric Markets, "There's No Place in Metrication for Emotionalism," Weights & Measurement, LX, No. 1 (1976), 12A.

the United States notice that by 1978, they will only accept imports that are marked solely in metric units. It has been suggested that the United States loses about $60 million to $1 billion annually in exports because of its disparate units of weights and measures.[5] Another disadvantage of the current system of United States measurement relates to education and communications in the fields of science and technology. Arnold believes the United States has lost its position as a world leader in science and technology, and that the United States cannot hope to regain its world influence if it does not go metric.[6] He further points out that the metric system is the language of science and, due to the continued use of the customary system in American schools and in other sectors of American society, "Metric countries have a distinct advantage in the preparation of scientific citizens who are more at home, more comfortable, and more understanding in the developing of the scientific age."[7]

Supporting this notion, Hallerberg listed as an advantage of the metric system the notion that "A common measurement language that is used by scientists, engineers, and industrial workers would improve communications and

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[5]Claibourne Pell, "Conversion Will Pay Off in Dollars, Sense," Los Angeles Times, December 28, 1975, Part VII, p. 1, col. 1.

[6]C. J. Arnold, "The U.S. in a Metric World," Metric News, November-December, 1975, pp. 22-23.

[7]Arnold, p. 23.

reduce barriers among different sectors of society."[8]

While the advantages and disadvantages of a United States conversion to the metric system have been debated for nearly two centuries, compelling political and economic forces are tending to bring a close to the debate.

In August, 1968, the Metric Study Act (Public Law 90-472) was enacted by Congress of the United States to provide a three-year study of the potential impact and the effects of increasing use of the metric system in the United States. A series of interim reports was presented to the United States Congress during the period 1968 through 1971. The final report, titled A Metric America--A Decision Whose Time Has Come, was submitted to Congress in July, 1971. The report concluded that the United States should change to the metric system through a coordinated national program and recommended:

> - That the United States change to the International System deliberately and carefully;
> - That this be done through a coordinated national program;
> - That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special programs described in the report, to a central coordinating body responsible to all sectors of our society;
> - That within this guiding framework, detailed plans and timetables be worked out by these sectors themselves;
> - That early priority be given to educating every American school child and the public to think in metric terms;

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[8]Arthur E. Hallerberg, "Commonly Listed Advantages of the Metric System," The Arithmetic Teacher, XX (April, 1973), 255.

- That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;
- That, in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover shall "lie where they fall";
- 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 predominantly, though not exclusively, metric;
- That there be a firm government commitment to this goal.[9]

On December 23, 1975, the President of the United States signed the Metric Conversion Act of 1975. This new law declares "a national policy of coordinating the increasing use of the metric system in the United States" and establishes "A United States Metric Board to coordinate the voluntary conversion to the metric system."[10]

In California, two significant events brought metric transition closer to education. First, in anticipation of the adoption of new California mathematics textbooks in 1976, it was determined that mathematics instructional materials shall "employ the metric system known as the International System of Units (SI) as the standard units of measurement."[11] Thus, all new mathematics instructional

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[9]U.S. Department of Commerce, National Bureau of Standards, A Metric America: A Decision Whose Time Has Come, National Bureau of Standards Special Publication No. 345 (Washington: Government Printing Office, 1971), p. iii.

[10]Metric Conversion Act of 1975, Public Law 94-168, 94th Congress, H.R. 8674, 89 Stat. 1007 (1975).

[11]California State Department of Education, Criteria for Evaluating Instructional Materials in the Subjects of Health, Mathematics, Music, Science, and the Social Sciences (Sacramento: Bureau of Publications, California State Department of Education, 1974), p. 10.

materials to be adopted in California in 1976 should include measurement instruction in metric units.

Secondly, the recent California framework for mathematics, Mathematics Framework for California Public Schools, K-12, contains a measurement strand at the elementary and secondary levels which advocates the metric system of measurement for California public school instruction. It declares that, "The International System of Units (SI) should be the system of standard units taught in the schools of California."[12] Further, the framework establishes a timeframe by which all students will begin metric instruction beginning in September, 1976.

In summary, the United States is on an irreversible course of action toward metric conversion; yet a recent exploratory survey of elementary school teachers indicates that schools are not yet devoting much attention to the metric system which has significant implications for educators.[13]

STATEMENT OF THE PROBLEM

National conversion to a new measurement system is a unique and universal phenomenon that lacks precedents in the

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[12]California State Department of Education, Mathematics Framework for California Public Schools, Kindergarten Through Grade Twelve (Sacramento: Bureau of Publications, California State Department of Education, 1975), p. 18.

[13]National Advisory Committee on Mathematical Education, Overview and Analysis of School Mathematics, Grades K-12 (Washington: Conference Board of the Mathematical Sciences, 1975), p. 43.

United States. Due to its lack of precedents, education administrators are faced with the immediate question of how to implement metric education in their local school districts without knowledge or understanding of its dimensions.

Goldhammer et al. studied superintendents' perceptions of their problems.[14] They interviewed 47 school superintendents of various sized districts in 22 states and found that there were six classes of problems superintendents perceived themselves as having. Among the six problems were educational change. Explicating the troubles superintendents face when confronted with change, Goldhammer et al. commented that:

> Organizing to meet and direct change is one of the responsibilities which trouble superintendents. That this is an area of deep concern was demonstrated by a superintendent who asked, "How do you implement? How do you get going? How do you get the district ready for innovation?"[15]

Further, Goldhammer et al. listed administrative concerns about staff resistance to change, about obtaining staff commitment to change, and about the difficulty in facilitating change based upon traditional budgetary allocations.[16] It is logical to believe that school superintendents will have similar concerns about organizing to meet and direct

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[14]Keith Goldhammer et al., Issues and Problems in Contemporary Educational Administration (Eugene: The Center for the Advanced Study of Educational Administration, University of Oregon, 1967), pp. 11-19.

[15]Goldhammer et al., p. 18.

[16]Goldhammer et al., pp. 18-19.

change brought about by national metric transition.

While Great Britain, Australia, South Africa, New Zealand, and Canada have recently, or are now currently, in the process of national metric conversion, few studies appear to be available about their experiences. In a recent study of other nations undergoing metric transition, Chalupsky et al. noted:

> One of the grim conclusions of our overseas studies was the almost complete absence of evaluation components in any aspect of metric education. . . . We found the lack of any but the most subjective evaluation of teacher training, and the complete lack of instructional evaluation, especially disheartening.
>
> To complete our conversion to metric education will take some time. Well-designed evaluative research now could help later training programs. It is unfortunate that we cannot capitalize on existing evaluation of training models and materials conducted by the other countries that have gone metric. None exist.[17]

Enlightened educators who recognize metric transition as a change phenomenon may turn to the literature on change to find, as Baldridge did, that:

> Analysts and scholars studying the problem of educational change have been baffled by the difficulty of translating new educational designs into usable organizational forms which can be implemented in the field. Although hundreds of research articles have been added to the professional literature, there still seems to be a paucity of understanding about the basic diffusion and implementation process. There is a shortage of usable information for the practical administrator who wants to incorporate

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[17]Albert B. Chalupsky et al., Metric Inservice Teacher Training: Learning from the English and Australian Experience, National Institute of Education Project No. C-74-0117, Final Report (Palo Alto, Calif.: American Institutes for Research in the Behavioral Sciences, 1975), p. 63.

innovations into his organization. . . .[18]

Specifically, the problem is that there is a lack of data, research, theory, practice, and pragmatic experience relative to the implementation of the metric system--elements typically used by educators to make judgments in solving educational problems. Education administrators and other interested education personnel have no previous experience and little data from which they can make professional judgments in their efforts to implement metric education in local public school districts.

PURPOSE OF THE STUDY

The purpose of the study was to provide knowledge and understanding of specified aspects of metric transition in local public school districts (K-6). The study sought to describe the initiation and implementation stages of change in eight local public school districts (K-6) currently undergoing metric transition. The study further sought to determine whether a paradigm for metric transition in local public school districts (K-6) was feasible, and if so, to make recommendations for developing such a paradigm. Specifically, the objectives of the study were:

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[18]J. Victor Baldridge, "Political and Structural Protection of Educational Innovations," What Do Research Findings Say About Getting Innovations Into Schools: A Symposium, eds., Sanford Temkin and Mary V. Brown, U.S., Educational Resources Information Center, ERIC Document ED 103 987, January, 1974, p. 12.

1. To describe the heuristics and change strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric transition in eight selected public school districts (K-6) in San Diego County, California.

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5. To describe metric cognitive and affective changes on a population of districts' organizational members and metric cognitive changes on a population of pupils in each of the eight school districts under study.

6. To analyze the findings of the study to determine whether a paradigm for metric transition in local school districts is feasible, and if so, to make recommendations for developing such a paradigm.

SIGNIFICANCE OF THE STUDY

The significance of the present study is that it can provide the kinds of facts, data, and measured field experiences upon which future professional judgments can be

based. The study provides knowledge about various aspects of metric diffusion strategies and provides penetrating insights into the nature of metric transition, metric education, and teacher inservice patterns. In general, this study provides the basis for planned metric transition for local school districts similar to those in the study, thus increasing the practitioner's power to understand and control the diffusion of metric education.

As one of the first metric studies, the study also provides a starting point for more rigorous studies for metric transition in education while contributing to the field and study of adoption and diffusion of innovations in education.

DELIMITATIONS OF THE STUDY

The study was derived from the larger problem of national conversion to the metric measurement system in the United States. National metric conversion implies a need for universal metric education--education that transcends all sectors of society and all people in all walks of life. The larger problem was, and remains, that of identifying the various audiences and their educational needs, developing strategies to meet those needs, and implementing those strategies so that there is a smooth and coordinated national transition to a metric system of measurement. The study was concerned only with that sector of society identified as public education and was further delineated in scope

by geography, audience, and focus.

The study was limited to eight local public school districts in San Diego County, California. It did not include nonpublic schools in San Diego County, nor did it include public or nonpublic school districts outside San Diego County, California.

The study described specified aspects and processes of districts undergoing metric transition. Emphasis was placed on describing the districts themselves; the strategies, tactics, or processes used by the districts to implement metric education; and the metric cognitive changes on a population of students and teachers in each of the districts during a period of their transition. The study was not concerned with administration, parent education, community education, curriculum, curriculum development, materials analysis and development, or methods of instruction per se, except as they may generally relate to recommendations for developing a paradigm for metric transition in local school districts.

DEFINITION OF TERMS

A number of terms used in the study require specific definition:

Change: The term change as used in the study follows Lippitt's definition as "any planned or unplanned alteration of the status quo in an organism, situation, or

process."[19]

Change agent: There are several definitions of change agent in the literature. Some define a change agent as an individual; while others include groups, agencies, or institutions as a change agent in their definitions. The term change agent as used in the study is best defined by combining definitions used by Good[20] and Rogers.[21] A change agent in this study is a person, group, agency, or other medium that attempts to alter, change, or restructure concepts, conditions, or processes in an attempt to influence the strength and/or direction of adoption decisions.

Community: In the study, community refers to the aggregate of private and public groups, institutions, organizations, or agencies that make up and influence the greater learning environment of the elementary school pupil, exclusive of the school and home setting. The community as defined includes the mass media, local service clubs, local government, local private and public agencies, stores, shops, businesses, and other local organizations, institutions, or organized groups that generally support, reinforce, or influence metric education of pupils in local school districts.

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[19]Gordon L. Lippitt, Visualizing Change (Fairfax, Va.: NTL-Learning Resources Corporation, 1973), p. 37.

[20]Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Company, 1973), p. 89.

[21]Everett M. Rogers, Diffusion of Innovations (New York: Free Press of Glencoe, 1962), p. 17.

Community education: Community education refers to pedagogy aimed at the community for the purpose of winning support for metric transition in education and influencing metric transition in the community.

Compatibility: The term compatibility refers to one of five characteristics of innovations defined by Rogers and Shoemaker as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of the receivers."[22]

Complexity: The term complexity refers to one of five characteristics of innovations defined as the degree to which an innovation is perceived as relatively easy to understand and use.

Control pupils (Ct P's): The term control pupils (Ct P's) refers to those pupils belonging to intact classes randomly selected from the control teacher population.

Control teachers (Ct's): Control teachers (Ct's) are defined as those teachers with a district under study who received no metric inservice education from district metric multipliers.

Diffusion: The term diffusion as used in the study is taken from Rogers and is "the process by which an innovation spreads."[23]

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[22]Everett M. Rogers and F. Floyd Shoemaker, Communications of Innovations: A Cross-Cultural Approach, 2d ed. (New York: The Free Press, 1971), p. 145.

[23]Rogers, p. 13.

Experimental pupils (Et P's): The term experimental pupils (Et P's) refers to those pupils belonging to intact classes randomly selected from the experimental teacher (Et) population.

Experimental teachers (Et's): Experimental teachers (Et's) are defined as those teachers within a district under study who received metric inservice education from district metric multipliers.

Implementation stage: It is generally accepted that there are three stages in the diffusion of innovations in a complex organization: (1) the initiation or support stage, (2) the implementation stage, and (3) the incorporation stage.[24] The implementation stage is the second stage of the diffusion process. The implementation stage is defined as the diffusion process internal to the school system under study and "the process that, when successful, results in the alteration of organizational members' behavior and attitudes, so that they conform to the expectations of the innovation."[25]

Initiation stage: The initiation stage is the first stage in the diffusion of an innovation in a complex organization. The initiation stage in the study is defined as the

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[24]Paul Berman and Milbrey Wallin McLaughlin, Federal Programs Supporting Educational Change: Vol. I, A Model of Educational Change (Santa Monica, Calif.: The Rand Corporation, 1974), p. 17; see also Joseph B. Giacquinta, "The Process of Organizational Change in Schools," Review of Research in Education, ed. Fred N. Kerlinger (Itasca, Ill.: F. E. Peacock Publishers, 1973), p. 197.

[25]Giacquinta, p. 197.

collective decisions, commitments, and agreements made by and between the Regional Metric Resource Centre and the districts under investigation.

Innovation: The term innovation as used in the study is broadly defined after Rogers, who stated:

> An innovation is an idea perceived as new by the individual. It really matters little, as far as human behavior is concerned, whether or not an idea is "objectively" new as measured by the amount of time elapses since its first use or discovery. It is the newness of the idea to the individual that determines his reaction to it. . . .[26]

Inservice education: The term inservice education refers to planned activities for the improvement of instructional staff members as professional practitioners with the intent of changing their instructional practices. In the study, three sets of professional practitioners were provided with inservice education: the district metric specialists, the metric multipliers, and the district teachers. In the study, the terms metric training and inservice training refer to metric inservice education.

Metric conversion: The term metric conversion for the purpose of the study has the same connotation as the term metric transition.

Metric education: The term metric education tends to be used loosely by practitioners and in the literature and is sometimes mistakenly used to mean metric transition. The term metric education tends to have a broad meaning to

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[26]Rogers, p. 54.

some and a narrower meaning to others; but, in any case, its meaning refers to the teaching/learning process. The narrowest meaning of metric education refers to those educational activities in the mathematics curriculum, exclusively using metric vocabulary, symbols, and units. A broader meaning of metric education includes all concepts in the narrower meaning of metric education, as well as concepts related to the general study of measurement: arbitrary units of measurement, estimation, and approximation, to name but a few. The broader meaning may also include the teaching/learning of requisite general mathematics concepts relevant to measurement--as an example, powers of ten. The broadest meaning of metric education includes any teaching/learning activity that requires knowledge or skills of measurement and, therefore, transcends the mathematics curriculum to include such curricular areas as science, social science, physical education, art, home economics, and any other curricular area requiring measurement knowledge or skills. Even the broadest meaning of metric education is subsumed under the rubric metric conversion or metric transition. Metric education as used in the study shall refer to the broadest meaning described above.

Metric system: The metric system as referred to in the study is that system of metric measurement adopted by the Eleventh General Conference on Weights and Measures in 1960 and formally given the title Systeme International d'Unites, interpreted into English as the International

System of Units and universally abbreviated as SI.

Metric transition: The term metric transition as used in the study refers to the phenomenon described by the collective states or processes necessary to bring about the change state required in implementing metric education in social systems. In an educational system, the phenomenon collectively includes all learner systems that directly and indirectly effect or affect metric education of pupils. Significant learner audiences would include the pupils, teachers, teacher multipliers, specialists, education administrators, school boards, parents, and the general community of the school system. Other significant dimensions of metric transition include: inservice education; planning and programs (e.g., teacher, specialist, and administrator); curriculum development (e.g., state frameworks, courses of study, scopes and sequences, lesson plans, and learner performance objectives); identification, selection, acquisition/development, and distribution of materials; learner diagnosis and achievement measures; and parent and community education programs.

Model: The term model in the study will be defined after Lippitt as a "representation of a phenomenon which displays the identifiable structural elements of that phenomenon, the relationships among those elements, and the processes involved."[27]

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[27]Lippitt, p. 73.

Multiplier (Em): The term multiplier refers to the district metric multiplier and is that person who acts as intermediary expertise between the district metric specialist and other intermediaries or teachers within a district.

Observability: The term observability refers to one of five characteristics of innovations defined by Rogers and Shoemaker as "the degree to which the results of an innovation are visible to others."[28]

Paradigm: The term paradigm and the term model will be used synonymously and interchangeably in the study. The term paradigm will be the preferred term.

Planned change: Planned change as used in this study is defined by Lippitt as "an intended, designed, or purposive attempt by an individual, group, organization, or larger social system to influence directly the status quo of itself, another organism, or a situation."[29]

Relative advantage: The term relative advantage refers to one of five characteristics of innovations defined by Rogers and Shoemaker as "the degree to which an innovation is perceived as being better than the idea it supersedes."[30]

Specialist (S): The term specialist as used in the study refers to persons identified and selected by a district's administration to provide the expertise, planning,

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[28]Rogers and Shoemaker, p. 155.

[29]Lippitt, p. 37.

[30]Rogers and Shoemaker, p. 138.

and coordination for district metric transition. In the study, a specialist is sometimes referred to as the metric specialist, district specialist, district metric specialist, or simply as specialist.

Strategy: The term strategy as used in the study is taken from Miles who defined strategy as "a means (usually involving a sequence of specified activities) for causing an advocated innovation to become successfully . . . installed in an on-going educational system."[31]

Tactic: The term tactic as used in the study refers to the maneuvering or disposing of forces into positions of advantage to accomplish an end. More specifically to this study, tactic refers to various activities, procedures, or processes subsumed under broader strategies to accomplish metric transition.

Trialability: The term trialability refers to one of five characteristics of innovations defined by Rogers and Shoemaker as "the degree to which an innovation may be experimented with on a limited basis."[32]

OVERVIEW

In Chapter 2, pertinent literature relevant to metric transition and to the diffusion and adoption of

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[31]Matthew B. Miles, ed., Innovation in Education (New York: Teachers College, Columbia University, 1964), pp. 18-19.

[32]Rogers and Shoemaker, p. 155.

innovations is reviewed. In Chapter 3, the reader will find a description of the research approach, the design of the study and data collection plan, the sample populations, the instrumentation, the data analysis plan, and the methodological assumptions and limitations. The results and findings of the study are organized and reported in Chapter 4. Finally, conclusions and implications are drawn in Chapter 5.

Chapter 2

REVIEW OF THE LITERATURE

This chapter reviews the research and conceptual literature considered relevant and necessary to understand the present study. The study sought to describe the initiation and implementation stages of change in eight local public school districts (K-6) currently undergoing metric transition. For this reason, the review focuses on literature related to the metric system of measurement and the diffusion and adoption of educational innovations.

METRIC SYSTEM LITERATURE

Literature related to the metric system has only recently emerged. Bormet made an examination of the periodical and journal literature published in 1971, 1972, and 1973 under the descriptor metric system using as sources the Current Index to Journals in Education, Educational Research Information Center, Education Index, and the Unabridged Readers' Guide to Periodical Literature. He found 11 articles for the year 1971, 11 articles for the year 1972, and 21 articles for the year 1973.[1] The present investigator found no metric descriptor in the ERIC system

[1]David Bormet, "Metrication in Education . . . A Review," American Metric Journal, III, No. 3 (May/June, 1974), 5.

during 1973. However, in August, 1974, an ERIC search under the descriptor metric system produced an off-line bibliographic citation list of 119 documents. An updated off-line citation list printed in November of 1976 produced 180 additional citations. Analyzing the titles, descriptors, and abstracts of the 299 citations, the investigator made a frequency count of the documents under eight categories. The analysis is reported in Table 1.

Table 1

Frequency of ERIC Citations, February, 1969-May, 1976, by Categories

Category	Frequency
History of the metric system	9
Rationale for metric conversion	22
Policy statements (laws, acts, and resolutions)	12
Position papers (needs, issues, and trends)	91
Current programs and projects	21
Curriculum and teaching/learning activities	118
Materials analysis, selection and recommendations	12
Bibliographies and reference materials	14
Total all categories	299

General Problem Areas in Metric Transition

Citations classified as position papers in Table 1, the second largest category with 91 listings, were documents

that discussed trends, needs, problems, plans, issues, and consequences of a national metric transition. Ninety per cent of the documents cited could be classified as conceptual literature as opposed to research literature. The Chalupsky, Crawford, and Carr study appeared to be one of the more comprehensive research studies in the metric literature and was one of the first to be reviewed by the investigator.[2]

Chalupsky, Crawford, and Carr, in a study of five nations that have recently undergone or are currently undergoing a conversion to the metric system, reported nine major problem areas in the metric transition process: (1) resistance to change, (2) teaching materials and textbooks, (3) equipment conversion, (4) teacher training, (5) vocational and adult education, (6) communication and coordination, (7) lack of firm direction, (8) special problems in the instruction and use of the metric system, and (9) breadth of impact.[3]

Curriculum Concerns

As reported in Table 1, the greatest number of metric documents cited dealt with matters of curriculum and

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[2]Albert B. Chalupsky, Jack J. Crawford, and Edwin M. Carr, Going Metric: An Analysis of Experiences in Five Nations and Their Implications for U.S. Educational Planning, National Institute of Education Project No. 3-2173, Final Report (Palo Alto, Calif.: American Institutes for Research in the Behavioral Sciences, 1974).

[3]Chalupsky, Crawford, and Carr, p. 93.

with teaching-learning activities related to metric instruction. Such documents included guides, handbooks, curriculum frameworks, courses of study, units of instruction, and teaching activities. These documents were aimed at specific learning audiences and specific disciplines (e.g., teachers of adults, parents, elementary pupils, secondary students, vocational education teachers, and teachers of the blind, to name but a few). Content ranged from general to specific information and tended to reflect special problems in the instruction and use of the metric system--one of the nine problem areas in metric transition reported by Chalupsky, Crawford, and Carr above.[4] The quantity of documents cited in this category tends to support the notion that curriculum development is an important component of metric transition in education.

Expanded Role of the School

Chalupsky, Crawford, and Carr further found that metrication provides an expanded role for schools in adult education and noted that:

> During the course of metric conversion in the countries studied, the schools have been presented with the opportunity to expand their role in the community and assume greater responsibilities for adult education. Metric conversion in the U.S. will no doubt offer similar challenges. Schools will very likely be called upon to provide additional courses for adults--both general education teachers and specific job training teachers of many disciplines . . . can all contribute. Parent-teacher association meetings and other school functions can

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[4]Chalupsky, Crawford, and Carr, p. 93.

> be instrumental in setting the neighborhood tone toward SI. Even more important, but more likely to be overlooked, is the role that students can, and will, play in educating their parents. The attitudes and practices of teachers, as reflected through their students, will do much to convince parents to support or resist metric conversion.[5]

It should be noted that the investigators explicitly stated that general education teachers would be called upon to provide adult education, implying an expanded role for the elementary school which traditionally does not act in that capacity. While parents are more frequently involved in elementary school activities, direct instruction of adults is not typically a role an elementary school plays.

Schoonover also supported the concept of the schools' role in providing community and parent metric education.[6] Richardson saw the school as having a role in consumer education. Speaking of consumer education, he stated:

> Education must be conceived in the broad terms of its many purposes, its timing, and its diverse audiences. Clearly, the schools, the advertising media, and general information media must all play parts in any major campaign.[7]

Advocacy and Leadership

Schoonover not only supported the concept of the school's role in providing community and parent metric education, but implied that educators should act as

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[5]Chalupsky, Crawford, and Carr, pp. 122-23.

[6]Jean Way Schoonover, "Communicating a Metric Education Plan," Metric Reporter, June 27, 1975, pp. 2, 6.

[7]Lee Richardson, "Metric Consumer Concerns," Metric Reporter, September 17, 1976, p. 4.

advocates for metric transition among community and parent groups. She suggested that strategies be employed to generate wide community acceptance of the changeover to metric education in schools and generate parent involvement. Among the strategies she suggested were endorsement by credible spokesmen and women, meetings with community groups, communications blitzes, PTA programs, parent-sponsored school metric programs, news releases, television interviews, articles, and speakers.[8]

An advocacy position was also suggested by Dr. Mary Ellis and the Educational and Industrial Training Coordinating Committee of the American National Metric Council, who, after a recent metric education survey of each state and territory, commented:

> We learned a lot about many of the states, but much more is greatly needed. We can no longer take a passive role. With over 17,000 school districts and millions of teachers and students to be affected by metrication, coordination and leadership are vitally important.[9]

Elliott Richardson, U.S. Secretary of Commerce, was more direct about educators and others playing an advocacy role. He stated:

> There may be some confusion that the passage of the Metric Conversion Act will relieve businessmen, industrialists, educators, and other who have been toiling in the metric vineyard from primary responsibility. This is wrong and runs contrary to the intentions of both the Administration and the

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[8]Schoonover, pp. 2, 6.

[9]"Metric Education Survey Results," Metric Reporter, December 10, 1976, p. 8.

> Congress. . . . The U.S. Metric Board will serve as a facilitator, but will not be the initiator. . . . It will be the duty of all of us to act as public advocates for the move to metrics.[10]

Currently, many educators appear reticent to assume a leadership role in initiating metric education; yet the notion that education and educators must assume a leadership role in implementing the metric system comes from many sources.[11] The feeling for urgency and the need for leadership was expressed by Riles during an address he made the first week of school year 1973:

> 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 now 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.[12]

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[10]Elliott L. Richardson, "A Nation Among Nations," Examining the Metric Issues (Washington, D.C.: American National Metric Council, 1976).

[11]David Bormet, "Metrication in Education . . . A Review," American Metric Journal, III, No. 3 (May-June, 1974), 9; see also Jeffrey V. Odom, "The Metric System: Learn It! Think It! Teach It!" Instructor, LXXXIII (October, 1973), 50-60; see also Lottie Viets, "Experiences for Metric Missionaries," American Teacher, XX (April, 1973), 369-70.

[12]Opinion expressed by Wilson Riles, Superintendent of Public Instruction, State of California, in an address ("Impact of Metric Conversion") at UCLA Metric Conference/ Exhibit, September 7-8, 1973, University of California at Los Angeles, September 8, 1973 (printed copy available from the Bureau of Publications, California State Department of Education.

Coordination, Collaboration, and Planning

The imperative need for coordination in metric transition efforts is generally accepted.[13] Speaking for education, Bell stated:

> I believe the need is clear to all of us. The nation is committed to eventual and complete conversion. What is needed now is exactly the coordination authorized in the Metric Conversion Act so that educators can draw upon and contribute to the efforts of business, industry, and government.[14]

Swanson argued a case for collaboration among public and private sectors: a working partnership during national metric transition.[15] While his perspective was primarily aimed at the relationships between industry and government, some of the same arguments might be used for collaboration between industry and education.

The notion that a planned metric transition is not only preferred but essential to the social, economic, and political welfare of the United States was made clear by Pell and others.[16] What the literature failed to make clear

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[13]Albert B. Chalupsky and Jack J. Crawford, "Preparing the Educator to go Metric," Phi Delta Kappan, LXII (December, 1975), 263; see also U.S. Department of Commerce, A Metric America: A Decision Whose Time Has Come, National Bureau of Standards Special Publication No. 345 (Washington, D. C.: Government Printing Office, 1971), p. 85. (Hereafter referred to as U.S. Department of Commerce, A Metric America. . . .)

[14]T. H. Bell, "The U.S. Office of Education and Metric Education," Examining the Metric Issues (Washington, D. C.: American National Metric Council, 1976).

[15]C. A. Swanson, "Working Partnership in Going Metric," Metric Bulletin, II, No. 10 (August, 1975), 9-12.

[16]Claiborne Pell, "Conversion Will Pay Off in Dollars, Sense," Los Angeles Times, December 28, 1975, Part VII, p. 1; see also U.S. Department of Commerce, A Metric America . . ., pp. xv-xvi; see also Riles, "Impact of Metric Conversion."

was how one goes about implementing metric education in local school districts even though educational change is generally perceived by school superintendents as a problem area.[17]

Materials Analysis and Selection

Chalupsky, Crawford, and Carr reported that teaching materials and textbooks represented one of the nine problem areas in metric transition process in the countries they studied.[18] In a later study Chalupsky et al. reported that:

> In the early stages of metric conversion, teaching staff, sometimes in almost a panic, grasp at the first seemingly relevant teaching aids to come along. Too often, the early flood of materials contains many items of poor quality, from the viewpoint of construction or a combination of these shortcomings. Unfortunately, technical assistance in identifying useful materials may not be available in the early phases of teacher training.[19]

Table 1 lists 12 ERIC documents related to materials analysis and selection indicating the present concern for the subject.

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[17]Keith Goldhammer et al., Issues and Problems in Contemporary Educational Administration (Eugene: The Center for the Advanced Study of Educational Administration, University of Oregon, 1967), pp. 11-19.

[18]Chalupsky, Crawford, and Carr, p. 93.

[19]Albert B. Chalupsky et al., Metric Inservice Teacher Training: Learning from the English and Australian Experience, National Institute of Education Project No. C-74-0117, Final Report (Palo Alto, Calif.: American Institutes for Research in the Behavioral Sciences, 1975), p. 63.

Evaluation

As was indicated in the statement of the problem in Chapter 1, Chalupsky et al. expressed their concern about the lack of evaluation components in any aspect of metric education overseas. They found the "lack of any but the most subjective evaluation of teacher training, and the complete lack of instructional evaluation. . . ."[20] They advocated well-designed evaluative research of training models, student instruction, and metric materials in the early phases of American metric transition.

Teacher Inservice Education

Concerns about staff development in the literature tended to center around which teachers should be involved, how much inservice training is necessary, and what should be stressed, as is indicated in the literature cited below.

Based on a critical review of the metric teacher inservice training experiences in England and Australia, Chalupsky et al. reported implications for teacher training in the United States. Among these were:

> The reduction of anxieties, particularly among older teachers, should be dealt with before actual training in SI.
>
> Priorities in training should be given to teachers in all subject areas, not just math and sciences.
>
> Training should be scheduled in short activity sessions, distributed over time, and alternated with classroom tryouts of materials and strategies.
>
> To gain maximum proficiency in teaching the metric system of measurement, teacher inservice

[20] Chalupsky et al., p. 63.

> training should encompass the same exercises as those the students will perform.[21]

Gibb agreed with Chalupsky et al. that all teachers need some inservice education. She stated:

> . . . although the mathematics teachers can be expected to need more time for the preparation of learning opportunities for students, the entire faculty should have familiarity and competency in using metric measure and thinking metrics.[22]

She further suggested 10 to 15 hours of teacher inservice education with a half dozen weekly sessions of 90 to 100 minutes each. Gibb indicated that the basic units of the metric system, their relationships with each other, proper symbols, and hands-on measuring activities should be stressed.[23]

Trent surveyed a random sample of rural and urban elementary and secondary teachers in the state of Nevada to determine the need for metric inservice education and the present knowledge of the metric system among Nevada teachers. Data indicated: (1) a need for metric inservice workshops for both rural and metropolitan elementary levels, (2) that junior and senior high teachers were more adequately prepared in the metric system than their elementary counterparts, but suggested a need for inservice education for

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[21]Chalupsky et al., pp. 60-63.

[22]Glenadine E. Gibb, Moving to Metrics in Our Schools, U.S. Educational Resources Information Center, ERIC Document ED 110 348, February, 1975.

[23]Gibb, p. 4.

secondary teachers as well.[24]

The Interstate Consortium on Metric Education (ICME) made several recommendations relevant to inservice education programs. They recommended that inservice education programs be designed for administrators and support personnel as well as teachers. They believed that such programs should include a metric awareness level and an experience activity level. It was suggested that introductory programs should be of 3 to 6 hours duration, but personnel engaged in teaching measurement to students should be of 10 to 16 hours duration. Direct metric measurement experience, that is, hands-on metric activities, were stressed for all metric education programs.[25]

Further ICME recommendations indicated that a core of resource personnel should be developed to implement metric education programs in local school districts. ICME provided the rationale that:

> The need for implementing a variety of metric education programs at the local level necessitates the training of resource personnel who can carry out these programs effectively. A core of resource personnel could be trained and then, in turn, train others to assist in implementing metric

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[24]John H. Trent, Need for In-Service and Pre-Service Education, U.S., Educational Resources Information Center, ERIC Document ED 113 188, February, 1975.

[25]California State Department of Education, Interstate Consortium on Metric Education, Final Report (Sacramento: Bureau of Publications, California State Department of Education, 1975), pp. 10-11. (Hereafter referred to as California State Department of Education, Interstate Consortium . . . .)

education programs all the way to the local school board.[26]

The notion of using intermediaries to produce a multiplier effect in training does not appear to be a new concept. Hoehn reported using such a staff development strategy for dissemination of the Teaching Behavior Improvement Program (TBIP) developed by the Michigan-Ohio Regional Education Laboratory (MOREL). Upon completion of the development of the Teaching Behavior Improvement Program, a Leader Training Program was designed to train school-based inservice leaders to implement the TBIP in their school districts. In effect, a small number of persons were trained as trainers who, in turn, trained others as trainers, thus producing a riple effect.[27]

There appears to be some logic in using a multiplier approach for innovation diffusion, particularly when there are unlimited learners and limited resources. However, at least two potential drawbacks are immediately apparent. One drawback relates to the commitment of successive intermediaries in carrying out the training process, that is, do the intermediaries actually carry out their responsibilities to train others? Hoehn reported that approximately 50 per cent of the persons trained as intermediary trainers returned to

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[26]California State Department of Education, Interstate Consortium . . ., p. 11.

[27]Lilburn P. Hoehn, Leader Training Program, U.S., Educational Resources Information Center, ERIC Document ED 035 095, July, 1969.

their district settings and implemented the TBIP.[28] The other potential drawback relates to a possible loss of content fidelity through the use of successive trainers. Like the successive duplication of videotapes, the question needs to be asked whether or not the degree of degeneration of the content is such that the message is lost. Hoehn did not comment on this.

Summary

In summary, the emerging literature related to the metric system of measurement appeared to lack distinction and scholarliness. The literature was primarily conceptual literature as opposed to research literature and tended to focus on the macro-problem of national metric transition. The literature did not conceptualize the elements and forces of metric transition in education as a unified whole, nor did it provide a rational analysis or the process aspects of the diffusion of metric education. In fact, the literature did not acknowledge metric education as an innovation, nor did it treat the metric transition process from an adoption/diffusion/innovation perspective. It was of interest to note that while the metric literature was replete with arguments, issues, and problems related to change to a new system of measurement, only the present study viewed metric transition from a diffusion/adoption/innovation perspective. The literature did reflect, however, some educator problems

[28]Hoehn, p. 1.

and concerns about metric transition in public school districts.

The literature suggested that teacher, parent, and community education were significant components in the metric transition process; that staff development and curriculum development were essential aspects of metric education; that provisions needed to be made for evaluation of instructional materials, teacher training, and instruction; and that leadership, planning, coordination, and collaboration were important ingredients to a smooth and orderly metric transition. The literature further suggested a multiplier approach to staff development and a hands-on experience approach to learning as strategies in implementing metric education.

DIFFUSION, ADOPTION, INNOVATION LITERATURE

The present study viewed metric transition as a change phenomenon and viewed the implementation of the metric system in local school districts as the diffusion and adoption of an educational innovation. The investigator therefore reviewed the literature on the diffusion and adoption of educational innovations for data relevant to the study.

Research Traditions

Rogers reviewed over 500 research diffusion studies completed between 1900 and 1960, traced their academic

ancestry and determined that there were six research traditions from which studies in the diffusion and adoption of innovations were derived: anthropology, early sociology, rural sociology, education, industrial, and medical sociology. Rogers synthesized the analyses completed by diffusion researchers into 52 generalizations seeking a rapprochement between research and theory--a rapprochement that he never found.[29]

Research in the diffusion and adoption of innovations increased rapidly after the 1960's. Rogers and Shoemaker discovered that there were three times as many publications on the subject than there had been eight years before when Rogers accomplished his first study. They speculated that more diffusion research had been done between 1960 and 1970 than during the previous thirty years. They reported seven research traditions as opposed to six found in Rogers' earlier work. They added a communications tradition which began emerging in the 1960's and dropped the term industrial tradition in favor of a marketing tradition, which appeared to be also emerging in the 1960's. Thus, as of 1971, Rogers and Shoemaker perceived seven research traditions from which studies in the diffusion and adoption of innovations tended to be emerging: anthropology, early sociology, rural sociology, education, medical

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[29]Everett M. Rogers, Diffusion of Innovations (New York: Free Press of Glencoe, 1962), pp. 22-56, 311-16.

sociology, communications, and marketing.[30]

Types of Early Research

Seeking a rapprochement between research and theory, Rogers and Shoemaker analyzed and synthesized the content of over 1,500 documents reporting empirical research results. They developed a typology of diffusion research around eight dependent variables, associated independent variables, and associated units of analysis based upon the methods and generalizations reported in the documents studied. The eight dependent variables were: (1) rate of adoption of an innovation in a social system, (2) rate of adoption of innovations in different social systems, (3) attributes of innovations as perceived by members of a social system, (4) innovations of members of a social system, (5) earliness of knowing about an innovation by members of a social system, (6) opinion leadership in diffusing innovations, (7) communication channel use, and (8) consequences of the innovation. Independent variables cited included: (1) attributes of innovations, (2) system norms, (3) characteristics of a social system, and (4) innovativeness and other characteristics of members of a social system. They stated that the most popular diffusion research type used innovativeness of members of a social system as its dependent variable. They reported that:

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[30]Everett M. Rogers and F. Floyd Shoemaker, Communications of Innovations: A Cross-Cultural Approach, 2d ed. (New York: The Free Press, 1971), pp. 45-70.

> . . . more than half (58.4 per cent) of all the empirical generalizations reported in publications in the Michigan State University Diffusion Document Center dealt with [individual] innovativeness.[31]

Six of the eight types of research studied used members of a social system as their units of analysis. Just one research type--rate of adoption of innovation in different social systems--used social system as its unit of analysis.[32]

Diffusion Models

Research in education, innovation and diffusion rose rapidly during the post-Sputnik era with the emergence of the federal government as a full partner in public education. Research and development centers; regional laboratories; information, retrieval, and dissemination centers; private profit and nonprofit development organizations; and federally funded school programs emerged in relation to, or as a reflection of, the conscious efforts of the federal government to promote innovation in local education practices.[33] A large number of project and policy studies emerged, as well as a continuing growth of analytical treatments of the problems and processes of planned change in education.[34] The literature of the late sixties tends to

[31]Rogers and Shoemaker, p. 71.

[32]Rogers and Shoemaker, pp. 69-76.

[33]Ronald G. Havelock, "The Utilisation of Educational Research and Development," British Journal of Educational Technology, II, No. 2 (May, 1971), 84.

[34]Paul Berman and Milbrey Wallin McLaughlin, Federal Programs Supporting Educational Change, Vol. I, A Model of Educational Change (Santa Monica, Calif.: The Rand Corporation, 1974), pp. 3-5.

reflect concerns about research and development, knowledge utilization, dissemination, and the adoption processes.[35] Havelock described four models which reflected the concerns of the late sixties: the RD & D Model, the Social Interaction Mode, the Problem Solving Model, and the Linkage Model.

The RD & D (Research, Development, and Diffusion) Model was portrayed as a rational diffusion model guided by five assumptions or characteristics: (1) a rational sequence in the evolution and application of an innovation, including research, development, production, dissemination, application, and evaluation; (2) planning; (3) a division and coordination of labor; (4) a passive, but rational, consumer; and (5) a high initial development cost with mass audience dissemination. The names Henry Brickell, David Clark, and Egon Guba were associated with this concept.[36]

The Social Interaction Model stressed social interaction in the process of diffusion. Havelock identified five generalizations related to this perspective of the process of innovation diffusion:

> (1) That the individual user or adopter belongs to a network of social relations which largely influences his adoption behaviour; (2) that his place in the network . . . is a good predictor of his rate of acceptance of new ideas; (3) that informal personal contact is a vital part of the influence and adoption process; (4) that group membership and reference

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[35]Harbons S. Bhola, Alice Jwaideh, and James Knowlton, "Training the Change Makers in Education," Audio-Visual Instruction, XVIII, No. 1 (January, 1973), 22-23.

[36]Havelock, p. 85.

> group identifications are major predictors of individual adoption; and (5) that the rate of diffusion through a social system follows a predictable S-curve pattern. . . .[37]

Paul Mort, Donald Ross, Richard Carlson, and Everett Rogers were among those associated with this perspective.

The Problem Solving Model was a user-oriented or client system ordered model. It assumed that the user or client system would initiate appropriate action to assess its needs, diagnose its problems, search and retrieve needed outside resources to solve the problem, fabricate a solution, and apply it. Change and innovation was conceived as self-initiated and self-applied. Ronald Lippitt, Goodwin Watson, and Matthew Miles were linked with this point of view.[38]

The Linkage Model was developed by Havelock as a synthesis of the three previous models, taking what he perceived to be the best attributes of each. Central to the model was a resource linking agency between the user and various remote resources systems. The linking agency functioned as a facilitator and coordinator servicing the needs of the user. Salient characteristics included: (1) a user or client system as a problem-solver; (2) more and more remote resource systems providing a flow of knowledge or

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[37]Havelock, pp. 85-86.

[38]Egon G. Guba, "A Diffusion Mechanism for the Center for Vocational and Technical Education," Conceptual Strategies for Utilizing Research and Development Products in Education (Columbus, Ohio: The Center for Vocational Education, Ohio State University, 1971), p. 3; see also Havelock, p. 87.

innovation; and (3) a resource agency, linking the two, through social interaction, mutual influence, and collaboration.[39]

Concerns About Past Research

Literature in the past five years tends to reflect the concerns of organizational change, organization development, organizational self-renewal, and school reform.[40] The literature also reflects disillusionment and dissatisfaction in the success and effectiveness of federal programs.[41] Perhaps, more important to the present study, the literature reflects disenchantment with the focus of past research and tends to seek answers to questions asked at the implementation stage of innovation diffusion in complex organizations.[42]

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[39]Havelock, pp. 88-95.

[40]Robert G. Owens and Carl R. Steinhoff, Administering Change in Schools (Englewood Cliffs, N. J.: Prentice-Hall, 1975); see also J. Victor Baldridge and Terrence E. Deal, eds., Managing Change in Educational Organizations (Berkeley: McCutchan Publishing Corporation, 1975); see also Richard A. Schmuck and Matthew B. Miles, eds., Organization Development in Schools (Palo Alto, Calif.: National Press Books, 1971); see also Seymour B. Sarason, The Culture of the School and the Problem of Change (Boston: Allyn and Bacon, 1971).

[41]Berman and McLaughlin, p. 1.

[42]J. Victor Baldridge, "Political and Structural Protection of Educational Innovations," What Do Research Findings Say About Getting Innovations Into Schools? A Symposium, eds. Sanford Temkin and Mary V. Brown, U.S., Educational Resources Information Center, ERIC Document ED 103 987, January, 1974; see also Glenn Heathers, Planned Educational Change in Search of a Research Tradition, U.S., Educational Resources Information Center, ERIC (continued)

Scanlon complained that:

> Although considerable efforts over the past thirty years have produced a quantity of theoretical research, there is still a paucity of practical know-how as to the implementation of innovative practices into schools.[43]

Giacquinta echoed these remarks and stated:

> Past appraisals of the literature on educational change are contradictory. Some portray it as replete with conclusive studies and theory; others find little sound research or theory. . . . As research designed to test hypotheses derived from theory about organizational change, the quality is poor, and little is contributed to systematic understanding of organizational change in schools.[44]

Berman and McLaughlin faulted the Havelock models as focusing:

> . . . almost exclusively on how people behave and how institutions are characterized before an innovative strategy is implemented. Thus . . . the problem of effecting change is framed primarily in terms of bringing about the adoption of innovation.[45]

Baldridge cited three themes that permeate the bulk

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[42](continued) Document ED 108 303, May, 1974; see also Bernard C. Watson, "Research and Innovation: Unanswered Questions," What Do Research Findings Say About Getting Innovations Into Schools? A Symposium, eds. Sanford Temkin and Mary V. Brown, U.S., Educational Resources Information Center, ERIC Document ED 103 987, January, 1974; see also Robert E. Klitgaard, Models of Educational Innovation and Implications for Research, U.S., Educational Resources Information Center, ERIC Document ED 078 603, March, 1973.

[43]Robert G. Scanlon, Building Relationships for the Dissemination of Innovations, U.S., Educational Resources Information Center, ERIC Document ED 108 302, August, 1973, p. 4.

[44]Joseph B. Giacquinta, "The Process of Organizational Change in Schools," Review of Research in Education, ed. Fred N. Kerlinger (Itasca, Ill.: F. E. Peacock Publishers, 1973), p. 178.

[45]Berman and McLaughlin, p. 7.

of the literature and tend to be traditionally followed: (1) research generally focuses on the early stages of the development and diffusion cycle, (2) it focuses on a narrow range of innovations, and (3) it focuses on individual adopters and the rate of adoption among groups of people.[46] Baldridge argued for a drastic reshaping of the intellectual tradition surrounding the diffusion of innovation. He stated:

> As we shift our focus away from single, mechanical, technological inventions to large-scale social innovations, it is important to have a fresh perspective on the problem of innovation diffusion. In essence, we are arguing: (1) that organizations are now the major adopters of social invention, and (2) that organizational factors and organizational dynamics are the major variables which will influence the amount, rate, and the permanence of innovations.[47]

Implementation Perspective

In a recent study of federal programs supporting educational change, Berman and McLaughlin found that:

> . . . the most difficult and complex part of the problem of innovation has to do, not with preadoptive behavior, but with postadoption behavior, or with the process of implementation. In almost all the instances studied, adoption was not an issue; problems of implementation dominated the outcome and the success of the innovative projects.[48]

They convincingly argued for an implementation perspective to planned change as opposed to an adoption perspective which

[46]Baldridge, pp. 14-19.

[47]Baldridge, p. 21.

[48]Berman and McLaughlin, p. 8.

they felt has dominated past research. They lamented that:

> . . . there is no theory or analytical understanding of implementation in the educational literature or in other literature. . . . At best, educational experts have accumulated wisdom in the form of principles, guidelines, and advice for change agents. . . . Without denying the validity of any particular common-sense procedure, such advice usually suffers from both inconsistency and incompleteness: Implementers are often faced, on crucial matters, with principles leading to divergent alternatives, and inadequate information (and understanding) to choose among them. The need for a more systematic understanding of the process of implementation is evident.[49]

McLaughlin described two levels of implementation, micro and macro, and took the view that:

> . . . Local innovators have a micro-problem--they must learn to implement new ideas and practices effectively. Concurrently, central planners and federal policy makers face a macro-problem--their federal plans can be implemented only as a cumulated product of many micro-level, local implementations.[50]

A national metric transition appears to present similar problems to education. There are "more than sixty-two million Americans engaged full-time as students, teachers, or administrators in the nation's educational enterprise."[51] The macro-problem for educators appears to be the diffusion and adoption of the metric system among these sixty-two million Americans. The micro-problem appears to be the

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[49]Berman and McLaughlin, p. 12.

[50]Milbrey Wallin McLaughlin, Macro and Micro Implementation, U.S., Educational Resources Information Center, ERIC Document ED 118 447, May, 1975, p. 4.

[51]U.S. Department of Commerce, National Bureau of Standards, U.S. Metric Study Interim Report: Education, National Bureau of Standards Special Publication No. 345-6 (Washington: Government Printing Office, 1971), p. 111.

diffusion and adoption of the metric system within each of the individual local school districts of the United States. The present study addressed itself to the micro-problem: the problem of implementing the metric system in local public school districts.

Three Stages in Organizational Innovation

Giacquinta proposed three basic stages in organizational innovation: (1) initiation of the innovation, (2) implementation, and (3) incorporation.[52] Berman and McLaughlin agreed and labeled the three stages: (1) support, (2) implementation, and (3) incorporation.[53]

Giacquinta defines the initiation stage as:

> . . . the process that, when successful, leads to the introduction of organizational innovations. It is characterized by activities such as defining the problem to be solved, specifying various possible solutions, and adopting one of the innovations.[54]

Berman and McLaughlin described the characteristics of their support stage as follows:

> The support stage includes more than the familiar concepts of "search," "needs assessment," and "selection." The introduction of an innovative project into a school or district requires a series of decisions by individual actors within the local policy system to support the proposed project.[55]

They listed among the decisions and considerations central

[52]Giacquinta, p. 197.

[53]Berman and McLaughlin, pp. 16-18.

[54]Giacquinta, p. 197.

[55]Berman and McLaughlin, pp. 16-17.

to the support stage: the educational value of the proposed innovation, the expected response of important interest groups, the amount of disruption or change implied for the school organization, whether the "time is right" from the perspective of actors in the district, and the short- and long-term benefits to the district. "Clearly," Berman and McLaughlin concluded, "the commitments made in the support stage affect what happens when project implementation begins."[56]

In the present study, the initiation or support stage was described by the strategies and actions of the Regional Metric Resource Centre, Department of Education, San Diego County, with respect to its interface with the districts under study. However, the primary focus of the study was the observation and description of the implementation stage.

Implementation and the Diffusion Process

Drawing from an analysis of educational innovation attempted in 200 school districts throughout the United States, McLaughlin found that the implementation process consisted of "an interplay between the innovative plan and the institutional setting in which the plan may adapt to the setting or the setting to the plan"[57]--a concept of mutual

[56]Berman and McLaughlin, p. 17.

[57]McLaughlin, p. 6.

adaptation.

Miles suggested that implementation should be viewed:

> . . . as diffusion internal to school systems. Whether innovations are imported, or are locally designed, the question of spread from classroom to classroom and building to building within the local district is of prime importance.[58]

It is generally accepted that the process of diffusion is defined as the (1) acceptance, (2) over time, (3) of some specific item--an idea or practice, (4) by individuals, groups, or other adopting units, linked to (5) specific channels of communication, (6) to a social structure, and (7) to a given system of values or culture.[59] Brickell proposed that the extent and rate of change in an organization depended upon four multiple factors: the images of the practitioner, the characteristics of the adoption setting, the characteristics of the innovation, and the diffusion strategies and tactics.[60] The literature reflects variant, but recurrent, themes of these four interrelated factors

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[58]Matthew B. Miles, ed., Innovation in Education (New York: Teachers College, Columbia University, 1964), p. 197.

[59]Richard O. Carlson, Summary and Critique of Educational Diffusion Research, U.S., Educational Resources Information Center, ERIC Document ED 026 535, June, 1968, p. 5; see also Harbons Bhola, "Innovations Research and Theory" (Paper prepared as a preconference document for the Conference on Strategies for Educational Change held in Washington, D.C., under the joint sponsorship of the School of Education, Ohio State University; and the U.S. Office of Education, November 8-10, 1965), p. 29.

[60]Henry M. Brickell, "Alternative Diffusion Strategies," Conceptual Strategies for Utilizing Research and Development Products in Education (Columbus, Ohio: The Center for Vocational Education, Ohio State University, 1971), pp. 2, 11, 18, 25.

associated with the diffusion process.[61] These four themes are discussed below as the characteristics of the innovation, characteristics of the adoption setting, characteristics of organizational members, and diffusion strategies.

Characteristics of the innovation. Hull and Kester listed two subcategories of innovations: the form (e.g., instructional materials and installable systems), and perceived attributes (e.g., cost, relative advantage, and compatibility with existing content).[62]

Berman and McLaughlin spoke of invariant and variant forms of innovations and cited technology or product innovations as invariate in form and possessing the following general attributes:

- Clarity and specificity of goals
- Specificity of treatment
- A clear relation between treatment and outcome
- Passive user involvement
- A high level of certainty of outcome
- A unitary adopter.[63]

They cited educational innovations as variant in form and possessing general attributes such as:

- Treatment is incompletely specified
- Outcomes are uncertain
- Active user involvement is required

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[61]Giacquinta, p. 179.

[62]William L. Hull and Ralph J. Kester, Perceived Effectiveness of Innovation Diffusion Tactics (Columbus, Ohio: The Center for Vocational Education, Ohio State University, 1975), p. 5.

[63]Berman and McLaughlin, p. 9.

- The adopter is not unitary, but a policy system or policy units
- The relationship of project treatment to overall institutional goals is unclear or unspecified.[64]

Brickell claimed, "Innovations cannot be classified into single categories, but they can be described along a number of dimensions."[65] Some dimensions Brickell used were: magnitude, completeness, complexity, flexibility, interaction with existing programs, trial possibility, content, effect on student test performance, staff performance, staff roles, social setting, equipment and materials, time, space, and cost.[66]

Rogers and Shoemaker cited five important characteristics of innovations, as sensed by the receivers, that contribute to different rates of adoption: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. The relative advantage, compatibility, trialability, and observability of an innovation, as perceived by members of a social system, were viewed as positively related to its rate of adoption. Complexity of an innovation, as perceived by members of a social system, was viewed as negatively related to its rate of adoption.[67] The current study described the district metric multipliers' and teachers' perceptions of the metric

[64]Berman and McLaughlin, pp. 9-10.

[65]Brickell, p. 18.

[66]Brickell, pp. 18-25.

[67]Rogers and Shoemaker, pp. 137-56.

system along the above five dimensions.

Characteristics of the adoption setting. The literature tends to reflect two domains of concern relative to the characteristics of the adoption setting: (1) the characteristics of district structure or environment, and (2) the characteristics of the school structure or environment. These two concerns are reflected in the citations below.

Sarason explored the culture of the school and the problems of change. He described the modal way in which change is introduced and effected in the school culture, the complex roles, the demands, the built-in conflicts, and the relationships of school personnel. He also discussed the importance of the principal in determining the fate of the change process and the variance in cultures among schools.[68]

Deal, Meyer, and Scott, in a recent study of 188 elementary schools located in 34 school districts in the San Francisco Bay area, related organizational characteristics at both the district level and school levels to two types of educational innovations: instructional (differentiation in reading instruction), and organizational (the organization of teachers into small work groups to teach reading).[69] They found that:

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[68]Seymour B. Sarason, The Culture of the School and the Problem of Changes (Boston: Allyn and Bacon, 1971).

> District level organizational characteristics related to innovation are special administrative ratio, per pupil expenditure, and external funding. Money and special administrators affect both measures [the instructional and organizational type of innovations]; external funding affects only instructional differentiation [the instructional type of innovation].[70]

At the school level, they reported that evaluation structure, open space, and community climate were important organizational characteristics to the instructional innovation; and, except for evaluation structure, these same characteristics were also significant to the organizational type innovation. Size of both schools and school districts was cited as a characteristic that constrains curricular innovation, while district wealth and external funding--characteristics found in large urban areas--were cited as facilitating forces.[71]

Baldridge too argued that district size was an important factor in innovation. He argued that a critical mass of organizational participants is needed to generate what he calls "a demand structure to facilitate innovation."[72] He further argued that district size makes a series of demands about coordination, control, and complexity to which a district must respond and suggested that

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[69]Terrence E. Deal, John W. Meyer, and W. Richard Scott, "Organizational Differences on Educational Innovation," Managing Change in Educational Organizations, eds. J. Victor Baldridge and Terrence E. Deal (Berkeley: McCutchan Publishing Corporation, 1975), pp. 111-12.

[71]Deal, Meyer, and Scott, p. 120.

[72]Deal, Meyer, and Scott, pp. 123-26.

staff differentiation and structural complexity are critical for innovation.[73]

In a study of the relationship between internal and external organizational variables and the adoption of a specific educational innovation, Paul used coordination, hierarchical communication, specialization, and role clarity as the definition of organizational structure and stated that organizational structure could be viewed:

> . . . as an organizational and administrative property of roles and role expectations. If the role of an organization is explicitly defined and the expectations of incumbents are systematically coordinated, the structure can be inferred.[74]

The present study described six general characteristics of the districts under study: district type, district size, district personnel resources, district economic factors, district pupil background factors, and district pupil performance factors. Further, the study described the multiplier approach, which may be defined both as an approach to inservice education and as a surrogate organizational structure.

Characteristics of organizational members. The literature tends to reflect two concerns relative to the characteristics of individuals involved in the diffusion and

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[73]Baldridge, pp. 45-46.

[74]Douglas Paul, The Concept of Structure for Describing the Diffusion of an Innovation Through Interorganizational Linkages, U.S., Educational Resources Information Center, ERIC Document ED 102 706, April, 1975, p. 5.

adoption process: those related to personalities and those related to role functions.

Brickell developed ten images of practitioners and suggested that a different approach was necessary to reach each practitioner.[75] Rogers spoke of adopter categories, that is, a classification of individuals within a social system on the basis of their innovativeness. He listed five adopter categories of individuals: (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards.[76] Bohla distinguished between advocates, defined as those who sponsor an innovation for the purpose of gaining its acceptance; and change agents, referred to as analysts, specialists, or advisers in a change situation.[77]

Sarason[78] and others[79] saw the principal as playing a key role in innovation and a gatekeeper to innovation diffusion at the school level. House[80] and others[81] spoke

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[75]Brickell, pp. 2-9.

[76]Rogers, pp. 148-92.

[77]Bohla, pp. 17-18.

[78]Sarason, pp. 110-32.

[79]Mark Chesler, Richard A. Schmuck, and Ronald Lippitt, "The Principal's Role in Facilitating Innovation," Managing Change in Educational Organizations, eds. J. Victor Baldridge and Terrence E. Deal (Berkeley: McCutchan Publishing Corp., 1975), pp. 321-27; see also McLaughlin, p. 12.

[80]Ernest R. House, "The Micropolitics of Innovation: Nine Propositions," Phi Delta Kappan, LVII, No. 5 (January, 1976), 338.

[81]Richard O. Carlson, "School Superintendents and Adoption of Modern Math: A Social Structure Profile," Innovations in Education, ed. Matthew B. Miles (New York: Bureau of Publications, Teachers College, Columbia University, 1964), pp. 330-31.

of the importance of the superintendent and his top staff as playing key roles in introducing and supporting innovations in their districts.

Baldridge and Deal complained of the individualistic bias in past research and claimed that:

> Until recently, most of the research on innovation diffusion has been individualistic. Studies have focused on a single technical invention . . . and the factors that cause an individual user . . . to adopt or reject it. Quite often, the individual characteristics of the adopter receive most of the attention: What type of farmer will adopt a new fertilizer? What kind of physician will start using a new drug? What personal characteristics cause teachers to accept or reject a new approach to instruction?[82]

Katz and Kahn suggested that there was an inherent weakness in the individual approach to organizational change. They argued that there was a psychological fallacy in concentrating on individuals, that "The assumption has been that, since the organization is made up of individuals, we can change the organization by changing its members."[83] They believed concentrating on individuals is an oversimplification of the problem and felt there is some confusion between individual change and organizational change. They warned that:

> The confusion between individual and organizational change is due, in part, to the lack of precise terminology for distinguishing between behavior

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[82]Baldridge and Deal, p. 3.

[83]Daniel Katz and Robert L. Kahn, The Social Psychology of Organizations (New York: John Wiley and Sons, Inc., 1966), p. 391.

> determined largely by structured roles within a system, and behavior determined more directly by personality needs and values. The behavior of people in organizations is still the behavior of individuals, but it has a different set of determinants than behavior outside organizational roles.[84]

One could infer from Katz and Kahn that roles and role expectations of organizational members are more critical factors in organizational change than are personality or individual characteristics of organizational members. As reinforcement for such an inference, it is noted that Paul, who was cited earlier, related organizational members' roles and role expectations to organizational structure;[85] and Baldridge found in a recent study that few individual characteristics correlated highly with change efforts. Specifically, Baldridge found that:

> . . . variables, such as sex, age, social origin, and years in the school or district, had no relation to change efforts when organizational position . . . was controlled.
>
> In fact, all the individual characteristics that related to change were obviously tied to organizational structure--rank, position, administrative responsibilities. The evidence raises serious doubts about the influence of individual characteristics when the innovation is being adopted by an organization.[86]

The present study did not focus on individual characteristics, but did describe the execution of district plans in relation to the roles and role expectations of organizational members in the districts under study.

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[84]Katz and Kahn, pp. 390-91.

[85]Paul, p. 5.

[86]Baldridge, pp. 22-23.

Diffusion strategies. Giacquinta identified two domains of diffusion strategies: those that stressed knowledge and understanding and those that stressed commitment.[87] He concluded that:

> Many agents and students of educational change now view strategies as adequate only when they are designed to foster commitment as well as knowledge and understanding.[88]

Brickell argued that there is no finite set of diffusion strategies and indicated that:

> An infinite list [of strategies] can be generated by assuming that diffusion has three aspects: it involves (1) placing an innovation with given characteristics into (2) a setting that has certain features and in which (3) the practitioner has customary ways of behaving. Since there is an unending list of potential innovations and an enormous variety of settings as well as limitless ways for practitioners to behave, there is no end to possible strategies, that is, the imaginable combination of innovations with settings with practitioners' behavior is without limit.[89]

McLaughlin identified adaptive planning, staff training keyed to the local setting, local materials development, and critical mass as key elements of implementation strategies that individually or together promoted mutual adaptation.[90] He also found that teachers strongly preferred very concrete how-to-do-it workshops, as opposed to a more general, inspirational lecture, and that such workshops

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[87]Giacquinta, p. 184.

[88]Giacquinta, pp. 184-85.

[89]Brickell, pp. 35-36.

[90]McLaughlin, p. 92.

should be given by local personnel as opposed to outside sources.[91] McLaughlin further found that:

> Although project participants did not show much resistance to innovation, particularly where there was a strong commitment on the part of the district, non-project personnel sometimes impeded project implementation. Where project teachers felt "isolated" (and unappreciated), negative or indifferent attitudes from non-participants erroded staff morale and constituted a pressure for the project teacher to "give up."[92]

McLaughlin, in support of Baldridge,[93] concluded that the need for a critical mass of project participants is necessary in order to build support and morale of project staff.[94]

Sarason expressed concern about current methods of introducing change within school districts and stated:

> A large percentage of proposals of change are intended to affect all or most of the schools within a system. The assumption seems to be that since the change is considered as an improvement over what exists, it should be spread as wide as possible as soon as possible. The introduction of new curricula is, of course, a clear example of this. What is so strange here is that those who initiate this degree of change are quite aware of two things: that different schools in the system can be depended on differentially to respond to or implement the proposed change, and that they, the sources, implementers of change, do not have the time adequately to oversee this degree of change. What is strange is that awareness of these two factors seems to be unconnected with or to have no effect on thinking about the scope of the

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[91]McLaughlin, p. 11.

[92]McLaughlin, p. 11.

[93]Baldridge, p. 45.

[94]McLaughlin, p. 12.

change.[95]

Sarason argued that:

> Aside from the fact that there will never be "enough" professional personnel . . . the justification for initiating a change in many different places [within the school district] at the same time is not obvious.[96]

He suggested that change should be tried out in those schools having the right climate and extending later.

One of the weaknesses of Sarason's arguments is that he assumes there are no strategies that a school district may use to meet his concerns and still provide a widespread and high degree of change. It could be argued that a multiplier approach, wherein someone from each school unit becomes a mini-expert and advocate of an induced innovation, could meet his concerns and provide a widespread and high degree of change. One multiplier at each school site should answer Sarason's concern for "enough school personnel." If the multiplier were self-selected or an appointed member of the local school culture, much of Sarason's concern for meeting the differential needs of each school's culture would also be met.

Baldridge suggested a strategy of providing for more role specialization and the creation of specialized training positions and administrative roles. He argued:

> The more school systems develop hierarchical differentiation, the more they will be able to

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[95]Sarason, pp. 213-14.

[96]Sarason, p. 214.

> handle innovation. That is, the more the systems build in middle-level managers between teachers and district administrators, the more support can be given to teachers to meet specialized roles. Examples of such middle-level roles would include a richer variety of curriculum experts, skilled technology directors . . . , and even special "change agents" whose jobs are to foster and disseminate innovations.[97]

Paul contradicts Baldridge. In a recent study, Paul found:

> High specialization was considered as one source of . . . low internal coordination, i.e., distinctive roles tended to segregate members and act as a limiting factor for coordination.[98]

The Deal, Meyer, and Scott study cited earlier tends to provide some insight into this contradiction. In the districts studied, Deal, Meyer, and Scott found that "there is a disconnected pattern of district and school influences on innovation at the classroom level," and that while "the classroom is affected somewhat by the higher levels or by sources of authority outside the bureaucratic structure . . . it remains largely independent of the characteristics of school or school districts."[99]

Explicating these findings, they stated:

> In adopting new patterns of work or new instructional materials and techniques, the higher organizational levels do not control or coordinate the responses of the lower ones. Innovations do not appear to enter the school through formal organizational channels. On this basis, it appears that school organizations are

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[97]Baldridge, p. 35.

[98]Paul, p. 11.

[99]Deal, Meyer, and Scott, p. 124.

> doubly segmented: schools within the districts; classrooms within the schools. Each segment or level reacts to a highly innovative educational climate, selecting from this environment new and more complex organizational and instructional forms without centralized coordination and control to make selection systematic.[100]

They further stated that:

> . . . the adoption of innovation has been largely unsystematic and uncoordinated, with the result that innovations adopted may not have the organizational support necessary to move them toward implementation and installation.[101]

Yet, Deal, Meyer, and Scott conceded that:

> Many of the newer instructional or staffing developments create the need for higher levels of organizational coordination, differentiation, specialization, and problem-solving capacity in districts and schools, capacities frequently underdeveloped in traditional patterns of school organization.[102]

There appears to be some disparity between what is and what should be. It would appear that the Paul and the Deal, Meyer, and Scott studies described what is based upon their researches; while Baldridge suggested what should be based upon his conception of the problem.

Again, one could make a case for the use of a multiplier approach strategy for the diffusion of educational innovations. Such an approach would have the potential for providing a critical mass of organizational participants and could act, not only as a strategy, but also act as an organizational structure to provide coordination, hierarchical

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[100]Deal, Meyer, and Scott, pp. 124-25.

[101]Deal, Meyer, and Scott, p. 125.

[102]Deal, Meyer, and Scott, p. 110.

communication, specialization, differentiation, problem-solving capacity, and role clarity, as was suggested by Baldridge.[103] Such a notion was alluded to by Miles. He stated:

> A strategy may also involve deliberate causation of innovation in associated areas, beyond use of the innovation itself. This is connected with the idea of "multiplier effects" as a strategic goal. Strategies devoted to encouraging extra communication among system members about the existence and efficacy of innovations, to the creation of facilitating, supporting, legitimating groups to aid diffusion of a series of innovations, and to teaching system members to use an innovation . . . and help spread it to others, all fall in this category.[104]

Summary

In summary, the literature related to diffusion, adoption, and innovation is extensive and extends back over the past 75 years. Studies in the diffusion and adoption of innovations appear to have emerged from seven research traditions: anthropology, early sociology, rural sociology, education, medical sociology, communications and marketing. Earlier studies were sociological in nature and focused on the innovativeness of individuals in a social system and on the rate of adoption of an innovation among members of a social system. Innovation and diffusion research in education rose rapidly during the post-Sputnik era with the emergence of the federal government as a full partner in public education. Diffusion models also began to emerge as

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[103]Baldridge, pp. 45-46.

[104]Miles, p. 648.

a consequence of the increased interest in innovation and diffusion. The most frequently cited models were those described by Havelock: the RD & D Model, the Social Interaction Model, the Problem Solving Model, and the Linkage Model.[105]

Recent studies were replete with reviews citing the shortcomings of past researches. Such reviews cited, among other things, that data were contradictory and inaccurate, that research focus was tradition bound and biased, and that concepts were placed in mixed domains and lacked definition and clarity. The investigator found little systematic ordering of ideas about phenomena in the field of inquiry, no general theory, and no principles upon which practitioners may have confidence.

Present studies reflect a shift in research focus. The focus appears to be more on organizations as adopters than on individuals as adopters. Focus is more on organizational factors and organizational dynamics that influence the amount, rate, and permanence of innovation in complex organizations than on sociological factors and dynamics that affect the rate of adoption of innovations among members of a social system. Three stages in organizational innovation have been identified: the initiation stage, the implementation stage, and the incorporation stage. Current studies appear to be giving greater attention to the

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[105]Havelock, pp. 85-95.

implementation process in installing innovations in complex organizations. The implementation process has been viewed as an interplay of multiple, interrelated, and interacting factors within an institutional setting.

Four general and interrelated factors have been associated with the diffusion process: (1) characteristics of the organizational setting, (2) characteristics of the organization members, (3) characteristics of the innovation, and (4) diffusion strategies and tactics. Special administrative ratio, per pupil expenditure, and external funding were viewed as important organizational characteristics in innovation. Data suggested that size of a district was an important factor in innovation diffusion; that curricular innovation is constrained in large districts by demands related to coordination, control, and complexity. Wealth and external funding, characteristics found in large urban areas, on the other hand, were cited as facilitating forces. Data suggested that behavior of members in an organizational setting was largely determined by their structured roles; while personality characteristics and variables such as sex, age, social origin, and years in the district was viewed as having less relation to change efforts than role structure and role expectations of organizations members. Five attributes of innovations as perceived by receivers were cited as contributing to different rates of adoption of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability.

Diffusion strategies that foster commitment as well as knowledge and understanding were viewed as more adequate than those that foster one or the other. Adaptive planning, staff training keyed to the local setting, local materials development, and how-to-do-it workshops were seen as strategies and tactics that facilitate the diffusion process. Strategies and tactics that provide a critical mass of changing members were also viewed to facilitate the diffusion process by building support and morale for changing members and by reducing resistance to change among organizational members not involved in the change. Strategies and tactics that provide for increased role specialization and creation of specialized teaching positions and administrative roles (multiplier approach) were viewed as facilitating forces in the diffusion and adoption of innovations. Data suggested that such strategies could provide increased coordination, communication, control, support, and problem-solving capacity within organizations that use them.

Chapter 3

RESEARCH METHOD AND PROCEDURES

This chapter will describe the research method and procedures used in conducting the study. Five objectives of the study were:

1. To describe the heuristics and change strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric transition in eight selected public school districts (K-6) in San Diego County, California.

2. To describe specified characteristics of the eight selected public school districts under investigation.

3. To describe the execution of district plans as they relate to the installation of metric education in the districts under study.

4. To describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study.

5. To describe metric cognitive and affective changes on a population of districts' organizational members and metric cognitive changes on a population of pupils in the eight school districts under study.

The chapter presents a description of the research

method; a general description of the design of the study; a description of the procedures, sample population, instrumentation, and data analysis plan for each of the objectives of the study; and the methodological assumptions and limitations of the study.

GENERAL DESIGN OF THE STUDY

The study was designed to describe the initiation and implementation stages of the diffusion of metric education in eight local school districts. The study was also designed to describe the degree of implementation in each school district under investigation. The overall design of the study is presented in Tables 2, 3, and 4.

Table 2 presents the general design used in the study to describe the initiation stage. The initiation stage was defined as the collective decisions, commitments, and agreements made by, and between, the Regional Metric Resource Centre and the districts involved. The study described two aspects of the initiation stage: the Regional Metric Resource Centre heuristics and the Regional Metric Resource Centre strategies (Objective 1 of the study).

Table 3 presents the general design used in the study to describe the implementation stage. The implementation stage was defined as the diffusion process internal to the school systems in the study. The study described three aspects of the implementation stage: (1) the characteristics of the districts involved (Objective 2 of the study);

Table 2

General Design for the Study of the Initiation Stage:
Objective 1

Aspects Described	Population Sample	Instrumentation
Regional Metric Resource Centre Heuristics	Regional Metric Resource Centre	Regional Metric Resource Centre documents and records
Regional Metric Resource Centre Strategies	Regional Metric Resource Centre	Regional Metric Resource Centre documents and records

Table 3

General Design for the Study of the Implementation Stage:
Objectives 2, 3, and 4

Aspects Described	Population Sample	Instrumentation
Characteristics of Districts	All 8 districts	Department of Education, San Diego County, documents and records
Execution of District Plans Specialist Level Multiplier Level Teacher Level	All specialists, multipliers, and sample teachers	Regional Metric Resource Centre documents and records, 1975-76; Specialist Metric Survey, 1975-76; Multiplier Metric Survey, 1975-76; Teacher Metric Survey; Specialist interviews
Organizational Members' Perceptions of the Innovation, Metric System		
Multipliers (Em's)	All multipliers	1975-76 Multiplier Metric Survey
Teachers-Experimental (Et's)	Sample teachers	1975-76 Teacher Metric Survey
Teachers-Control (Ct's)	Sample teachers	1975-76 Teacher Metric Survey

Table 4

General Design for the Study of the Degree of Implementation: Objective 5

Aspects Described	Population Sample	Instrumentation
Cognitive & Affective Changes in Organizational Members		
District Multipliers (Em's)	All multipliers	Metric Awareness Measure, Participant Attitude Scale
District Teachers-Experimental (Et's)	Sample teachers	Metric Awareness Measure, Participant Attitude Scale
District Teachers-Control (Ct's)	Sample teachers	Metric Awareness Measure, Participant Attitude Scale
Multiplier Pupils (Em P's)	Sample pupils	Student Metric Measurement
Experimental Teacher Pupils (Et P's)	Sample pupils	Student Metric Measurement
Control Teacher Pupils (Ct P's)	Sample pupils	Student Metric Measurement

(2) the execution of district plans (Objective 3 of the study); and (3) the organizational members' perceptions of the innovation, metric system (Objective 4 of the study).

Table 4 presents the general design used in the study to describe the degree of implementation in each district. The degree of implementation was described by cognitive and affective changes in districts' organizational members (Objective 5 of the study).

OBJECTIVE 1: REGIONAL METRIC RESOURCE CENTRE HEURISTICS AND STRATEGIES

The first objective of the study was to describe the heuristics and strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric education in eight selected public school districts (K-6) in San Diego County, California.

Procedures

The investigator reviewed Regional Metric Resource Centre documents and records to determine which heuristics and strategies were relevant to the initiation stage of the diffusion process. The investigator, who was the Director of the Regional Metric Resource Centre, made judgments about which heuristics and strategies were relevant to the study. The Regional Metric Resource Centre heuristics and strategies were then described in a narrative style using relevant excerpts from appropriate Centre documents and records.

Sample Population

The study involved eight local school districts in San Diego County, California, which were participants in an ESEA, Title IV-C project granted to the Department of Education, San Diego County, in July, 1974, and titled Metric Education in San Diego County, and further described by the ESEA, Title IV-C Office, State of California, as ESEA, Title IV-C project, #1601. Under the project grant, a Regional Metric Resource Centre was established at the Department of Education, San Diego County, to introduce metric education to a limited number of local public school districts.

The Department of Education, San Diego County, Regional Metric Resource Centre, acted as a catalyst for regional metric conversion and provided limited resources and a support system to specified local educational agencies to aid them in their transition to metric education. The initial selection of the eight districts was based upon interest and commitment, and the following procedures and criteria were used.

A form letter was sent to chief administrative officers of all 37 school districts in San Diego County having a kindergarten through sixth grade pupil population. The letter generally described the program and the basic commitments of the participating districts and the Regional Metric Resource Centre. Those districts interested in participation were to return a tear sheet as an indication of interest.

Nineteen of the 37 districts returned the tear sheet expressing interest in participating in the Regional Metric Resource Centre program. Based upon the resources available, it was pre-established that only eight (approximately 20 per cent) of the public school districts in San Diego County would participate, along with two nonpublic school agencies.

The 19 public school districts who returned the tear sheets were rank ordered by the size of their K-6 pupil population. Districts with the largest K-6 pupil populations were given first refusal to participate based upon a written agreement (Appendix A). In effect, the written agreement stated that the local participating agency agreed to: (1) identify and appoint at least one district metric "specialist" for purposes of developing metric implementation and inservice plans; (2) appoint a district administrator to work jointly with the district specialist and the Regional Metric Resource Centre staff in the planning and implementation of the program; (3) authorize the district metric "specialist" to train "multipliers" who, in turn, would train teachers; and (4) provide annual budget dollars for classroom instructional materials in support of trained classroom personnel.

The Regional Metric Resource Centre was, in return, to provide: (1) a training program and expertise to support district specialists and their training programs; (2) release time dollars for the purposes of releasing a specified

number of specialists and multipliers for training; (3) on-site support services through a mobile (van) metric support system; and (4) a decreasing subsidy in support of district classroom materials purchases.

The study dealt only with those eight public school districts previously selected and participating with the Regional Metric Resource Centre in school year 1975-76 under the ESEA, Title III grant to the Department of Education, San Diego County, California. Two nonpublic school districts participating in the ESEA project were not part of the study due to the differential treatment given them.

District metric specialists (S's). By definition, the district metric specialist was that person in each district identified and selected to provide the expertise, planning, and coordination for district metric transition. One specialist was chosen by each district's administration in fulfillment of that district's agreement with the Regional Metric Resource Centre. Criteria for selection of specialists were at the discretion of each district's administration.

District metric multipliers (Em's). By definition, a district multiplier was that person who acted as a training intermediary between a district's metric specialist and other intermediaries or teachers within the district. After receiving metric inservice education from district metric

specialists, multipliers were to provide metric inservice education to other teachers. District specialists were encouraged by the Centre's staff to select at least one multiplier from the staff of each elementary school within their district. Criteria for selection and the methods or processes for the selection of multipliers within any given district were at the discretion of the district and their metric specialist.

Instrumentation

Various Centre documents and records were used to gather data for describing the Regional Metric Resource Centre heuristics and strategies. Among the documents and records used were the ESEA Title III Continuation Application, 1975, the Centre's Metric Education Agreement (Appendix A), the Centre's Specifications for District Plans for Metric Education (Appendix B), the Centre's fiscal records, and a set of district log books.

In that the investigator was the director of the Regional Metric Resource Centre, district log books were set up at the beginning of the project to record information and data relevant to the study. A log book in the nature of a 7.6 centimetre three-ring binder was established for each district. Each district log book contained such things as annotated notes; district implementation plans; district agreements; statistics on district personnel; lists of multipliers and experimental teachers; specialist and

multiplier inservice plans; and specialist, multiplier, and teacher activity records. Information and data were entered into each log at the time of the event described or at the time data were collected. It was assumed that the process used in the development of each district log book provided for a source of reliable and valid information and data relevant to the study.

Data Analysis Plan

Information related to Centre heuristics were found to be explicitly outlined in the Regional Metric Resource Centre document, ESEA Title III Continuation Application, April, 1975, and were listed directly from the document. Content analysis of Centre documents and records was required to determine Centre strategies. The investigator reviewed and analyzed Centre documents and records and judged that the Centre used five basic strategies at the initiation stage of the metric diffusion process. Each of the basic strategies was described in a narrative fashion in Chapter 4 analyzing the intent and purpose for each strategy identified. Evidence of each strategy's existence was presented in the narrative. A summary analysis was written to analyze the findings relevant to the first objective of the study.

OBJECTIVE 2: CHARACTERISTICS OF DISTRICTS

The second objective of the study was to describe specified characteristics of the eight selected public school districts under investigation.

Procedures

Data found in the review of literature suggested four organizational characteristics related to innovation diffusion: district size, special administrative ratio, per pupil expenditure, and external funding.[1] The investigator also interviewed appropriate professional staff members of the Department of Education, San Diego County, to identify what district characteristics were typically used by practitioners in making comparative judgments about districts under their study. In addition to the characteristics suggested by the literature, Department of Education staff suggested district type (whether unified or elementary), district pupil background factors, and district pupil performance factors as district characteristics relevant to practitioners. Six general characteristics of the districts under investigation were identified and described: (1) district type, (2) district size, (3) district personnel resources, (4) district economic factors, (5) district pupil

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[1]Terrence E. Deal, John W. Meyer, and W. Richard Scott, "Organizational Differences on Educational Innovation," Managing Change in Educational Organizations, eds. J. Victor Bladridge and Terrence E. Deal (Berkeley: McCutchan Publishing Corporation, 1975), pp. 111-12.

background factors, and (6) district pupil performance factors.

Sample Population

Selected characteristics of districts were described for eight public school districts participating with the Regional Metric Resource Centre during school year 1975-76 under an ESEA Title III grant to the Department of Education, San Diego County, California. Criteria and procedures for selection of the districts under investigation were described earlier in the chapter.

Instrumentation

Various Department of Education, San Diego County, documents and records were used to gather data for describing the characteristics of districts. Among the documents and records used were the Directory: School Districts and Department of Education, San Diego, California 1975-76, Annual Report of Financial Transactions of the School Districts of San Diego County 1975, California Assessment Program Profile of School District Performance 1974-75, and the San Diego County School Districts Tests Results and Other Factors 1974-75.

The above documents were official documents annually prepared by the Department of Education, San Diego County. They provided descriptive statistics about local school districts in San Diego County. It was assumed that their reliability and validity lie in their continued refinement

and use for decision-makers over the years.

Data Analysis Plan

Content analysis of Department of Education, San Diego County, documentary sources and published data was required to identify data relevant to the six general characteristics being described. Data were abstracted from the documentary, and published data sources and tables were prepared. Descriptive narrative was prepared to accompany the tables, and a summary analysis was written to analyze the findings relevant to the second objective of the study.

OBJECTIVE 3: EXECUTION OF DISTRICT PLANS

The third objective of the study was to describe the execution of district plans as they relate to the installation of metric education in the districts under study.

Procedures

The execution of district plans was defined as the tactics, methods, and procedures used by districts in the study to implement their districtwide metric education plans. The execution of district plans was described by seeking answers to the following questions: Did districts use an inservice approach whereby a metric specialist trained selected district personnel to train others, that is, did the districts use a multiplier approach? If a multiplier approach was not used, what pattern of inservice

education was used? If a multiplier approach was used, what criteria were used in the selection of multipliers? How were multipliers trained? How were multipliers deployed or dispersed within districts? How were teachers selected? How were teachers trained? How did specialists, multipliers, and teachers perceive the importance of school based parent and community metric education programs? and How many specialists, multipliers, or teachers held school based parent or community education programs?

Data and information for answering the above questions were gathered from five major sources: (1) 1975-76 Specialist Metric Survey, (2) 1975-76 Multiplier Metric Survey, (3) 1975-76 Teacher Metric Survey, (4) semi-structured interviews with district metric specialists, and (5) Regional Metric Resource Centre district log books.[2]

1975-76 Specialist Metric Survey procedures. All eight district specialists were mailed 1975-76 Specialist Metric Survey forms at his or her school district address. All eight specialists (100 per cent) returned the completed survey forms in person at their last 1975-76 meeting with the Centre staff.

1975-76 Multiplier Metric Survey procedures. All district multipliers (103) identified in the Centre's

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[2]All documents and instruments are on file at the Regional Metric Resource Centre, Department of Education, San Diego County, 6401 Linda Vista Road, San Diego, California, 92111.

district log books were mailed 1975-76 Multiplier Metric Survey forms at his or her school district address at the end of the 1975-76 school year. Enclosed was an appropriate cover letter and a return, pre-addressed, stamped envelope. Two follow-up letters with an additional copy of the survey form and return envelope were mailed at two-week intervals to those who had not returned their survey form. Of 103 multiplier survey forms sent, 91 (88 per cent) were returned.

1975-76 Teacher Metric Survey procedures. A random sample of approximately 65 teachers from each school district were randomly chosen to receive the 1975-76 Teacher Metric Survey. As a matter of convenience, two procedures were used in the random selection of teachers. In smaller districts, all K-6 teachers in each district were numbered consecutively, and a sample of approximately 65 were randomly selected using a table of random numbers.[3] In larger districts, a two-step process was used to select teachers to receive surveys. First, a school was randomly selected from the district, then a teacher was randomly selected from the school using the same table of random numbers. This process was repeated until approximately 65 teachers were selected for each district. The survey form was mailed directly to each randomly selected teacher at his

[3]E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton-Mifflin Company, 1953), pp. 385-87.

or her school address at the end of the 1975-76 school year. Enclosed was an appropriate cover letter and a return, pre-addressed, stamped envelope. Two follow-up letters with an additional copy of the survey form and return envelope were mailed at two-week intervals to those who had not responded. Of 520 teacher surveys sent, 403 (78 per cent) were returned.

Semi-structured interviews. All eight specialists (100 per cent) returned the completed 1975-76 Specialist Metric Survey forms in person at their last 1975-76 meeting with the Centre staff. The investigator used each specialist's completed survey form as an interview guideline and audiotaped each interview. Interviews were used to verify information reported on the surveys and to provide the investigator with a more in-depth understanding of the tactics and procedures used to execute their district's metric implementation plans. Audiotapes of the interviews were reviewed by the investigator while writing the execution of district plans narrative in order to provide clarity about the distribution and dispersion of multipliers in districts and to verify data relevant to multiplier and teacher training.

District log books. Regional Metric Resource Centre log books, described earlier in the study, were searched for multiplier instructional plans (Appendix C) and specialist and multiplier activity records (Appendix D). A content

analysis of specialist and multiplier plans and records was made to determine the methods of instruction used by specialists and multipliers in their inservice activities. Information gathered from the records was reported in the narrative describing the execution of district plans.

Population Sample

All district metric specialists (8), all district metric multipliers (103), and a random sample of approximately 65 teachers from each school district received survey forms. Procedures for selecting the teacher population sample to receive metric survey forms were described earlier in this section of the study.

Instrumentation

Three survey instruments were developed and used to gather data: the 1975-76 Specialist Metric Survey, the 1975-76 Multiplier Metric Survey, and the 1975-76 Teacher Metric Survey. The three survey instruments were developed by the Regional Metric Resource Center staff in cooperation with an outside independent contractor. The surveys solicited demographic data, descriptive data, and opinions using both closed form and free response type questions. Questions were arranged under topical headings relevant to the information sought. As an example, the 1975-76 Multiplier Metric Survey included seven topical headings: (1) Multiplier Inservice Training, (2) Description of Teacher Inservice Activities, (3) Selection of Teachers and

Multipliers, (4) Support of Metric Activities, (5) Pupil Instruction, (6) Parent/Community Metric Education, and (7) Opinions About Metric. Specialist and teacher surveys were similarly organized.

Each survey was developed using standard guidelines as suggested by Isaac and Michael, Borg, Fox, and Good and Scates.[4] These authors suggested that content validity was generally high when such guidelines were followed. In addition, the 1975-76 instruments were based upon survey instruments used by the Centre during the 1974-75 school year. Changes were incorporated in the present instruments to improve item clarity and efficiency and to assure greater reliability and validity based upon the earlier field tests.

Data Analysis Plan

Data from surveys were codified on IBM data sheets, key punched on IBM cards, and entered into a computer for analysis. Appropriate descriptive statistics were calculated for groups, and question categories and tables were generated. Answers to the questions relevant to the execution of district plans were answered in a descriptive narrative, and findings were reported in a summary analysis.

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[4]Stephen Isaac and William B. Michael, Handbook in Research and Evaluation (San Diego: Robert R. Knapp, Publishers, 1971), pp. 92-94; see also Walter R. Borg, Educational Research: An Introduction (New York: David McKay Company, 1969), pp. 206-21; see also David J. Fox, The Research Process in Education (New York: Holt, Rinehart and Winston, Inc., 1969), pp. 548-54; see also Carter V. Good and Douglas E. Scates, Methods of Research (New York: Appleton-Century-Crofts, Inc., 1954), pp. 614-26.

OBJECTIVE 4: ORGANIZATIONAL MEMBERS' PERCEPTIONS OF THE INNOVATION, METRIC SYSTEM

The fourth objective of the study was to describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study.

Procedures

Data in the review of the literature (Chapter 2) suggested that the extent and rate of adoption of an innovation was related to organizational members' perceptions of the innovation. Rogers and Shoemaker cited five attributes or characteristics of innovations, as sensed by receivers of innovations, that contribute to different rates of adoption: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability.[5] In the study, district multipliers and teachers (receivers of the innovation, metric system) were assessed to determine their perceptions of the innovation along the five dimensions suggested above. Data were collected by using the 1975-76 Multiplier Metric Survey and the 1975-76 Teacher Metric Survey. The procedures for the distribution and gathering of the surveys were described earlier in the study under Objective 3: Execution of District Plans.

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[5]Everett M. Rogers and F. Floyd Shoemaker, Communications of Innovations: A Cross-Cultural Approach, 2d ed. (New York: The Free Press, 1971), pp. 22-23.

Sample Population

The sample populations used for assessing multipliers' and teachers' perceptions of the innovation, metric system, were the same samples of multipliers and teachers who received the 1975-76 multiplier and teacher surveys. These sample populations were described earlier in Objective 3: Execution of District Plans.

Instrumentation

The 1975-76 Multiplier Metric Survey and 1975-76 Teacher Metric Survey included an identical section labeled Opinions About Metric. The section listed 20 statements followed by a Likert type response scale. Four statements were designed to assess a respondent's perception of the metric system along each of the five dimensions: relative advantage, compatibility, complexity, trialability, and observability. For example, four statements were designed to assess a respondent's perception of the complexity of the metric system, that is, the degree to which it was perceived as being relatively easy to understand and use. One statement read: "The metric system is a simpler system to learn than our present measurement system." Responses were marked on a Likert type scale of Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree. Some statements were worded positively and others negatively, and the four statements for each attribute were scrambled throughout the list of 20 to preclude bias in responses.

Data Analysis Plan

Data from the Opinions About Metric section of the 1975-76 Multiplier Metric Survey and the 1975-76 Teacher Metric Survey instruments were codified on IBM data sheets, key punched on IBM cards, and entered into a computer for analysis. Descriptive statistics in the form of means and standard deviations were calculated and reported in tabular form for each attribute of the innovation by groups of subjects and by districts. Findings were reported in a summary analysis.

OBJECTIVE 5: COGNITIVE AND AFFECTIVE CHANGES IN ORGANIZATIONAL MEMBERS

The fifth objective of the study was to describe metric cognitive and affective changes on a population of districts' organizational members and metric cognitive changes on a population of pupils in the eight school districts under study.

Procedures

A quasi-experimental research design was used to measure cognitive and affective changes on all districts' metric multipliers and a sample of each district's teachers. In addition, cognitive changes on a sample of pupils in each district were also assessed. The research design and procedures for each population were independently determined.

Multiplier and teacher design and procedures. The research design used for multipliers and teachers was a

quasi-experimental, nonequivalent, experimental-control group, pretest/posttest design:

	Pretest	Treatment	Posttest
Multipliers (Em)	T_1	X	T_2
Teacher Experimental (Et)	T_1	X	T_2
Teacher Control (Ct)	T_1	·	T_2

All multipliers in each district were treated as a single group. Two tests were administered to each group of multipliers in each district by their district metric specialist. Each group received a cognitive test, Metric Awareness Measure--Form A; and an affective test, Participant Attitude Scale.[6] The two tests were administered to each district group as pretests (T_1) immediately preceding metric instruction (X) by the specialists, and the same two tests were administered as posttests (T_2) by the specialists immediately following their instruction of the multipliers. The pretest and posttest cognitive measures were collected and scored by the district specialists, then turned over to the Regional Metric Resource Centre staff for rescoring and analysis. The affective tests were collected by the district specialists and turned over to the Regional Metric Resource Centre staff for scoring and analysis.

Two tests were administered to both the experimental teachers (Et's) and control teachers (Ct's) in each district

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[6]Teacher cognitive and affective test instruments are available from the Regional Metric Resource Centre, Department of Education, San Diego County, 6401 Linda Vista Road, San Diego, California, 92111.

by the district metric multipliers. Each group, Et and Ct, received a cognitive test, Metric Awareness Measure--Form A; and an affective test, Participant Attitude Scale, as pretests and posttests. The two tests were administered to both the Et's and Ct's as pretests (T_1) immediately preceding metric instruction (X) provided by the multipliers to the Et's. No instruction was provided by multipliers or other district personnel to the Ct's. The same two tests were administered by multipliers to both Et's and Ct's as posttests (T_2) immediately following the multiplier's inservice training of Et's. The pretest and posttest cognitive measures were collected and scored by the district multipliers giving the tests. The multipliers mailed both the prescored cognitive measures and unscored affective measures to the Regional Metric Resource Centre staff in stamped, pre-addressed envelopes. The Regional Metric Resource Centre staff rescored the cognitive measures and scored the affective measures.

Pupil design and procedures. The research design used for the pupil sample in each district was a nonequivalent, experimental-control group, pretest/posttest design:

	Pretest	Treatment	Posttest
Multiplier Pupils (Em P's)	T_1	X	T_2
Experimental Teachers (Et P's)	T_1	X	T_2
Control Teacher Pupils (Ct P's)	T_1	·	T_2

Multiplier pupils (Em P's) were intact classes randomly selected from the multiplier (Em) population. The experimental teacher pupils (Et P's) were intact classes randomly selected from the experimental teacher (Et) population. The control teacher pupils (Ct P's) were intact classes randomly selected from the control teacher (Ct) population. The pupil pretest (T_1) was administered to pupils by the selected multipliers (Em's), experimental teachers (Et's), and control teachers (Ct's) at approximately the same time and just prior to the inservice education of experimental teachers (Et's). Posttests (T_2) were administered to all groups by the same teachers immediately following the metric inservice education of experimental teachers (Et's).

Pupils were tested with the Student Metric Measurement instrument.[7] The same test form and level was used for both the pretest and posttest. Test packets were made up based on a maximum administration of 35 pupils. Each test packet included: an administrative guide, an answer key, a set of 35 test booklets, a blank class list form, and a return, pre-addressed stamped envelope. Pretest and posttest packets were distributed by the district metric specialists. Instructions were given to the teacher that upon completion of test administration, the class list form

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[7]Copies of the Student Metric Measurement, Levels I, II, III, and IV, their administrative guides and keys may be obtained from the Regional Metric Resource Centre, Department of Education, San Diego County, 6401 Linda Vista Road, San Diego, California, 92111.

was to be filled out and all materials returned by United States Postal Service in the pre-addressed, stamped envelope enclosed in the packet. Teacher scoring of pupil tests was optional. However, all pupil tests, whether previously corrected by teachers or not, were corrected by the Regional Metric Resource Centre staff in order to provide consistency in scoring standards.

Sample Populations

Multiplier, teacher, and pupil populations are described below as the multiplier population (Em's), teacher populations (Et's and Ct's), multiplier pupil population (Em P's), and teacher pupil populations (Et P's and Ct P's).

Multiplier population (Em's). District metric multipliers (Em's) were defined and described earlier in Chapter 3 and elsewhere in the study. For the purposes of assessing and describing metric cognitive and affective changes in district multipliers, all multipliers in all districts made up the population sample.

Teacher populations (Et's and Ct's). Experimental teachers, referred to as Et's, were by definition those teachers within a district who received metric instruction from district metric multipliers. Control teachers, referred to as Ct's, were by definition those teachers within a district who received no metric instruction from district metric multipliers. The uniqueness of district

metric implementation plans precluded the identification and selection of experimental and control teachers prior to teacher metric inservice instruction. Experimental teachers (Et's) and control teachers (Ct's) were therefore identified on an ex post facto basis using the following criteria.

Teachers who received both cognitive and affective pretests and posttests were divided into four categories: (1) teachers trained only by the district (E_1's); (2) teachers trained by the district and who received additional metric training outside the district, e.g., university coursework (E_2's); (3) teachers who received metric training outside the district only, e.g., university coursework or professional association workshops (C_1's); and (4) teachers who received no metric training at all (C_2's). For the purpose of the study, the E_1 and E_2 teachers were collectively defined as the experimental teachers and were referred to as Et's. The C_1 and C_2 teachers were collectively defined as the control teachers and were referred to as Ct's.

Multiplier pupil population (Em P's). Seven multipliers, one at each grade level, kindergarten through sixth grade, were randomly selected in each district to administer the Student Metric Measurement as a pretest and posttest to their intact classes. All multipliers in each district were grouped by grade level in each district. Multipliers who had no classes, special classes (e.g.,

gifted, retarded), or who had combination classes greater than three levels were rejected from selection due to the exceptional nature of the classes. Multipliers who had K-1, 2-3, or 4-5 combination classes were rejected from selection due to their incompatibility with the test levels administered. Less than one per cent were rejected due to the unusualness of such combinations. Multipliers with typical two level combinations--1-2, 3-4, and 5-6--were placed in both grade levels for possible sample selection. Lastly, multipliers having three class level combinations were assigned and selected from the middle level of the class combination; for example, a multiplier having a K-1-2 class combination was assigned to the first grade group for selection. After being sorted by district and by grade level, each multiplier at each grade level was numbered, and one was selected at each grade level in each district by use of a table of random numbers.[8] If there was no multiplier at a particular grade level within a district, that particular pupil sample cell remained empty.

Teacher pupil populations (Et P's and Ct P's). In that experimental teacher (Et) and control teacher (Ct) populations were determined on an ex post facto basis and pupils had to be tested prior to teacher inservice education, some procedure had to be devised for the selection of intact classes to be tested that would be representative of Et's

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[8]Lindquist, pp. 385-87.

and Ct's. The following procedures were used to select intact classes representative of Et and Ct populations.

Fourteen teachers, two at each grade level, kindergarten through sixth grade, were selected in each district to administer the Student Metric Measurement as a pretest and posttest to their intact classes. Selection of the intact classes to be tested was made from two stratified samples: one stratum was representative of potential experimental teachers (Et's), and the other stratum representative of potential control teachers (Ct's) in each district. Potential Et's and Ct's were identified and selected from those teachers returning Participant Cards--cards reflecting a teacher's intent to receive metric instruction from a district multiplier. Cards returned and reflecting a teacher's intent to receive metric instruction from a district multiplier were grouped as potential Et's. Cards returned and reflecting no intent to participate in district metric inservice were grouped as potential Ct's. Each group of cards was sorted by district and by grade level. One teacher at each grade level in each district was randomly selected, using a table of random numbers.[9] Thus, seven potential Et's and seven potential Ct's were selected for each district. A list of alternative potential Et and Ct teachers was generated for each district as well.

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[9]Lindquist, pp. 385-87.

The district multipliers solicited the cooperation of the selected teachers in pretesting and posttesting their intact classes at the times specified by the multipliers. If a selected teacher was not able or willing to test their intact classes, the multipliers solicited cooperation from a potential Et or Ct on the alternative list.

The pupil sample population for testing, then, was considered to be a random sampling of intact classes of potential Et and Ct teachers. Actual classification of pupil experimental groups (Et P's) and pupil control groups (Ct P's) was based upon an ex post facto classification of experimental and control teachers.

Instrumentation

The Metric Awareness Measure--Form A, a cognitive measure; and the Participant Attitude Scale, an affective measure, were used to assess multiplier and teacher cognitive and affective changes. The Student Metric Measurement was used to assess cognitive changes in pupils. These instruments are described below.

Metric Awareness Measure--Form A. The Metric Awareness Measure--Form A was developed by Regional Metric Centre staff as a cognitive measure of metric knowledge. The instrument was used as a pretest and posttest to measure ten areas of metric knowledge. To assure content validity, a panel of experts determined, through a judging process, that there were ten areas of metric knowledge that a teacher

should master through inservice training. The ten areas identified were: the historical background of the metric system; current events in metric transition; knowledge of specified SI metric symbols; knowledge of the base units of the metric system; knowledge of how to convert between metric units; and knowledge of five concepts of measurement: length, area, volume, temperature, and mass. A pool of items was developed under each of the ten topics and judged by experts for their appropriateness. Based upon the panel's judgments, a 50-item Metric Awareness Measurement--Form A was developed. The completed test was recycled to the panel of experts and revised until the test was judged to be both valid and reliable for the purpose intended.

Participant Attitude Scale. The Participant Attitude Scale was developed by the Regional Metric Resource Centre staff in cooperation with an outside independent evaluator. The instrument is characterized as a semantic differential that measures five concepts: teaching, math, teacher inservice, metric education, and measurement by metric system. The study concerned only the latter two concepts: metric education and measurement by metric system.

The independent evaluator developed the paired adjective scales based upon suggested procedures by

Osgood, Suce, and Tannenbaum.[10] There were twelve paired adjectives selected for each of the five concepts to be measured. A test-retest reliability coefficient was calculated on a random sample of teacher Participant Attitude Scale pretests and posttests. The resulting Pearson product-moment correlation coefficients were: Teaching, r = .74; Math, r = .63; Teacher Inservice, r = .68; Metric Education, r = .64; and Measurement by Metric System, r = .67.

Student Metric Measurement. The Student Metric Measurement was a multilevel criterion referenced instrument developed by the Regional Metric Resource Centre staff in cooperation with an outside independent consultant. The tests were designed to measure pupil metric concept development and skill application at the K-6 grade levels. Four test levels were developed and administered to the experimental and control pupils at the appropriate grade levels. The following procedures were used to assure content validity and reliability.

An item pool was generated based upon a set of performance objectives validated by 25 resource experts across the United States. Initial prototype tests were developed for each grade level, kindergarten through sixth grade, from the item pool. Each initial prototype test was

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[10]Charles E. Osgood, George J. Suce, and Percy Tannenbaum, Measurement of Meaning (Urbana: University of Illinois Press, 1957), pp. 53-61.

field tested relative to pupil communication indicators, teacher usability indicators, and analysis of test item difficulty and discrimination, and then revised into four test levels: Level K (kindergarten), Level 1 (grades 1 and 2), Level 2 (grades 3 and 4), and Level 3 (grades 5 and 6).

In addition to the above procedures used to establish validity and reliability strength, a pretest-posttest item analysis for each test level was completed. The analysis consisted of a determination of the level of difficulty and the effectiveness of each test item in discriminating between students who scored high versus students who scored low on the overall test scores. Test item difficulty was determined using the following procedures. The number of correct responses for each item was tallied and recorded. For each item, the total correct responses were divided by the total number of responses (both correct and incorrect) made to the item. This result was then multiplied by 100 to produce the index of difficulty as a percentage.

The procedure for calculating test item discrimination was calculated by first separating from the total group of pupils the 27 per cent scoring highest and lowest on total test scores. The per cent of correct responses to each item was calculated for each of the higher and lower groups. Product-moment correlation coefficients (r) in the bivariate population were then calculated. As a second measure of discrimination, tetrachoric correlation coefficients (r_t) in the bivariate population were calculated.

All test items not meeting difficulty and discrimination standards were either deleted or revised until the several tests were judged to be both valid and reliable for the purpose intended.

Data Analysis Plan

Multiplier and teacher data gathered by the Metric Awareness Measure--Form A and the Participant Attitude Scale and pupil data gathered by the Student Metric Measurement instrument were codified on IBM data sheets, key punched on IBM data cards, and entered into a computer for analysis.

Multiplier (Em) and teacher (Et and Ct) data analysis. Multiplier (Em) and teacher (Et and Ct) cognitive test scores were summarized by calculating the pretest and posttest mean scores for correct answers on the Metric Awareness Measure--Form A. A percentage was calculated for each group's pretest and posttest mean scores by dividing the mean scores by the total number of test items. Gains or losses between each group's pretest and posttest mean scores were determined by calculating the difference between pretest and posttest mean scores for each group. An analysis of covariance (ANOCVA) was used to determine significant differences between pretest and posttest measures, between districts, and between groups using the pretest as a covariate. Where an analysis of covariance indicated significant differences between groups (at the .05 level of confidence or above), a Scheffé method

(S-method)[11] was employed to determine which groups were significantly different. Appropriate tables were prepared and findings reported in a summary analysis.

Affective data (Participant Attitude Scale) for each group were summated over the twelve paired adjectives for each of the two concepts relevant to the study: metric education and measurement with metric system. Mean scores, percentages, and gains and losses for each group were calculated in the same manner as used for cognitive data above. The same statistical analyses were employed on affective data as were employed on cognitive data. Appropriate tables were prepared, and findings were reported in a summary analysis.

Multiplier pupil (Em P's) and teacher pupil (Et P's and Ct P's) data analysis. Multiplier pupil (Em P's), experimental pupil (Et P's), and control teacher pupil (Ct P's) data were summarized by calculating the pretest and posttest mean scores for correct answers on the student Metric Measurement for each group by grade level. The number, mean, and standard deviation for each group's pretests and posttests were calculated and reported in tabular form. Gains or losses between each group's pretest and posttest mean scores were determined by calculating the difference between pretest and posttest mean scores for each

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[11]Gene V. Glass and Julian C. Stanley, Statistical Methods in Education and Psychology (Englewood Cliffs: Prentice-Hall, Inc., 1970), pp. 388-97.

group. An analysis of covariance (ANOCVA) was employed to determine significant differences between pretest and post-test measures, between districts, and between groups for each grade level using the pretest as a covariate. Where an analysis of covariance indicated significant differences between groups (at the .05 level of confidence or above), a Scheffé method (S-method) was employed to determine which group or groups were significantly different. Appropriate tables were prepared and findings reported in a summary analysis.

METHODOLOGICAL ASSUMPTIONS AND LIMITATIONS

The following methodological assumptions and limitations were recognized by the investigator:

1. It was recognized that the study was limited to a sample of districts in a specific geographical location. Specific characteristics or aspects of the districts under study may have been regionally specific and not generalizable to other educational systems in the United States. However, it was assumed that while districts may vary in specific aspects, that the general aspects of the districts under study were more similar than dissimilar to other comparable districts in the United States.

2. It was recognized that there may have been aspects and dimensions of innovation diffusion that may have been excluded in the study. It was assumed that the aspects

described in the study were the relevant and critical aspects, particularly as they relate to the initiation and implementation stages of innovation diffusion in complex organizations.

3. It was recognized that experimenter control in the selection and treatment of subjects was limited by the multiplier approach. It was assumed that specialists, multipliers, and teachers were diligent in carrying out the selection and treatment processes as prescribed by the experimenter to the degree that the critical and essential aspects of selection and treatment were not lost.

4. It was further assumed that cognitive and affective changes in organizational members were a result of metric inservice education and instruction, that changes in multipliers were primarily a result of specialists' instruction, that changes in teachers were primarily a result of multipliers' instruction, and that changes in pupils were primarily a result of teachers' instruction. The investigator recognized that such changes may have occurred as a result of history, maturation, testing, biases of selection, instrumentation, statistical regression, experimental mortality, or combinations of such factors. It was assumed that the quasi-experimental designs utilized in the study provided for reasonable control of such factors.

5. It was recognized that the instruments developed by the Regional Metric Resource Centre had limitations relative to their validity and reliability. It was assumed

that the procedures used to develop the instruments produced a relatively high degree of validity. It was assumed that the degree of reliability was reasonable and not dissimilar to that of other instruments situationally oriented and developed.

6. It was assumed that the procedures and techniques used to gather data were appropriate procedures to use under the given conditions of a natural setting. The collection of data by a source external to the districts under study provided a degree of anonymity for the sampling populations. It was assumed that the degree of anonymity was such as to ensure honesty in sample population responses.

7. It was also assumed that the statistical procedures used were appropriate for the level of data obtained.

Chapter 4

ANALYSIS OF RESULTS AND FINDINGS

The purpose of this chapter is to describe and analyze the findings that relate to each of five objectives of the study:

1. To describe the heuristics and change strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric transition in eight selected public school districts (K-6) in San Diego County, California.

2. To describe specified characteristics of the eight selected public school districts under investigation.

3. To describe the execution of district plans as they relate to the installation of metric education in the districts under study.

4. To describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study.

5. To describe metric cognitive and affective changes on a population of districts' organizational members and metric cognitive changes on a population of pupils in each of the eight school districts under study.

OBJECTIVE 1: METRIC REGIONAL RESOURCE CENTRE HEURISTICS AND STRATEGIES

The first objective of the study was to describe the heuristics and strategies of the Regional Metric Resource Centre. The investigator reviewed Regional Metric Resource Centre documents and records to determine what overriding heuristics and strategies of the Centre were operating during the time of the study.

Centre Heuristics

The Metric Education in San Diego County ESEA Title III Continuation Application April-1975, listed twelve program heuristics that were used to determine the Centre program. They were:

1. That the program sincerely meet the needs of the local education agency
2. That the program not compromise the autonomy of the local participating educational agency
3. That the administration of participating agencies make some increasing dollar commitment to the metric conversion program
4. That the project objectives and activities be consistent and compatible with the programs and roles of the State (Title III); the LEA (Department of Education, San Diego County); and local participating agencies (private and public school districts)
5. That program design tend to emphasize exemplary solutions to problems of metric conversion
6. That program outcomes provide effective districtwide implementation models and inservice models as a function of district organizational patterns, resources, and other significant attributes
7. That local participating districts share in the planning of continuation programs and carrying out current programs
8. That emphasis of program products, where possible, be placed upon areas given least concern or attention by other programs or agencies
9. That the project act as a catalytic regional

center and provide coordination, information, resources, and a support system to district metric conversion programs

10. That an Evaluation Plan and Research Design be developed and implemented to identify, describe, capture, exercise, rate, measure, and, above all, correlate and predict metric conversion models for school systems

11. That a teacher-multiplier concept be utilized by district inservice models to obtain maximum efficience for districtwide change

12. That the program design provide maximum potential for program continuation on the part of the LEA and participating districts when federal funds terminate.[1]

The investigator, who was the Director of the Regional Metric Resource Centre at the time of the study, confirms that the above heuristics were frequently used as guidelines for putting the Centre program into effect and were used for subsequent decision-making in operating the Centre's program.

Centre Strategies

The investigator reviewed Regional Metric Resource Centre documents and records and judged that five overriding change strategies were used by the Centre at the initiation stage of the diffusion process. The five strategies are described below.

Commitment. One strategy used by the Centre staff was to obtain a strong form of commitment from local public school districts to participate in a three-year planned,

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[1]Superintendent of Schools, Department of Education, San Diego County, Metric Education in San Diego County ESEA Title III Continuation Application-April 1975 (San Diego: Department of Education, San Diego County, 1975), pp. 3f-3g.

staged transition to a metric education program. It was felt that a strong commitment needed to be made at the outset of the program to ensure continued district support over a three-year period. There were three important dimensions for a strong commitment. First, a written agreement must be developed between the participating district and the host agency of the Centre (the Department of Education, San Diego County). It was felt that this would strengthen the commitment by providing legitimacy to Centre and district relationships. Second, a district administrator must be appointed by the participating school district to act as liaison between the Centre and the participating district. Such a commitment was intended to ensure a continued communication link between the Centre staff and district administration, as well as provide administrative continuity for program support over the three years. Third, the participating district must make an increasing dollar contribution to metric transition over the three-year period and, thus, provide credibility to the district commitment. Evidence of such a commitment strategy was found in the written agreement between the participating districts and the Department of Education, San Diego County (Appendix A). Eight agreements between the Department of Education, San Diego County, and the districts under study were found in the Centre's district log books. The agreements were signed by the Superintendent of Schools, Department of Education, San Diego County,

and the various district superintendents, and were authorized by their respective governing boards. Section II, 3, of the agreements stipulated that a district administrator would be appointed

> . . . to jointly review and critique the above plans with the metric "specialist" and project staff for purposes of making recommendations to the district superintendent and/or district board for implementation with students during the school years, 1975-76 and 1976-77.

The intent of Section II, 3, was for each district to appoint an administrator to act as a contact person for the project, and that an administrator was appointed and did act as a liaison person between Centre staff and the participating district. Attachment "A" of the agreement showed a budget schedule providing an increasing district dollar commitment on the part of the participating districts with $0 to be committed during school year 1974-75, $900 to be committed during school year 1975-76, and $1,200 to be committed during school year 1976-77. Actual expenditures of districts for metric transition during these years will be found elsewhere in the study.

Centre seed money. A second strategy used by the Centre staff was the allocation of dollars to each participating school district to act as "seed money" for metric transition. It was the Centre staff's intent to provide incentive for participating school districts to make a planned, staged transition to metric education by having the Centre provide increasing dollar support for three

years with no dollar commitment from districts during the first year. Dollars contributed by the Centre during the first year were viewed by the Centre's staff as "seed money." Attachment "A" of the written agreements and the Centre budgets for fiscal years 1974-75, 1975-76, and 1976-77 confirmed that the Centre allocated for each district $805 for fiscal year 1974-75, $2,015 for fiscal year 1975-76, and $2,345 for fiscal year 1976-77.

Multiplier approach. A third strategy used by the Centre staff was to encourage participating districts to use a multiplier approach in implementing teacher inservice education. This strategy was based upon the assumption that there were limited resources and unlimited learners, and that under these conditions, and based upon a Centre study of other state and national programs, a multiplier approach appeared to be a more efficient approach to teacher inservice education. The written agreement between the Centre and the participating districts confirmed that districts were to appoint a metric "specialist" who would provide metric instruction to "multipliers" (intermediaries) who, in turn, would provide metric instruction to teachers. While the Centre advocated a multiplier approach, the Centre staff stated that they would have honored other approaches if they had been suggested or requested in deference to the Centre's heuristics to meet local education agency needs and not to compromise the autonomy of

the local participating educational agency. The Centre document, Specifications for District Plans for Metric Education (Appendix B), was used as a guideline by district specialists for development of district implementation plans and verified that a multiplier approach was encouraged for district teacher inservice education.

District plans. A fourth strategy conceived by the Centre staff related to the development of district implementation plans. The Centre staff required that specialists in participating districts develop a districtwide plan for metric transition in grades kindergarten through sixth grade. It was believed that a district would more likely carry out its implementation of metric education if it had a comprehensive plan for action. The plans were to act as guidelines for district metric transition. If the plans were ratified by each district's administration, it was believed that the plans would also tend to act as further commitment and provide greater assurance for continued metric transition beyond the life of the project. Therefore, the written agreements between the Centre and the participating districts included provisions for the development of districtwide metric implementation plans. While the Centre staff provided a set of specifications to act as guidelines in developing the plans, the plans were to be unique to each district and based on each specialist's knowledge of the unique resources, organizational

patterns, and political structures in their district. The plans for each district were reviewed and critiqued jointly by the Centre staff, the district administrator, and the district specialist. Centre specifications also called for submission of multiplier plans for inservicing teachers and for teacher plans for instructing pupils during fiscal year 1975-76.

A review of the Centre's district log books disclosed that each specialist did submit a districtwide metric implementation plan in fiscal year 1974-75, to be put in operation during school year 1975-76. District log books also indicated that approximately 75 per cent of district multipliers submitted instructional plans in fiscal year 1975-76 for the purpose of inservicing teachers during that year. Less than 2 per cent of the teachers in the study turned in classroom instructional plans. All plans turned in tended to follow Centre specifications.

The Metric Education Agreement (Appendix A) verified that district plans were part of an overriding strategy of the Centre. The Agreement stated in Section II, 2, that the district shall "Authorize this specialist to participate in a forty-hour training session for the purpose of developing district K through 6 metric implementation and inservice plans in fiscal year 1974-75. . . ."

Center support system. The fifth strategy used by the Centre staff was to provide on-site support services to

districts implementing district metric transition plans. The Centre provided a staff member and mobile unit in support of on-site district program activities. The mobile unit was equipped with a Centre staff member, catalogs of metric materials, displays of metric materials, films and filmstrips, audio-visual equipment, and a limited amount of production supplies and equipment. The mobile unit was scheduled on request to support district-initiated multiplier training, teacher inservice education, parent education, and community education programs. The mobile unit operated on a district demand basis as opposed to initiative taken by the Centre staff. Centre policy gave priority of mobile unit support to district-initiated multiplier training, teacher inservice education, parent education, and community education programs, in that order. A second Centre policy related to the function and use of mobile unit staff at on-site meetings. District personnel were seen as responsible for providing leadership and conducting any district-initiated programs, while Centre staff members were only to act as assistants to the leader, if so requested. Table 5 presents data on how the mobile support unit was used in support of district programs during school year 1975-76.

Summary Analysis

The initiation stage in the diffusion of metric education in the 8 school districts under study was

Table 5

Frequency and Percentage of Use of Metric Regional Resource Centre Mobile Unit[a]

Frequency of Use	District								
	A	B	C	D	E	F	G	H	Total
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
In Support of Specialist's Inservice of Multipliers	4 (67)	2 (100)	3 (38)	1 (14)	1 (8)	1 (100)	1 (50)	1 (1)	14 (29)
In Support of Multiplier's Inservice of Teachers	0 (0)	0 (0)	4 (50)	5 (72)	10 (84)	0 (0)	1 (50)	8 (8)	28 (58)
In Support of District Parent Education Programs	2 (33)	0 (0)	1 (12)	1 (14)	1 (8)	0 (0)	0 (0)	1 (1)	6 (13)
In Support of District Community Education Programs	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total District Use	6 (100)	2 (100)	8 (100)	7 (100)	12 (100)	1 (100)	2 (100)	10 (100)	48 (100)

[a]Data summarized from Regional Metric Resource Center, Department of Education, San Diego County, Mobile Log Book.

described by 11 heuristics and 5 change strategies used by the Regional Metric Resource Centre. Data indicate that the Centre acted as an outside change agent in initiating the diffusion of metric education in the eight school districts under study and acted as a facilitator and coordinator in servicing the needs of the user systems.

Heuristics 1, 2, 4, 7, and 9, coupled with Centre seed money and Centre support system strategies, suggest that a helping relationship between the Centre (change agent) and the districts (users or client systems) was intended and established. Heuristics 3, 10, and 11, coupled with the Centre's commitment, multiplier approach, and district plan strategies suggest that the Centre had a high degree of concern for district commitment, planning, and the division and coordination of labor. Heuristics 1, 3, and 7 also suggest a Centre concern for mutual adaption and collaboration. Data indicate (Table 5) that the Centre's mobile support system was used most frequently (58 per cent) for on-site support of districts' multipliers' training of teachers at the school building level.

OBJECTIVE 2: CHARACTERISTICS OF DISTRICTS

The second objective of the study was to describe specified characteristics of the eight public school districts under investigation. The six general characteristics described were district type, district size, special personnel resources, district economic factors, district

pupil background factors, and district pupil performance factors.

District Type

Table 6 shows that among the eight school districts in the study, two were unified school districts and six were elementary school districts. The unified districts contained elementary schools (grades K-6), three-year junior high schools (grades 7, 8, and 9), and three-year senior high schools (grades 10, 11, and 12). Three of the elementary school districts were K-8 elementary districts containing elementary schools (K-6) and junior high schools (grades 7 and 8). The remaining three elementary school districts contained only elementary schools (K-6).

District Size

Tables 7 and 8 present district size along four dimensions: average daily attendance, average class size, numbers of teachers, and numbers of schools. Table 7 shows total ADA, total teachers, and total schools in each district for school year 1975-76; while Table 8 shows ADA, number of teachers, and number of schools based on the K-6 enrollments in each district for school year 1975-76.

Districts were classified as being either metropolitan, large, medium, or small in size based upon K-6 enrollments (Table 8). Districts having a K-6 ADA of 20,000 or more were classified as metropolitan in size. Districts having a K-6 ADA of 10,000 to 19,000 were

Table 6

Type of District by Elementary/Unified, Organizational Patterns, and Grade Span[a]

Type	District							
	A	B	C	D	E	F	G	H
Elementary/Unified	Unified	Elem	Elem	Elem	Unified	Elem	Elem	Elem
Organizational Patterns	6-3-3	6-0-0	6-2-0	6-2-0	6-3-3	6-0-0	6-0-0	6-2-0
Grade Span	K-12	K-6	K-8	K-8	K-12	K-6	K-6	K-8

[a]Superintendent of Schools, Department of Education, San Diego County, Directory: School Districts and Department of Education San Diego County, California 1975-76 (San Diego: Department of Education, San Diego County, 1975), pp. 276-77.

Table 7

Size of Districts Using Total ADA as Index

Size Categories	District							
	A	B	C	D	E	F	G	H
Total District ADA[a]	121,953	15,193	13,247	13,164	9,989	5,637	4,718	3,592
Average Class Size (K-8)[b]	30.1	28.6	31.8	29.7	29.7	28.7	29.4	31.5
Number of Teachers[c]	4,052	531	417	443	349	196	160	114
Number of Schools[d]	162	28	21	21	13	11	9	8

[a]Superintendent of Schools, Department of Education, San Diego County, Enrollment by Grades 1965-75 Fall (San Diego: Department of Education, San Diego County, February, 1976).

[b]Superintendent of Schools, Department of Education, San Diego County, San Diego County School Districts Test Results and Other Factors 1974-75 (San Diego: Department of Education, San Diego County, January, 1976).

[c]Data computed by dividing Total District ADA by Average Class Size (K-8).

[d]Superintendent of Snhools, Department of Education, San Diego County, Directory: School Districts and Department of Education San Diego County, California 1975-76 (San Diego: Department of Education, San Diego County, 1975), p. 27.

Table 8

Size of Districts Using K-6 ADA as Index

Size Categories	Districts							
	A	B	C	D	E	F	G	H
District ADA (K-6)[a]	63,399	14,648	9,538	9,666	4,691	5,581	4,643	2,637
Average Class Size (K-8)[b]	30.1	28.6	31.8	29.7	28.6	28.7	29.4	31.5
Number of Teachers (K-6)[c]	2,106	512	300	325	164	194	158	84
Number of Schools (Elem.)[d]	124	28	17	17	9	11	9	6

[a]Superintendent of Schools, Department of Education, San Diego County, Enrollment by Grades 1965-75 Fall (San Diego: Department of Education, San Diego County, February, 1976).

[b]Superintendent of Schools, Department of Education, San Diego County, San Diego County School Districts Test Results and Other Factors 1974-75 (San Diego: Department of Education, San Diego County, January, 1976).

[c]Data computed by dividing District ADA (K-6) by Average Class Size (K-8).

[d]Superintendent of Schools, Department of Education, San Diego County, Directory: School Districts and Department of Education San Diego County, California 1975-76 (San Diego: Department of Education, San Diego County, 1975), p. 27.

classified as large in size. Districts with a K-6 ADA of 3,000 to 9,999 were classified as medium in size, and districts with a K-6 ADA of 2,999 or less were classified as small in size.

Special Personnel Resources

Special personnel resources were described along four dimensions: the total number of certificated personnel with district level responsibilities, the number of certificated personnel at the district level having responsibilities for the mathematics curriculum, and the number of certificated personnel assigned at the school building level as mathematics resource people. Table 9 shows the number of certificated personnel for each of these categories in each district. The first three categories in Table 9 represent district level data that are cumulative and reflect a duplicated count of district office personnel. As an example, of the 183 certificated district office personnel in District "A", 27 had curriculum responsibilities; and of the 27, 3 were assigned responsibilities for the mathematics curriculum. Data in the fourth category of Table 9 (Mathematics Personnel-Building Level) reflect an unduplicated count of mathematics resource teachers assigned to schools in each district, that is, the 37 building level personnel in District "A" are not included in the 183 district level personnel listed above.

Table 9

Special Personnel Resources of Districts

Certificated Personnel	Districts[a]							
	A	B	C	D	E	F	G	H
Total--District Level[b]	183	56	31	31	23	9	14	10
Curriculum Personnel--District Level	27	7	3	3	3	2	2	1
Mathematics Personnel--District Level	3	1	0	0	0	0	1	0
Mathematics Personnel--Building Level	37	1	0	0	1	1	0	0

[a]District "A" data obtained through communications with Personnel Operations, San Diego Unified School District, San Diego, California; Districts "B"-"H" data obtained from Superintendent of Schools, Department of Education, San Diego County, Directory: School Districts and Department of Education San Diego County, California 1975-76 (San Diego: Department of Education, San Diego County, 1975).

[b]Data excludes nurses for all districts.

District Economic Factors

Tables 10, 11, and 12 present selected financial factors of the districts under study. Budget expenditures for 1975-76 were based upon approved 1975-76 budgets and estimated 1975-76 average daily attendances. Table 10 provides indicators of the financial well-being of the districts. Table 10 shows that Districts "E" and "G" had the highest proposed Expenditures for Instruction per ADA when compared to the other districts. Table 11 presents the proposed 1975-76 budget expenditures for each district under six basic categories established by the California School Accounting Manual[2] and along two dimensions: actual budget dollars and per cent of total expenditures. Table 11 shows that District "E" proposed to expend a smaller per cent of its total budget in the Certificated Salaries category than did the other districts, and proposed to expend a larger per cent of its total budget in the Books, Supplies, and Equipment category and Contracted Services category than did the other districts. Table 12 presents the amount of proposed expenditures for each district in the six budget categories per ADA. District "E" (Table 12) shows relatively high proposed expenditures per ADA in the categories of Books, Supplies, and Equipment and Contracted Services when compared to other districts.

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[2]California State Department of Education, California School Accounting Manual, School Business Administration Publication No. 8 (Sacramento: Bureau of Publications, California State Department of Education, 1973).

Table 10

District Financial Background Factors 1975-76[a]

Factors	District							
	A	B	C	D	E	F	G	H
Assessed Valuation--Average % Increase for Ten Year Period 1966-75	10%	12%	10%	13%	10%	11%	10%	7%
Assessed Valuation per unit of ADA Estimated 1975-76	28,417	17,987	21,351	22,427	18,426	10,955	18,733	18,361
Revenue Limit per ADA 1975-76	994.28	847.70	924.38	903.16	975.25	884.54	908.84	917.42
School District Tax Rates 1975-76	4.848	3.021	2.905	2.665	5.510	3.381	2.799	2.839
Total Income 1975-76	183,096,696	25,415,696	18,156,538	17,006,085	15,715,318	8,487,294	7,541,089	4,789,128
Federal Income 1975-76 (%)	8.93	4.80	5.61	4.77	4.39	9.59	10.57	4.66
Expenditures for Instruction per ADA[b]	777	787	738	657	820	695	843	645

[a]Superintendent of Schools, Department of Education, San Diego County, Annual Report of Financial Transactions of the School Districts of San Diego County, 1975 (San Diego: Department of Education, San Diego County, 1975), pp. 4-5, 12-14, 20-22, 30-42.

[b]Derived from 1975-76 total Instructional Program expenditures divided by total 1975-76 ADA, p. 30-42. Unified Districts A and E use total expenditures and ADA at both elementary and secondary levels.

Table 11

Budget Expenditures of School Districts 1975-76 by California Budget Categories[a]

Expenditures	District							
	A	B	C	D	E	F	G	H
Certificated Salaries:								
Dollars	104,433,251	2,602,438	9,730,711	9,347,816	7,760,889	4,267,446	3,685,458	2,507,468
% of Total Expenditures	58.34	67.18	63.81	62.07	56.85	61.16	59.67	60.35
Classified Salaries:								
Dollars	26,771,423	2,866,040	2,838,466	2,504,005	2,356,060	1,400,847	1,323,080	862,759
% of Total Expenditures	14.95	15.28	18.61	16.63	17.26	20.08	21.42	20.76
Employee Benefits:								
Dollars	16,198,963	1,455,828	1,387,000	1,460,786	1,335,059	703,604	589,300	375,723
% of Total Expenditures	9.05	7.76	9.10	9.70	9.78	10.08	9.54	9.04
Books, Supplies & Equipment:								
Dollars	8,034,095	975,950	626,465	957,387	970,492	311,454	305,900	163,812
% of Total Expenditures	4.49	5.20	3.94	6.36	7.11	4.46	4.95	4.11
Contracted Services & Other Expenses:								
Dollars	8,633,706	635,890	607,640	558,607	999,497	279,650	239,000	192,769
% of Total Expenditures	4.82	3.39	3.98	3.71	7.32	4.01	3.87	4.64
Capital Outlay:								
Dollars	14,951,630	222,320	59,242	231,359	229,217	14,500	34,000	52,548
% of Total Expenditures	8.35	1.19	1.27	1.53	1.68	.21	.55	.39

[a]Superintendent of Schools, Department of Education, San Diego County, Annual Report of Financial Transactions of the School Districts of San Diego County, 1975 (San Diego: Department of Education, San Diego County, 1976), pp. 30-35.

Table 12

Budget Expenditures of School Districts per 1975-76 ADA by California Budget Categories[a]

Expenditures per ADA	District							
	A	B	C	D	E	F	G	H
Certificated Salaries per ADA	829.65	786.92	737.17	694.33	779.13	748.68	767.81	668.66
Classified Salaries per ADA	212.68	178.96	215.04	185.99	236.53	245.76	275.64	230.07
Employee Benefits per ADA	128.69	90.90	105.08	108.50	134.03	123.44	122.77	100.19
Books, Supplies & Equipment per ADA	63.82	60.94	47.46	71.11	97.43	54.64	63.93	43.68
Contracted Services & Other Expenses per ADA	68.59	39.71	46.03	41.49	100.34	49.06	49.79	51.41
Capital Outlay per ADA	118.78	13.88	4.49	17.19	23.01	2.54	7.08	14.01

[a]Superintendent of Schools, Department of Education, San Diego County, Annual Report of Financial Transactions of the School Districts of San Diego County, 1975 (San Diego: Department of Education, San Diego County, 1976), pp. 30-35.

Tables 13, 14, 15, and 16 report by budget category the amount of dollars spent by each district for metric transition during fiscal years 1973-74, 1974-75, 1975-76, and estimated expenditures for metric transition in fiscal year 1976-77. Dashes in the tables indicate that data were not available or were not received for compilation. Zeros indicate that the respondents reported no money spent for that particular category. Total expenditures (Tables 14, 15, and 16) for each district include $805, $2,015, and $2,345 provided by the Regional Metric Resource Centre for years 1974-75, 1975-76, and 1976-77, respectively. For example, data for 1974-75 (Table 14) indicate that Districts "D", "E", and "H" provided no funds beyond the contributions made by the Regional Metric Resource Centre for that year, and that Districts "E" and "H" spent slightly less than the $805 allocated by the Centre for metric transition during that year. The total expenditures for District "A" for fiscal year 1976-77 (Table 16) include $33,196 received from a United States Office of Education grant. District "D" (Table 16) did not provide an estimate for 1976-77 expenditures, but the $2,345 allocated by the Centre is shown.

District Pupil Background Factors

Table 17 presents data describing selected types of pupil background information collected as part of the 1974-75, California Assessment Program. The Socio-Economic Index at Grade Six is an indicator of the occupations of the

Table 13

Expenditures for Districts' Metric Transition 1973-74 by California Budget Categories[a]

Expenditure Categories[b]	District							
	A	B	C	D	E	F	G	H
Certificated Salaries	3,000	500	-0-	-0-	-0-	-0-	-0-	-0-
Classified Salaries	500	100	-0-	-0-	-0-	-0-	-0-	-0-
Employee Benefits	300	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Books, Supplies & Equipment Replacement	5,000	2,000	-0-	-0-	-0-	-0-	-0-	-0-
Contracted Services & Other Expenses	500	-0-	-0-	-0-	-0-	18	-0-	-0-
Capital Outlay	5,000	2,000	-0-	-0-	-0-	75	-0-	-0-
Total Expenditures	14,300	4,600	-0-	-0-	-0-	93	-0-	-0-

[a]Data based on a survey conducted by the Regional Metric Resource Centre, Department of Education, San Diego County, in May, 1976.

[b]Categories based on California State Department of Education, California School Accounting Manual, School Business Administration Publication No. 8 (Sacramento: Bureau of Publications, California State Department of Education, 1973).

Table 14

Expenditures for Districts' Metric Transition 1974-75 by California Budget Categories[a]

Expenditure Categories[b]	District							
	A	B	C	D	E	F	G	H
Certificated Salaries	4,704	2,155	1,770	330	-0-	455	1,640	486
Classified Salaries	2,000	300	-0-	-0-	-0-	-0-	916	-0-
Employee Benefits	500	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Books, Supplies & Equipment Replacement	1,101	1,850	785	475	364	1,378	663	350
Contracted Services & Other Expenses	1,000	-0-	-0-	-0-	432	-0-	-0-	-0-
Capital Outlay	6,000	200	700	-0-	-0-	-0-	-0-	-0-
Total Expenditures	15,305	4,505	3,255	805	796	1,833	3,219	736

[a]District data based on a survey conducted by the Regional Metric Resource Centre, Department of Education, San Diego County, in May, 1976.

[b]Categories based on California State Department of Education, California School Accounting Manual, School Business Administration Publication No. 8 (Sacramento: Bureau of Publications, California State Department of Education, 1973).

Table 15

Expenditures for Districts' Metric Transition 1975-76 by California Budget Categories[a]

Expenditure Categories[b]	District							
	A	B	C	D	E	F	G	H
Certificated Salaries	6,602	4,215	2,750	580	300	1,120	2,754	4,564
Classified Salaries	2,000	500	100	-0-	-0-	-0-	1,834	-0-
Employee Benefits	500	-0-	-0-	-0-	-0-	-0-	-0-	39
Books, Supplies & Equipment Replacement	22,964	1,500	1,765	2,264	1,300	1,800	1,603	1,447
Contracted Services & Other Expenses	2,000	-0-	-0-	-0-	2,415	20	-0-	-0-
Capital Outlay	6,000	200	-0-	945	-0-	80	127	54
Total Expenditures	40,065	6,415	4,645	3,789	4,015	3,020	6,318	6,104

[a]District data based on a survey conducted by the Regional Metric Resource Centre, Department of Education, San Diego County, in May, 1976.

[b]Categories based on California State Department of Education, California School Accounting Manual, School Business Administration Publication No. 8 (Sacramento: Bureau of Publications, California State Department of Education, 1973).

Table 16

Estimated Expenditures for Districts' Metric Transition 1976-77
by California Budget Categories[a]

Expenditure Categories[b]	District							
	A	B	C	D	E	F	G	H
Certificated Salaries	13,145	3,345	2,400	--	-0-	2,000	2,754	2,345
Classified Salaries	6,000	500	250	--	-0-	-0-	1,834	-0-
Employee Benefits	700	-0-	-0-	--	-0-	-0-	-0-	50
Books, Supplies & Equipment Replacement	39,000	1,200	3,145	--	1,600	1,500	2,105	1,000
Contracted Services & Other Expenses	5,500	-0-	-0-	--	4,550	-0-	-0-	-0-
Capital Outlay	10,000	200	800	--	-0-	-0-	240	-0-
Total Expenditures	74,345	5,245	6,595	2,345	6,150	3,500	6,933	3,395

[a]District data based on a survey conducted by the Regional Metric Resource Centre, Department of Education, San Diego County, in May, 1976.

[b]Categories based on California State Department of Education, California School Accounting Manual, School Business Administration Publication No. 8 (Sacramento: Bureau of Publications, California State Department of Education, 1973).

Table 17

California Assessment Program Profile of Districts: Six Cultural-Socio-Economic Factors[a]

Cultural-Socio-Economic Factors	District A	B	C	D	E	F	G	H
Socioeconomic Index at Grade Six								
District Value	1.50	1.38	1.26	1.46	1.15	0.86	0.71	1.33
State Percentile Rank	78	69	59	75	48	23	16	66
Parent Education Index at Grade Six								
District Value	2.10	2.03	2.04	2.11	2.20	1.82	1.57	1.97
State Percentile Rank	73	64	65	77	82	36	11	51
Pupil Mobility at Entry Level								
District Value	44.7	38.1	38.8	43.4	46.3	50.4	49.7	41.4
State Percentile Rank	69	42	45	64	74	82	80	57
Percent Minority Pupils								
District Value	27.2	30.6	10.6	6.5	13.2	29.2	61.0	18.1
State Percentile Rank	70	74	40	25	47	72	93	58
Percent Spanish-surnamed								
District Value	11.6	22.0	7.6	5.4	10.5	19.9	40.6	9.6
State Percentile Rank	59	74	48	40	56	72	88	54
Percent Bilingual at Entry Level								
District Value	14.8	26.6	7.5	4.9	15.9	32.7	42.8	11.3
State Percentile Rank	61	76	45	33	63	83	88	55

[a]Superintendent of Schools, Department of Education, San Diego County, California Assessment Program of School District Performance, 1974-75 (San Diego: Department of Education, San Diego County, 1975).

sixth grade pupils' parents based on four occupational categories that correspond most closely with the occupation of the pupil's father, mother, or guardian. The four categories range from unskilled occupations to professional occupations with weights assigned to each category. The Socio-Economic Index at Grade Six--District Value is an average of the weights obtained for all sixth grade pupils in the district. A high score indicates that the district serves a community with a large percentage of people engaged in professional and semi-professional occupations. District values of all California school districts are rank-ordered to determine what percentage of the districts have a mean score lower than the one in question: this number is the State Percentile Rank. For example, Districts "F" and "G" in Table 17 show a relatively low socio-economic index when compared to the other districts in the study. When compared to other districts in the state of California, the percentile ranks of Districts "F" and "G" show that they rank in the bottom quartile.

The Parent Education Index at Grade Six (Table 17), like that of the Socio-Economic Index at Grade Six, is based on an average of weights given to selected categories to be measured. The parent education index is based on weights assigned to three educational levels of parents of sixth grade pupils: not a high school graduate, high school graduate, and college graduate or advanced degree. A high index value indicates that the parents of district pupils

have a relatively large amount of formal education. Table 17 shows that the parents in Districts "F" and "G" have a relatively small amount of formal education when compared to other districts in the study and other districts in California.

Pupil Mobility at Entry Level (Table 17) relates to when a pupil was first enrolled in the pupil's current school and whether the pupil had been continuously enrolled since the time of first enrollment. This factor is assessed in California at the second and third grade level. The pupil mobility value is the percentage of second and third grade pupils who were not continuously enrolled in that school since kindergarten or since first grade. In Table 17, Districts "F" and "G" show that 50.4 per cent and 49.7 per cent of the second and third grade pupils have not been continuously enrolled in the same school since they started.

The Percent Minority Pupils and Percent Spanish-surnamed Pupils (Table 17) were derived by dividing the minority enrollment and Spanish-surnamed enrollment by the total district enrollment. Data on the number of minority pupils and Spanish-surnamed pupils enrolled in the schools were collected in 1973-74 as part of the Elementary Secondary School Civil Rights Survey and included American Indians, Asian Americans, blacks, and Spanish-surnamed pupils. Table 17 shows that at the time of the survey, 61 per cent of the total pupils in District "G" were identified as minority pupils, and 40.6 per cent of the total pupils in the

district were Spanish-surnamed.

The Percent Bilingual at Entry Level (Table 17) is the percentage of pupils who were identified as fluent in English and having a second language, limited in English and having a second language, or non-English speaking.

District Pupil Performance Factors

Tables 18 and 19 show selected factors related to pupil achievement performance in each district based upon district test results for the 1974-75 school year as part of the California Assessment Program.

The district mean scores reported in Tables 18 and 19 provide information on the percentage of questions answered correctly by all the district students for the content areas and grades indicated. Alternatively, this score can be viewed as being the average (arithmetic mean) of the percentage of the items each pupil answered correctly on the state tests. As an example, in Table 18, the third grade district mean score for District "G" is 78.4. This signifies that of all the test items presented to the grade three pupils in District "G", 78.4 per cent of those items were answered correctly. Or alternatively, the average third grade pupil in District "G" answered 78.4 per cent of the items on the reading test correctly.

The State Percentile Rank of the Comparison Score Band indicates the percentile ranking obtained by the middle 50 per cent of the districts with similar background

Table 18

California Assessment Program Profile of Districts: Third and Sixth Grade Reading Achievement Factors[a]

Reading Achievement Factors	District							
	A	B	C	D	E	F	G	H
Third Grade:								
District Mean Score	82.8	79.9	83.5	83.7	86.1	82.0	78.4	83.8
State Percentile Rank	45	32	48	49	62	42	26	49
State Percentile Rank of the Comparison Score Band	35-62	28-51	49-79	48-78	38-65	15-29	12-23	38-66
Sixth Grade:								
District Mean Score	67.1	56.9	58.1	59.0	58.9	56.5	51.4	58.0
State Percentile Rank	49	47	55	60	59	46	22	54
State Percentile Rank of the Comparison Score Band	58-66	47-59	46-59	56-66	55-67	38-52	19-28	49-64

[a]Superintendent of Schools, Department of Education, San Diego County, California Assessment Program Profile of School District Performance, 1974-75 (San Diego: Department of Education, San Diego County, 1975).

Table 19

California Assessment Program Profile of Districts: Sixth Grade Mathematics Achievement Factors[a]

Sixth Grade Mathematics Achievement Factors	District							
	A	B	C	D	E	F	G	H
District Mean Score	51.7	48.6	52.2	50.8	49.9	50.0	47.4	52.9
State Percentile Rank	61	40	64	54	47	49	32	68
State Percentile Rank of the Comparison Score Band	58-68	50-62	47-60	56-68	51-65	35-50	18-31	49-66

[a]Superintendent of Schools, Department of Education, San Diego County, California Assessment Program Profile of School District Performance, 1974-75 (San Diego: Department of Education, San Diego, 1975).

characteristics. The procedures for calculation of Comparison Score Bands involve statistical analysis techniques that reveal the statewide relationships (correlations) among the background factors and the district mean scores. The Comparison Score Band provides a means by which districts in the state having similar background characteristics, such as thos found in Table 18, may be compared. State Percentile Rank scores greater than the Comparison-Score Band indicate that a district's pupils are performing above that expected when compared to other districts in California with a similar set of background characteristics, and vice versa. For example, District "F" in Table 18 shows a State Percentile Rank of 42 which is well above the State Percentile Rank of the Comparison Score Band which, in turn, indicates that District "F's" third grade pupils are performing well above expected when compared to other districts in California with a similar set of background characteristics.

Table 19 shows sixth grade Mathematics Achievement Factors for the districts under study. Achievement factors are interpreted the same as those in Table 18, which are described above.

Summary Analysis

Six general characteristics of the districts under study were described: (1) district type, (2) district size, (3) special personnel resources, (4) district economic

factors, and (5) district pupil performance factors. Data (Tables 6 through 19) indicate that the eight districts in the study could be characterized as follows:

District "A". District "A" was a large metropolitan sized unified school district with three mathematics resource personnel at the district level (Tables 6 through 9). In terms of its assessed valuation per unit of ADA, it was better off financially than any other district in the study (Table 10); but its expenditures for instruction per ADA, although above average, were fourth highest when compared to the other districts. District "A" demonstrated a commitment to metric transition prior to the Centre program through its expenditures for metric transition in school year 1973-74 (Table 13) and showed continuing financial commitment to metric transition in school years 1974-75 and 1975-76 (Tables 14 and 15). While its pupil population had a relatively large percentage of minority pupils, including a high percentage of Spanish speaking pupils, three other districts had higher percentages of minority and Spanish speaking pupils (Table 17). Reading achievement of sixth grade pupils in the district was about average when compared with the other districts in the study, but below average when compared with other districts in the state of California with similar background characteristics. Mathematics achievement of sixth grade pupils was above average when compared to the other districts in the study.

District "B". District "B" was a large K-6 elementary school district and was the second largest school district in the study, with one mathematics resource person at the district level (Tables 6 through 9). In terms of its assessed valuation per unit of ADA, it was below average when compared to the other districts in the study (Table 10). Its expenditures for instruction per ADA, however, were the third largest when compared to the other districts in the study (Table 10). District "B", like District "A", demonstrated a commitment to metric transition prior to the Centre program through its expenditures for metric transition in school year 1973-74 (Table 13). Data showed expenditures for metric transition during school years 1974-75 and 1975-76 beyond that required by their agreement with the Centre, an indication of increased commitment (Tables 14 and 15). In comparison with the other districts, District "B" had the second largest number of minority and Spanish speaking pupils (Table 17). Sixth grade pupil achievement in reading was slightly below average when compared to other districts in the study (Table 18). Sixth grade mathematics achievement was well below average when compared with other districts in the study and when compared with other districts in the state with similar background characteristics (Table 19).

District "C". District "C" was a medium sized K-8 elementary school district with no mathematics resource

personnel at the district level (Tables 6 through 9). The district was above average in terms of assessed valuation per unit of ADA when compared to the other districts in the study and slightly below average in its 1975-76 expenditures for instruction per ADA (Table 10). District "C" showed no expenditures for metric transition in 1973-74 (Table 13), the year preceding the Regional Metric Resource Centre program, but demonstrated financial commitment for metric transition during school years 1974-75 and 1975-76 (Tables 14 and 15) beyond that required in its agreement with the Centre for those years. District "C" was below average in its number of minority pupils when compared with other districts in the study (Table 17). Its sixth grade pupil achievement in reading and mathematics was above average when compared to other districts in the study (Tables 18 and 19).

District "D". District "D" was a medium sized K-8 elementary school district with no mathematics resource personnel at the district office level (Tables 6 through 9). The district ranked second highest in assessed valuation per unit of ADA, but ranked second lowest in its expenditures for instruction per ADA (Table 10). When compared to other districts, District "D" demonstrated no financial commitment for metric transition in 1973-74, the year preceding the Centre program (Table 13). Data showed no district expenditures for metric transition in 1974-75 beyond the

funds contributed by the Centre (Table 14). District expenditures for metric transition in 1975-76 were higher than required by Centre agreement (Table 15), but District "D" ranked the lowest in total expenditures (Tables 14 and 15) for metric transition when compared to other districts in the study. Data indicate that District "D" had the fewest number of minority pupils among the eight districts in the study (Table 17). The achievement level of sixth grade pupils in reading and mathematics tended to be above average when compared to the other districts in the study (Tables 18 and 19).

District "E". District "E" was a unified district that was classified as medium in size using its K-6 ADA as an index (Tables 6, 7, and 8). Data indicate that the district had no mathematics resource personnel at the district level (Table 9). The district's assessed valuation per unit of ADA was below average, and its expenditures for instruction per ADA were the third lowest when compared to other districts in the study (Table 10). District "E" demonstrated no commitment to metric transition through district expenditures for 1973-74 (Table 13). Data relevant to metric transition expenditures for 1974-75 and 1975-76 (Tables 14 and 15) indicate that District "E" made financial commitments above that required by Centre agreement. However, the district ranked second lowest in total expenditures for metric transition during school years 1974-75 and

1975-76 when compared to other districts in the study (Tables 14 and 15). District "E" ranked below average in the number of minority pupils when compared to other districts in the study (Table 18). Pupil achievement ranked above average for sixth grade reading achievement (Table 18) and below average for sixth grade mathematics achievement when compared to other districts (Table 19).

District "F". District "F" was classified as a medium sized K-6 elementary school district with no mathematics resource personnel at the district level (Tables 6 through 9). The district's assessed valuation per unit of ADA was the smallest of the districts in the study, and its expenditures for instruction per ADA were the second smallest when compared to the other districts in the study (Table 10). Data indicate small expenditures for metric transition in 1973-74, the year preceding the Regional Metric Resource Centre program (Table 13). Expenditures for metric transition in school years 1974-75 and 1975-76 exceeded that required by its agreement with the Centre (Tables 14 and 15). Data indicate that the district was above average in its number of minority pupils when compared with other districts in the study (Table 17). Data also indicate that sixth grade achievement in reading and mathematics was below average when compared to the other districts in the study, although district pupils were achieving where expected when compared with other districts in

California having similar background characteristics (Tables 18 and 19).

District "G". District "G" was classified as a medium sized K-6 elementary school district (Tables 6 through 8), and data indicate it had one district level mathematics resource person (Table 9). The assessed valuation per unit of ADA was below average when compared to the other districts in the study, but its expenditures for instruction per ADA were the highest among the eight districts (Table 10). District "G" demonstrated no commitment to metric transition through district expenditures for 1973-74, the year preceding the Centre program (Table 13). Expenditures for metric transition in 1974-75 and 1975-76 exceeded those required by Centre agreement, and total expenditures for the two years were the largest among the five medium sized districts (Tables 14 and 15). Data indicate that District "G" had the largest percentage of minority pupils, Spanish-surnamed pupils, and bilingual pupils of all the eight districts (Table 17). District "G" also had the lowest socio-economic index and lowest parent education index among the eight districts (Table 17). While District "G" also had lowest sixth grade pupil achievement in reading and mathematics of the eight districts, its achievement level factors were within the range expected when compared to other state districts of similar background characteristics (Tables 18 and 19).

District "H". District "H" was a K-8 elementary school district classified as small based on its K-6 enrollment (Table 8). It was the smallest school district in the study (Tables 6 through 8). The district had no mathematics resource personnel at the district level (Table 9). Its assessed valuation per unit of ADA was below average when compared with other districts in the study, and its expenditures for instruction per ADA were the lowest of the eight districts (Table 10). While data indicate that there were no expenditures for metric transition in 1973-74 and that the only expenditures for 1974-75 were those based on funds provided by the Regional Metric Resource Centre, district expenditures for 1975-76 exceeded that required by the agreement with the Centre for that year (Tables 13 through 15). The percentage of minority pupils in District "H" was slightly below average when compared with the other eight districts (Table 17). The sixth grade achievement level in reading and mathematics was above average when compared to othe other districts in the study (Tables 18 and 19).

OBJECTIVE 3: EXECUTION OF DISTRICT PLANS

The third objective of the study was to describe the execution of district plans as they relate to the installation of metric education in the eight school districts under study.

Data from interviews with all district specialists and data from the Centre's district log books indicate that all districts used a multiplier approach in their plans to provide teacher metric inservice training. That is, metric specialists in each district provided metric inservice education to a group of intermediaries who, in turn, provided metric inservice education to groups of teachers. The execution of districts' plans is described below under three topics: Multiplier Inservice Education, Teacher Inservice Education, and Parent and Community Education.

Multiplier Inservice Education

The study sought answers to the following questions about multiplier inservice education: How were multipliers selected? How were multipliers trained? and How were multipliers deployed or dispersed within districts?

Multiplier selection. Table 20 presents data relevant to tactics used by districts to select district metric multipliers. Data are in response to the 1975-76 Multiplier Metric Survey question: How were you selected as a multiplier? Of those responding to the question (Table 20), 38 per cent said they volunteered or self-selected to become multipliers, 30 per cent said they had been asked or requested by someone (specialist, principal, or peers), and 23 per cent indicated that their selection was a natural choice due to their encumbent role or assignment within the district (lead teacher or resource teacher). Other

Table 20

Tactics Used to Select Multipliers for Training by Frequency and Percentage[a]

Tactics	District								
	A	B	C	D	E	F	G	H	Total
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
Volunteered or self-selected	1 (20)	13 (54)	2 (22)	4 (57)	1 (25)	4 (40)	3 (27)	3 (27)	31 (38)
Appointed or selected by someone else	--	--	1 (11)	2 (29)	1 (25)	1 (10)	1 (9)	1 (9)	7 (9)
Requested (specialist, principal, peers)	--	4 (17)	3 (33)	1 (14)	--	5 (50)	6 (55)	5 (46)	24 (30)
Natural selection due to encumbant role assignment	4 (80)	7 (29)	3 (33)	-	2 (50)	--	1 (9)	2 (18)	19 (23)

[a]Tactics and data based on 1975-76 Multiplier Metric Survey question III, 1., "How were you selected as a multiplier?"

respondents (9 per cent) reported that they were appointed or selected by someone (principal or peers).

Multiplier training. Table 21 presents descriptive data relevant to the number of multipliers trained in each district, the average hours of training they received from district specialists, and the average number of training sessions held. Data produced from the 1975-76 Specialist Metric Survey indicated that a total of 103 multipliers were trained in 8 districts for an average of 14.1 hours in an average of 6 sessions (Table 21). Specialist activity records found in the Centre's district log books indicate that district specialists held three to eight meetings in combinations of two to four hour durations over a one to two month period. In all cases where activity records were found, the records indicated that specialists used media (overhead transparencies or films) and lecture methods to develop an awareness level (history, current events, and overview of the metric system) among multipliers in the early hours of training. Later hours of instruction included hands-on-experience type workshop activities.

Table 22 presents data relevant to tactics used by districts to schedule time for multiplier inservice education. Analysis indicates that 66 per cent of the multiplier respondents were released from their classroom assignments through the provision of a paid substitute or other coverage of their classroom during school hours. Eighteen per cent

Table 21

District Multiplier Training 1975-76: Number Trained, Average Hours Trained, and Average Number of Sessions

Questions	District								N	$\bar{X}$	SD
	A	B	C	D	E	F	G	H			
Number Trained?[a]	8	30	9	8	7	11	18	12	8	12.8	7.8
Average Hours Trained?[b]	5	15	20	20	10	16	11	16	8	14.1	5.2
Number of Training Sessions?[c]	--	6	8	7	3	6	6	6	7	6.0	1.5

[a]Number Trained was taken from responses to 1975-76 Specialist Metric Survey question I, 1., "How many multipliers have been trained in your district thus far?"

[b]Average Hours Trained was taken from responses to 1975-76 Specialist Metric Survey question I, 2., "Please specify average number of hours of training received by multipliers."

[c]Number of Training Sessions was derived from district specialists' interviews and Regional Metric Resource Centre district log books.

Table 22

Tactics Used to Release Multipliers (Em's) for Training by Frequency and Percentage[a]

Tactics	District								
	A	B	C	D	E	F	G	H	Total
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
Minimum day	--	--	--	--	--	--	2 (15)	--	2 (3)
Substitute, coverage	--	22 (85)	7 (88)	1 (17)	4 (80)	7 (87)	3 (23)	9 (100)	53 (66)
After school	--	--	1 (12)	5 (83)	1 (20)	--	7 (54)	--	14 (18)
Professional growth day	--	--	--	--	--	--	1 (8)	--	1 (--)
Faculty meeting	--	--	--	--	--	--	--	--	0 (0)
Release not necessary due to assignment	5 (100)	4 (15)	--	--	--	1 (13)	--	--	10 (13)

[a]Tactics and data based on 1975-76 Multiplier Metric Survey question I, 5, B, "How were you released for your training?"

of the multipliers responded that they were trained after school. Approximately 13 per cent required no release time or classroom coverage due to their district assignments (Districts "A", "B", and "F"; Table 22).

Multiplier deployment and dispersion. Data from Regional Metric Resource Centre district log books and specialist interviews indicate that Districts "B", "E", and "F" selected multipliers with the intent of having one for each elementary school in the district. Districts "G" and "H", the two smallest districts, selected multipliers with the intent of having two multipliers in each school.

District "C", containing 17 elementary and 4 junior high schools, was geographically organized into 4 areas--each area organized around one of the junior high schools. District "C" chose to implement metric education in one of its four areas in 1975-76 and selected one multiplier from that area's junior high school and two multipliers from each of the four feeder elementary schools. District "D" selected and trained one multiplier in 1975-76 from 8 (approximately half) of its 17 elementary schools.

District "A", a metropolitan size school district with 124 elementary schools, selected eight mathematics resource teachers in the district to act as metric multipliers. Unlike all other districts, these mutlipliers were responsible for holding large districtwide metric workshops at various locations within the district rather than

providing inservice training for the teachers in the schools from which they were selected.

Teacher Inservice Education

The study sought answers to the following questions: How were teachers selected? and How were teachers trained?

Teacher selection. Table 23 presents data relevant to tactics used by districts to select teachers to receive metric inservice education. Data are in response to the 1975-76 Multiplier Metric Survey question: How were teachers you trained selected? Of those responding to the question (Table 23), 45 per cent said that teachers volunteered or self-selected themselves; and 39 per cent responded that teacher metric inservice was required or mandatory. Other respondents indicated that teachers were requested (10 per cent) or appointed (6 per cent) to attend teacher metric inservice classes.

Teacher training. Table 24 presents descriptive data about the number of teachers (Et's) trained, the average hours of training received from district multipliers, and the average number of training sessions held. Data were in response to three questions on the 1975-76 Multiplier Metric Survey: How many teachers have you trained as a multiplier? On the average, how many hours was each teacher trained? and How many different sessions were held? An analysis of data in Table 24 indicates that 70 multipliers

Table 23

Tactics Used to Select Experimental Teachers (Et's) for Training by Frequency and Percentage[a]

Tactics	District								
	A	B	C	D	E	F	G	H	Total
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
Volunteered or self-selected	2 (67)	10 (53)	2 (25)	2 (33)	3 (60)	8 (100)	--	4 (33)	31 (45)
Appointed or selected by someone else	--	1 (5)	1 (12)	1 (17)	1 (20)	--	--	--	4 (6)
Requested (principal, peers, group vote)	1 (33)	3 (16)	--	1 (17)	--	--	--	2 (17)	7 (10)
Required, mandatory	--	5 (26)	5 (63)	2 (33)	1 (20)	--	8 (100)	6 (50)	27 (39)

[a]Tactics and data based on 1975-76 Multiplier Metric Survey question III, 3., "How were the teachers you trained selected?"

Table 24

District Teacher (ET's) Training 1975-76: Number Trained, Average Hours Trained, and Average Number of Sessions

Questions	District																										
	A			B			C			D			E			F			G			H			Total		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Number Trained?[a]	4	74.8	117.2	22	21.5	40.9	7	12.9	5.8	6	21.0	13.0	7	6.3	9.1	9	9.8	3.6	4	16.3	4.0	11	11.0	4.3	70	18.7	36.8
Average Hours Trained?[b]	4	5.3	5.9	22	4.9	2.4	8	3.9	2.2	6	6.2	2.6	7	6.4	1.6	9	3.9	2.2	4	2.3	1.3	11	6.9	2.3	71	5.1	2.7
Number of Training Sessions?[c]	4	6.0	3.7	22	4.3	4.8	8	2.6	1.4	6	3.3	1.0	7	1.9	0.4	9	3.0	1.9	4	3.3	3.2	11	2.2	0.4	71	3.3	3.2

[a]Number Trained was taken from responses to 1975-76 Multiplier Metric Survey question II, 1., "How many teachers have you trained as a multiplier?"

[b]Average Hours Trained was taken from responses to 1975-76 Multiplier Metric Survey question II, 2., "On the average, how many hours was each teacher trained?"

[c]Number of Training Sessions was taken from responses to 1975-76 Multiplier Metric Survey question III, 3., "How many different sessions were held?"

provided metric education to approximately 1,309 teachers in all districts. The average number of hours of teacher training was 5.1 with the average number of sessions being 3.3. An analysis of multipliers' activity records found in the Regional Metric Resource Centre district log books showed that district multipliers held one to six meetings in combinations of one to two hours duration over a four to six week period. In all cases where multiplier activity records were found, data indicated that multipliers used media (overhead transparencies or films) and lecture methods to develop an awareness level (history, current events, and overview of the metric system) with teachers in the early hours of training. Data also indicated that later hours of inservice education were given over to hands-on-experience type workshop activities.

Table 25 presents tactics used by districts to schedule time for teacher inservice meetings and workshops. Data are a result of 183 experimental teachers (Et's) responding to the question, How were you released for your inservice training? Table 25 shows that 41 per cent of the teachers responding received inservice training after school; 23 per cent were released during school hours through the use of a paid substitute or some other form of classroom coverage; and 17 per cent received metric inservice training on minimum days, that is, days pupils were sent home early or came to school late. Other tactics used included the use of professional growth days (6 per cent of respondents)

Table 25

Tactics Used to Release Experimental Teachers (Et's) by Frequency and Percentage[a]

Tactics	District								
	A	B	C	D	E	F	G	H	Total
	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
Minimum day	--	5 (19)	3 (12)	10 (56)	1 (6)	7 (27)	2 (11)	3 (9)	31 (17)
Substitute, coverage	5 (25)	2 (7)	5 (19)	--	--	11 (42)	11 (61)	25 (78)	59 (33)
After school	15 (75)	8 (30)	16 (62)	8 (44)	12 (75)	8 (31)	2 (11)	4 (13)	73 (41)
Professional growth day	--	6 (22)	1 (4)	--	--	--	3 (17)	--	10 (6)
Faculty meetings	--	4 (15)	1 (4)	--	1 (6)	--	--	--	6 (3)
Release not necessary due to assignment	--	--	--	--	--	--	--	--	--

[a]Tactics and data based on experimental teachers' (Et's) responses to 1975-76 Teacher Metric Survey, question I, 5., "How were you released for your inservice training?"

and faculty meetings (3 per cent of respondents).

Parent and Community Education

Table 26 presents data in response to the 1975-76 Specialist, Multiplier, and Teacher Metric Survey questions: Do you feel a school-based parent education program is a necessary component of district metric transition? and Have you held any parent programs in metric instruction? The number, frequency, and percentage of responses by specialists (S's), multipliers (Em's), experimental teachers (Et's), and control teachers (Ct's) are recorded for each question in Table 26.

Table 27 presents data in response to the 1975-76 Specialist, Multiplier, and Teacher Metric Survey questions: Do you feel a school-based community education program is a necessary component of district metric transition? and Have you held any community programs in metric transition? The number, frequency, and percentage of responses by specialists (S's), multipliers (Em's), experimental teachers (Et's), and control teachers (Ct's) are recorded for each question in Table 27.

Summary Analysis

All districts used some form of multiplier approach in the execution of their district plans. With the exception of District "A", the approach used was the selection of building level representatives who were trained in metric education by district metric specialists and who in turn

Table 26

Necessity of Parent Programs and Numbers of Specialists, Multipliers and Teachers Holding Parent Programs[a]

Survey Questions	Subjects	N	Yes		No	
			f	(%)	f	(%)
Are school-based parent programs necessary?	S's	8	8	(100)	0	(0)
	Em's	83	67	(81)	16	(19)
	Et's	212	151	(71)	61	(29)
	Ct's	172	125	(73)	47	(27)
Have you held any parent programs?	S's	8	5	(63)	3	(37)
	Em's	86	20	(23)	66	(77)
	Et's	218	22	(10)	196	(90)
	Ct's	181	4	(2)	177	(98)

[a]Questions and data based on 1975-76 Specialist, Multiplier, and Teacher Metric Surveys.

Key: S's = Metric Specialists
Em's = Metric Multipliers
Et's = Experimental Teachers
Ct's = Control Teachers

Table 27

Necessity of Community Programs and Numbers of Specialists, Multipliers, and Teachers Holding Community Programs[a]

Survey Questions	Subjects	N	Yes		No	
			f	(%)	f	(%)
Are school-based community programs necessary?	S's	8	8	(100)	0	(0)
	Em's	85	62	(73)	23	(27)
	Et's	199	99	(50)	100	(50)
	Ct's	159	89	(56)	70	(44)
Have you held any community programs?	S's	8	1	(12)	7	(88)
	Em's	85	6	(7)	79	(93)
	Et's	199	4	(2)	195	(98)
	Ct's	159	1	(1)	158	(99)

[a]Questions and data based on 1975-76 Specialist, Multiplier, and Teacher Metric Surveys.

Key: S's = Metric Specialists
Em's = Metric Multipliers
Et's = Experimental Teachers
Ct's = Control Teachers

trained teachers at the building site they represented. District "A" selected district mathematics resource personnel who in turn held districtwide metric workshops at various locations within the district. Most frequently multipliers volunteered or were requested to participate by the specialist or building principal. Multipliers were most frequently released from regular assignments by the use of a paid substitute in order to receive metric inservice training. Multipliers were trained by the district specialists on the average of 14.1 hours in an average of 6 sessions of 2 to 4 hour durations over a 1 to 2 month period using metric awareness level and direct metric measurement experience activities.

Teacher metric inservice training was usually voluntary or mandatory--some districts or schools requiring teachers to receive metric education while others did not. Most frequently teachers received metric inservice training after school, although teachers in some schools were released for inservice training by paid substitutes or some other form of classroom coverage. Teachers on the average received 5.1 hours of inservice training in an average of 3.3 sessions of 1 or 2 hour duration over a 4 to 6 week period using metric awareness level and direct metric measurement experience activities.

A high percentage of specialists, multipliers, experimental teachers, and control teachers perceived school based parent programs as a necessary component of a district

metric education program; and there appeared to be some relationship between the number of parent programs held and the levels of expertise or training of organizational members. That is, the percentage of specialists who held parent programs was greater than the percentage of multipliers who held parent programs, and the percentage of multipliers who held parent programs was greater than the percentage of experimental teachers who held parent programs. A larger percentage of experimental teachers held parent programs than did control teachers. A high percentage of specialists and multipliers perceived school-based community programs as a necessary component of district metric transition, while experimental and control teachers appeared to be evenly divided in their perception of community program necessity. A larger percentage of specialists and multipliers held community metric education programs than did experimental or control teachers, but fewer community programs were held than parent programs.

OBJECTIVE 4: ORGANIZATIONAL MEMBERS' PERCEPTIONS OF THE INNOVATION, METRIC SYSTEM

The fourth objective of the study was to describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study. Tables 28 and 29 present data relevant to multipliers', experimental teachers', and control teachers' perceptions of the metric system along five attributes of an innovation:

Table 28

Attributes of the Innovation (Metric System) as Perceived by Multipliers and Teachers by District[a]

Districts	Sub-jects[b]	N	Attributes											
			Relative Advantage		Compatibility		Complexity		Trialability		Observability		Total	
			$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^d$	SD
A	Em's	7	15.9	7.2	16.6	2.9	17.9	1.6	4.6	2.4	11.6	4.4	66.4	13.6
	Et's	23	17.0	3.5	16.4	2.1	17.8	2.1	8.0	4.1	13.1	3.6	72.3	7.6
	Ct's	42	13.7	5.8	15.3	2.4	16.9	2.3	8.5	4.9	12.4	3.5	66.9	12.7
B	Em's	26	18.9	1.5	17.1	1.8	18.7	1.6	6.6	2.3	14.6	3.2	75.9	4.6
	Et's	32	16.6	2.2	16.3	2.2	17.3	2.0	8.7	2.7	14.0	3.1	72.8	4.5
	Ct's	19	14.6	3.1	15.7	3.5	16.1	2.3	9.9	4.5	13.7	3.8	70.2	7.8
C	Em's	9	18.9	1.5	17.3	1.9	19.6	0.7	5.4	1.8	16.0	2.1	77.2	4.5
	Et's	33	15.4	3.8	16.0	3.5	16.5	2.6	9.4	4.2	14.2	3.2	71.5	8.8
	Ct's	33	13.8	4.8	15.3	2.3	16.4	2.4	9.2	4.4	13.2	3.3	67.9	10.8
D	Em's	6	15.5	7.7	16.5	3.8	18.0	1.4	6.8	5.3	13.5	4.8	70.3	17.4
	Et's	21	15.9	3.3	16.1	2.6	16.7	2.9	8.5	3.1	14.2	3.3	71.4	8.0
	Ct's	34	12.3	5.5	14.3	3.0	16.2	2.2	9.0	5.0	11.6	3.8	63.5	13.4

Table 28 (cont'd.)

Districts	Sub-jects[b]	N	Attributes											
			Relative Advantage		Compatibility		Complexity		Trialability		Observability		Total	
			$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^c$	SD	$\bar{X}^d$	SD
E	Em's	7	19.0	1.5	17.1	3.1	18.3	1.5	7.3	3.5	13.6	4.4	75.3	6.3
	Et's	25	16.2	2.9	16.3	2.1	17.7	1.9	7.8	3.1	14.5	2.8	72.4	6.2
	Ct's	19	11.1	6.2	13.9	2.0	16.0	2.1	8.3	5.4	11.9	4.4	61.4	14.4
F	Em's	11	18.2	2.6	17.4	1.8	18.3	2.8	7.7	2.8	14.5	2.9	76.0	6.8
	Et's	32	15.7	3.2	15.9	2.8	16.9	2.2	8.8	3.4	13.9	2.8	71.3	7.3
	Ct's	24	15.2	4.2	15.6	2.8	16.6	2.2	9.3	4.0	13.0	3.7	69.7	8.9
G	Em's	14	16.1	2.5	15.2	3.1	15.7	2.2	11.3	2.9	13.4	2.7	71.8	7.2
	Et's	22	16.1	3.1	16.0	2.4	16.9	2.2	8.5	3.3	13.8	3.2	71.2	8.0
	Ct's	25	13.9	3.7	14.9	2.0	15.6	2.1	11.6	3.9	12.5	3.3	68.5	8.3
H	Em's	12	17.2	3.2	16.8	2.7	17.3	2.9	7.9	2.9	14.3	4.6	73.3	7.1
	Et's	39	14.6	4.2	16.0	2.5	16.1	2.5	9.5	4.1	13.6	3.8	71.6	9.5
	Ct's	3	16.0	3.0	17.7	1.5	17.0	2.6	9.0	1.7	13.0	1.0	67.6	6.0

[a]Data based on 1975-76 Multiplier and Teacher Metric Surveys.

[b]Em's = Multipliers; Et's = Experimental Teachers; Ct's = Control Teachers.

[c]Most positive = 20.0; most negative = 4.0.

[d]Most positive = 100.0; most negative = 20.0.

Table 29

Attributes of the Innovation (Metric System) as Perceived by Multipliers and Teachers by Total Multipliers and Total Teachers[a]

Subjects	N	Attributes											
		Relative Advantage		Compatibility		Complexity		Trialability		Observability		Total	
		$\bar{X}^b$	SD	$\bar{X}^b$	SD	$\bar{X}^b$	SD	$\bar{X}^b$	SD	$\bar{X}^b$	SD	$\bar{X}^c$	SD
Multipliers (Em's)	92	17.7	3.5	16.8	2.5	17.9	2.3	7.4	3.4	14.1	3.5	73.9	8.4
Experimental Teachers (Et's)	227	15.8	3.4	16.1	2.6	16.9	2.4	8.7	3.6	13.9	3.2	71.5	7.6
Control Teachers (Ct's)	199	13.6	5.0	15.1	2.6	16.3	2.3	9.3	4.6	12.6	3.6	66.9	11.5

[a]Data based on 1975-76 Multiplier and Teacher Metric Survey.

[b]Most positive = 20.0; most negative = 4.0.

[c]Most positive = 100.0; most negative = 20.0.

relative advantage, compatibility, complexity, trialability, and observability. Data for multipliers (Em's) were taken from the 1975-76 Multiplier Metric Survey, and data for experimental teachers (Et's) and control teachers (Ct's) were taken from the 1975-76 Teacher Metric Survey.

Table 28 shows multipliers', experimental teachers', and control teachers' perceptions of each attribute by district. A mean score of 20.0 is most positive for each attribute shown, while a mean score of 4.0 is most negative. For example, relative advantage was defined as the degree to which an innovation is perceived as being better than the idea it supersedes. Mean scores approaching 20.0 for the attribute, relative advantage, would indicate that the respondents perceived the metric system as having a high degree of relative advantage over the customary system of measurement. Compatibility was defined as the degree to which an innovation is perceived as consistent with a receiver's existing values, past experiences, and needs. Scores approaching 20.0 for the attribute, compatibility, would indicate that the respondents perceived the metric system as being highly consistent with their existing values, past experiences, and needs. Complexity was defined as the degree to which an innovation is perceived by a receiver as being relatively easy to understand and use. Mean scores approaching 20.0 for the attribute, complexity, indicate that respondents perceived the metric system as easy to understand and use. Trialability was defined as the degree

to which an innovation may be tried or experimented with on a limited basis. Mean scores approaching 20.0 for the attribute, trialability, would indicate that respondents perceived the metric system as a system that may be tried or experimented with on a trial or limited basis. Mean scores approaching 4.0 for the attribute, trialability, would indicate that respondents perceived the metric system as an innovation that cannot be tried or experimented with on a limited basis. Observability was defined as the degree to which the results of an innovation are visible to others. A mean score approaching 20.0 for the attribute, observability, would indicate that the use of the metric system has been highly observed by the respondents. A mean score approaching 4.0 for the attribute, observability, would indicate that respondents have not observed a high use of the metric system in their environment. Total mean scores (Table 28) indicate respondents' overall perceptions of the innovation (metric system) across the five attributes. A mean score approaching 100.0 is most positive and would indicate that respondents perceived the innovation in a positive way. A mean score approaching 20.0 is most negative and would indicate that respondents perceived the metric system in a negative way.

Table 29 presents the perceptions of all multiplier (Em), experimental teacher (Et), and control teacher (Ct) respondents in all districts for each attribute of the innovation, metric system. A mean score of 20.0 is most

positive for each attribute, and a (total) mean score of 100.0 is most positive for the innovation as a whole. A mean score of 4.0 is most negative for each attribute and a (total) mean score of 20.0 is most negative for the innovation as a whole.

Summary Analysis

Generally, the innovation, metric system, was perceived by districts' organizational members as being better (relative advantage) than the customary system of measurement; as being consistent with the existing values, past experiences, and needs (compatibility); and as being relatively easy to understand and use (complexity). The metric system was not generally perceived as an innovation that may be tried or experimented with on a limited basis (trialability). District members were divided on their observation of the metric system in use (observability). Some felt the metric system was highly observable, while others felt it was not. Data (Table 29) indicate that there may be some relationship between the level of members' expertise or training and their perception of the metric system. Multipliers were generally more positive toward the innovation than experimental teachers, and experimental teachers were generally more positive than the control teachers.

OBJECTIVE 5: COGNITIVE AND AFFECTIVE CHANGES IN ORGANIZATIONAL MEMBERS

The fifth objective of the study was to describe metric cognitive and affective changes on a population of districts' organizational members and metric cognitive changes on a population of pupils in the eight school districts under study.

Multiplier (Em) and Teacher (Et & Ct) Cognitive and Affective Changes

Table 30 presents data relevant to pretest to posttest changes of districts' multipliers (Em's), experimental teachers (Et's), and control teachers (Et's) on the cognitive test, Metric Awareness Measure--Form A, and the concepts metric education and measurement by metric system on the affective test, Participant Attitude Scale. The number of subjects (N), mean scores ($\bar{X}$), and percentage correct are shown for each group assessed. Gain or loss between each group's pretest mean score and posttest mean score is also shown (Table 30). The highest score possible on the cognitive test was 50. A score of 48.0 through 84.0 on the affective test was interpreted as a positive attitude, while a score of 12.0 through 47.9 was interpreted as a negative attitude. Table 31 presents analysis of covariance (ANOCVA) data relevant to differences between pretest and posttest measures, between district, and between groups for the cognitive test. Data indicate that differences between pretest and posttest measures, between districts, and

Table 30

Multiplier (Em) and Teacher (Et & Ct) Pre/Post Cognitive and Affective Test Scores: Number, Mean, and Percentage Correct by Group

	Cognitive Test			Affective Test					
				Metric Education			Measurement by Metric System		
Test/Group	N	$\bar{X}^a$	(%)	N	$\bar{X}^b$	(%)	N	$\bar{X}^b$	(%)
Pre/Em's	74	30.1	(60)	36	63.3	(75)	36	64.2	(76)
Post/Em's	74	40.7	(81)	36	69.7	(83)	36	72.1	(86)
Gain-Loss		+10.6	(21)		+6.4	(8)		+7.9	(10)
Pre/Et's	298	22.4	(45)	204	56.3	(67)	204	57.4	(68)
Post/Et's	298	32.4	(65)	204	61.8	(74)	204	63.0	(75)
Gain-Loss		+10.0	(20)		+5.5	(7)		+5.6	(7)
Pre/Ct's	9	25.3	(51)	8	53.0	(63)	8	60.2	(72)
Post/Ct's	9	27.4	(55)	8	55.1	(66)	8	60.5	(72)
Gain-Loss		+2.1	(4)		+2.1	(3)		+0.3	(0)

[a]Mean scores reported with a possible score of 50.0.
[b]Mean scores 48.0-84.0 = positive attitude; 12.0-47.9 = negative attitude.

Table 31

Multiplier (Em) and Teacher (Et & Ct) Pre/Post Cognitive Test Scores: ANOCVA by Pre/Post Measures, Districts, and Groups

Source of Variation	Residuals			
	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	8332.72	8332.72	141.28***
Districts	7	7785.86	1112.27	18.86***
Groups	2	1174.82	587.41	9.96***
Error	370	21822.55	58.98	
Corrected Total	380	39115.95		

***p < .001.

between groups were significant at the .001 level of confidence. Tables 32 and 33 present analysis of covariance data relevant to differences found between pretest and posttest measures, between districts, and between groups for the affective test concepts: metric education and measurement by metric system. Data indicate that differences between pretest and posttest measures and between districts were significant at the .001 level of confidence, while differences between groups were significant at the .01 level of confidence (Tables 32 and 33).

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Cognitive Changes

Table 34 presents data relevant to pretest to posttest changes on districts' multiplier pupils (Em P's), experimental teacher pupils (Et P's), and control teacher pupils (Ct P's) using the Student Metric Measurement instrument. The number of pupils (N), mean scores ($\bar{X}$), and standard deviations (SD) are shown by grade level for each group assessed. Gain or loss between each group's pretest mean score and posttest mean score is also shown (Table 34). The key in Table 34 indicates the number of test items or the highest possible mean score for each grade level. Tables 35 through 41 present analysis of covariance (ANOCVA) data relevant to differences between pretest and posttest measures, between districts, and between groups for each grade level assessed. Data indicate that differences between pretest and posttest measures, between districts, and

Table 32

Multiplier (Em) and Teacher (Et & Ct) Pre/Post Affective Test Scores (Measurement by Metric System): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	13454.48	13454.48	129.94***
Districts	7	2993.99	427.71	3.61***
Groups	2	1185.86	593.93	5.73**
Error	238	24644.07	103.55	
Corrected Total	248	42278.40		

**p < .01.

***p < .001.

Table 33

Multiplier (Em) and Teacher (Et & Ct) Pre/Post Affective Test Scores (Metric Education): ANOCVA by Pre/Post Measures, Districts, and Groups

Source of Variation	Residuals			
	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	12629.22	12629.22	155.61***
Districts	7	2757.38	393.91	4.25***
Groups	2	713.49	356.75	4.40**
Error	238	19316.25	81.16	
Corrected Total	248	35416.34		

**p < .01.

***p < .001.

Table 34

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores: Number, Mean, and Standard Deviations by Group and Grade Level

Test/ Group	Grade Level																			
	K			1st			2nd			3rd			4th			5th			6th		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Pre/ Em P's	4	12.7	0.5	53	17.6	3.5	55	19.8	3.1	127	14.1	4.3	96	17.9	3.7	104	14.1	4.9	116	16.5	5.3
Post/ Em P's	4	14.0	0.0	53	21.6	2.6	55	22.5	2.3	127	20.7	3.7	96	23.8	2.7	104	29.1	7.6	116	33.0	6.6
Gain-Loss		+1.3			+4.0			+2.7			+6.6			+5.9			+15.0			+16.5	
Pre/ Et's	239	12.7	1.1	149	19.8	2.7	156	19.3	3.4	185	15.6	2.9	112	16.4	3.1	149	12.3	5.0	148	16.4	5.1
Post/ Et P's	239	13.4	1.1	149	21.4	2.7	156	21.2	2.9	185	21.1	3.2	112	23.1	3.1	149	26.0	8.7	148	30.6	6.8
Gain-Loss		+0.7			+1.6			+1.9			+5.5			+6.7			+13.7			+14.2	
Pre/ Ct P's	112	13.0	0.8	23	19.0	3.6	36	22.1	2.2	61	17.7	3.0	80	18.1	3.4	19	11.7	3.8	65	18.0	4.9
Post/ Ct P's	112	13.3	0.7	23	19.8	3.4	36	21.8	2.7	61	19.1	2.9	80	20.0	3.4	19	18.5	3.3	65	26.3	6.7
Gain-Loss		+0.3			+0.8			-0.3			+1.4			+1.9			+6.8			+8.3	

Key: K = 14 possible; 1st = 27 possible; 2nd = 27 possible; 3rd = 29 possible; 4th = 29 possible; 5th = 55 possible; 6th = 55 possible

Table 35

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (Kindergarten): ANOCVA by Pre/Post Measures, Districts, and Groups

Source of Variation	Residuals			
	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	48.00	48.00	45.81***
District	7	33.15	4.74	4.52***
Group	2	4.81	2.41	2.30
Error	344	360.43	1.05	
Corrected Total	354	446.39		

***p < .001.

Table 36

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (1st Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	173.97	173.97	24.81***
District	6	547.68	91.28	13.02***
Group	2	51.72	25.86	3.69*
Error	215	1507.68	7.01	
Corrected Total	224	2281.05		

*p < .05.

***p < .001.

Table 37

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (2nd Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	279.11	279.11	38.76***
District	5	223.79	44.76	6.22***
Group	2	24.23	12.11	1.68
Error	238	1713.65	7.20	
Corrected Total	246	2240.78		

***p < .001.

Table 38

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (3rd Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	219.68	219.68	16.33***
District	6	1324.98	220.83	16.41***
Group	2	144.23	72.11	5.36**
Error	341	4587.51	13.45	
Corrected Total	350	6276.40		

**p < .01.

***p < .001.

Table 39

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (4th Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

Source of Variation	Residuals			
	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	786.21	786.21	83.70***
Districts	7	797.19	113.88	12.12***
Group	2	309.14	154.57	16.46***
Error	257	2413.98	9.39	
Corrected Total	267	4306.52		

***p < .001.

Table 40

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (5th Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	5024.38	5024.38	86.01***
District	7	1532.45	218.92	3.75***
Group	2	918.28	459.14	7.86***
Error	294	17174.91	58.42	
Corrected Total	304	24650.02		

***p < .001.

Table 41

Multiplier Pupil (Em P's) and Teacher Pupil (Et P's & Ct P's) Pre/Post Cognitive Test Scores (6th Grade): ANOCVA by Pre/Post Measures, Districts, and Groups

	Residuals			
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Pre/Post Measures	1	4628.77	4628.77	115.21***
District	7	3242.84	463.26	11.53***
Group	2	1368.44	684.22	17.03***
Error	318	12775.72	40.18	
Corrected Total	328	22015.77		

***p < .001.

between groups were significant at the .05 level of confidence or above for all grade levels except kindergarten (Table 35) and second grade (Table 37). No significant differences between groups (Em P's, Et P's, and Ct P's) were found at the kindergarten and second grade levels.

Summary Analysis

Cognitive and affective test scores were analyzed for districts' multipliers (Em's), experimental teachers (Et's), and control teachers (Ct's) by analysis of covariance using the pretest as a covariate. Where significant F ratios were found, a Scheffé method (S-method) was employed to determine which groups were significantly different. The same analyses and techniques were employed with multiplier pupil (Em P's) data and teacher pupil (Et P's and Ct P's) data for each grade level.

Multiplier (Em) and teacher (Et & Ct) data analysis. Using an analysis of covariance, a comparison of cognitive test data between district's multipliers, experimental teachers, and control teachers indicated significant differences between groups at the .001 level of confidence (Table 31). Further analysis, using the Scheffé method (S-method), indicated that multipliers' posttest scores were significantly greater than experimental teachers' posttest scores and experimental teachers' posttest scores were significantly greater than control teacher posttest scores (Em's > Et's > Ct's).

Multiplier pupil (Em P's) and teacher pupil (Et P's & Ct P's) data analysis. An analysis of covariance of pupil data indicated no significant differences between multiplier pupils (Em P's), experimental teacher pupils (Et P's), and control teacher pupils (Ct P's) at the kindergarten level (Table 35) or at the second grade level (Table 37), although Em P gains were greater than Et P gains and Et P gains were greater than Ct P gains. Significant differences between groups were found, however, at the first grade level (.05 level of confidence); third grade level (.01 level of confidence); and at the fourth, fifth, and sixth grade levels (.001 level of confidence). Further analyses, using the Scheffé method (S-method), indicated that at the first grade and third grade levels the multiplier pupils' and experimental teacher pupils' posttest scores were significantly greater than control teacher pupils' posttest scores (Em P's = Et P's > Ct P's). At the fourth, fifth, and sixth grade levels, the multiplier pupils' posttest scores were significantly greater than experimental teacher pupils' posttest scores; and experimental teacher pupils' posttest scores were significantly greater than control teacher pupils' posttest scores (Em P's > Et P's > Ct P's).

Chapter 5

CONCLUSIONS, DISCUSSION, AND IMPLICATIONS

The concluding chapter fulfills the sixth objective of the study: to analyze the findings of the study to determine whether or not a paradigm for metric transition in local public school districts is feasible and, if so, to make recommendations for developing such a paradigm. The chapter is organized into four sections: (1) a review of the purpose of the study with a summary of the procedures and findings of the study, (2) major conclusions of the study, (3) a discussion of the findings of the study, and (4) implications of the study.

SUMMARY OF THE STUDY

The purpose of the study was to provide knowledge and understanding of specified aspects of metric transition in local public school districts (K-6). The study sought to describe the initiation and implementation stages of change in eight local public school districts (K-6) currently undergoing metric transition. The study further sought to determine whether a paradigm for metric transition in local public school districts (K-6) was feasible and, if so, to make recommendations for development such a paradigm. Specifically, the objectives of the study were:

1. To describe the heuristics and change strategies used by the Regional Metric Resource Centre, Department of Education, San Diego County, to initiate metric transition in eight selected public school districts (K-6) in San Diego County, California.

2. To describe specified characteristics of the eight selected public school districts under investigation.

3. To describe the execution of district plans as they relate to the installation of metric education in the districts under study.

4. To describe organizational members' perceptions of the innovation, metric system, in the eight school districts under study.

5. To describe metric cognitive and affective changes on a population of each district's organizational members and metric cognitive changes on a population of pupils in each of the eight school districts under study.

6. To analyze the findings of the study to determine whether a paradigm for metric transition in local public school districts is feasible and, if so, make recommendations for developing such a paradigm.

The basic method of the study was descriptive in nature. The description of Centre heuristics and strategies and the description of district characteristics were based upon content analysis of documents and records and published data sources. The description of the execution of district plans and the description of organizational members'

perceptions of the innovation, metric system, were based on surveys made on populations of districts' metric specialists, metric multipliers, and teachers. A quasi-experimental approach was used to gather data to describe cognitive and affective changes on districts' multipliers, experimental teachers, and control teachers using two Centre-developed instruments: Metric Awareness Measure--Form A and Participant Attitude Scale. A quasi-experimental approach was also used to gather data to describe metric cognitive changes on a population of districts' multiplier pupils, experimental teacher pupils, and control teacher pupils using the Centre-developed instrument: Student Metric Measurement.

Data from the study indicated that the Regional Metric Resource Centre acted as an outside agent in initiating the diffusion of metric education in the eight public school districts under investigation. Centre heuristics suggested a helping relationship between the Centre (change agent) and the districts (users or client systems). Five Centre strategies were identified at the initiation stage of the diffusion process: (1) commitment, (2) district plans, (3) a multiplier approach, (4) seed money, and (5) on-site support. At the initiation stage of the diffusion process, the Centre sought and obtained districts' commitments for metric transition, districtwide metric implementation plans, and a multiplier approach to metric inservice education and, in turn, provided districts with seed money and on-site support for district metric program implementation.

Although characteristics of districts differed in type, size, special personnel resources, district economic factors, pupil background factors, and pupil performance factors, all districts used some form of multiplier approach in the execution of their district metric implementation plans. With the exception of one district, the approach used was the selection of building level representatives who received metric education from district metric specialists and who, in turn, provided metric inservice training to teachers at the multipliers' building site. One district selected district mathematics resource personnel as multipliers who, after receiving training from the district specialist, held districtwide metric workshops at various locations within the district.

Multipliers in districts were most frequently released from regular assignments by the use of paid substitutes in order to receive metric inservice training. Multipliers were trained by the district specialists on the average of 14.1 hours in an average of 6 sessions of 2 to 4 hour durations over a 1 to 2 month period. District specialists used media and lecture methods to develop a metric awareness level in multipliers during the early hours of training and used hands-on experience activities in the latter hours of training. Teacher metric inservice training was provided by the districts' multipliers and was voluntary in some cases and mandatory in others. Most frequently, teachers received metric inservice training after school at

the school site. Teachers on the average received 5.1 hours of inservice training in an average of 3.3 sessions of 1 or 2 hour durations over a 4 to 6 week period. Multipliers used media and lecture methods to develop a metric awareness level in teachers during the early hours of training and used hands-on experience activities in the latter hours of training.

Specialists, multipliers, and teachers generally perceived school-based parent programs as a necessary component of a district metric education program. There was a direct relationship between the number of parent programs held and the levels of expertise or training received. A high percentage of specialists and multipliers perceived school-based community programs as a necessary component of district metric transition, while experimental and control teachers appeared evenly divided in their perception of community program necessity.

Districts' organizational members generally perceived the metric system positively. Data indicated a direct relationship between a member's level of expertise or training and his or her perception of the metric system. Multipliers were generally more positive toward the metric system than experimental teachers, and experimental teachers were generally more positive than the control teachers.

Data indicated that there were significant differences between districts' multipliers, experimental teachers, and control teachers on cognitive and affective tests.

Multipliers' posttest mean scores were significantly greater than experimental teachers' posttest mean scores, and experimental teachers' posttest mean scores were significantly greater than control teachers' posttest mean scores.

Posttest differences between multiplier pupils, experimental teacher pupils, and control teacher pupils varied by grade level. No significant differences were found between groups at the kindergarten and second grade levels. Significant differences between groups were found at the first grade and third grade levels with data showing that multiplier pupils and experimental pupils made significant posttest gains over the control teacher pupils. Significant differences were also found between groups at the fourth, fifth, and sixth grade levels. Multiplier pupils showed significant posttest gains over the experimental teacher pupils; and the experimental teacher pupils showed significant posttest gains over the control teacher pupils at the fourth, fifth, and sixth grade levels.

CONCLUSIONS

As a result of the study, conclusions were drawn from three major sources: (1) the metric literature; (2) the diffusion, adoption, and innovation literature; and (3) the study of eight districts undergoing metric transition.

Conclusions Drawn from the Metric Literature

As a result of a review of the metric literature, the following conclusions were drawn:

1. Teacher, parent, and community metric education are important components in the metric transition process.

2. Staff development and curriculum development are important elements of metric education.

3. A multiplier approach to staff development and a hands-on experience approach to learning are suggested strategies in implementing metric education.

4. Evaluation of instructional materials, teacher training, and pupil instruction are important aspects of program design.

5. Leadership, planning, coordination, and collaboration are essential aspects of a smooth and orderly metric transition.

Conclusions Drawn from the Diffusion, Adoption, and Innovation Literature

As a result of a review of the diffusion, adoption, and innovation literature, the following conclusions were drawn:

1. There are three basic stages in organizational innovation: (a) initiation stage, (b) implementation stage, and (c) incorporation stage. Commitments made at the initiation stage are viewed as having important effects on the implementation stage.

2. The implementation stage is viewed as an interplay of multiple, interrelated, and interacting factors within an institutional setting.

3. Four general and interrelated factors are associated with the implementation stage of innovation diffusion: (a) characteristics of the setting, (b) characteristics of the organizational members, (c) characteristics of the innovation, and (d) diffusion strategies and tactics.

4. Behavior of members in an organizational setting is largely determined by their structured roles; personality characteristics and variables such as sex, age, social origin, and years in the district have less relation to change efforts than do role structure and role expectations of organizational members.

5. Characteristics of innovations, as perceived by receivers, contribute to different rates of adoption of innovations. Five important characteristics of innovations are: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability.

6. Adaptive planning, staff training keyed to the local setting, local materials development, and how-to-do-it workshops are strategies and tactics that facilitate the diffusion process.

7. Strategies or tactics that provide a critical mass of organizational members in change can facilitate the diffusion process by building support and morale for changing members and by reducing resistance to change among

organizational members not involved in the change.

8. Strategies or tactics that provide for increased role specialization and creation of specialized teaching positions and administrative roles can facilitate the diffusion and adoption of innovations. Such strategies can provide increased coordination, communication, control, support, and problem-solving capacity within organizations during the implementation of education innovations.

Conclusions Drawn from the Study of Eight Districts Undergoing Metric Transition

As a result of the study of eight school districts (K-6) undergoing metric transition, the following conclusions were drawn:

1. A regional metric resource center can be an effective outside change agent in initiating the diffusion of metric education in local public school districts (K-6): (a) when obtaining strong district commitment to metric transition, (b) when requiring districtwide metric implementation plans, (c) when requiring a multiplier approach to metric inservice training, (d) when providing seed money, and (e) when providing on-site support for district metric program implementation.

2. A multiplier approach to local public school district metric inservice education is a feasible and effective metric inservice strategy.

3. A multiplier approach has the efficacy to

provide districts with an efficient and effective means for diffusing metric education by providing an ad hoc organizational structure which includes staff specialization, hierarchical communications, coordination, and teacher training keyed to local settings.

4. Selection of building level representatives as multipliers is a more efficient and preferred application of the multiplier approach.

5. School-based parent and community education programs are perceived by organizational members as important components of district metric transition.

6. The relative advantage, compatibility, complexity, trialability, and observability of the metric system, as perceived by organizational members (multipliers and teachers), are related to their expertise or training in the metric system; the greater their expertise or training, the greater their perception of the metric system's relative advantage, compatibility, and observability, and the less their perception of the metric system's complexity and trialability.

7. There is a relationship between organizational members' attitudes toward metric education and measurement by the metric system and their level of expertise or training; the greater the expertise or training, the more positive their attitude toward metric education and measurement by the metric system.

8. A significant change can be made in pupil metric

cognitive growth when: (a) strong metric commitment to metric transition is made, (b) districtwide metric implementation plans are developed, (c) a multiplier approach to metric inservice training is used, (d) funds are provided for release of metric specialists and multipliers, (e) funds are provided for the purchase or development of metric instructional materials, and (f) on-site staff support is provided for district metric program implementation.

DISCUSSION

The study described the initiation stage and implementation stage of the diffusion of metric education in eight local public school districts currently undergoing metric transition. Discussion of the findings are presented below under two topics: Initiation Stage and Implementation Stage.

Initiation Stage

Data in the study indicated that the Regional Metric Resource Centre acted as an outside change agent in initiating diffusion of metric education in the eight local school districts in the study. The Centre acted as facilitator and coordinator in servicing the needs of the users (districts). In this respect, the role and function of the Regional Metric Resource Centre was <u>not</u> unlike that of a linking agency referred to by Havelock in his Linkage Model for the

diffusion of innovations. In the Linkage Model, the linking agency functioned as an outside initiator, facilitator, and coordinator in servicing the needs of user or client systems. Data in the study indicated that such a model is effective for initiating metric education in grades kindergarten through six in local public school districts.

It would be logical to assume that a local public school district could self-initiate metric education if it used strategies similar to those used by the Regional Metric Resource Centre at the initiation stage. To accomplish this, a district member would have to seek local school board approval for the district superintendent to: (1) appoint a district metric specialist or coordinator to develop districtwide implementation plans in cooperation with an appointed district administrator, and (2) provide specified district funds to carry out a multiplier approach to purchase or develop metric instructional materials and to provide on-site staff support for district metric education programs. Thus, the initiation stage of the metric diffusion process may be self-initiated or carried out in cooperation with an outside change agent.

Implementation Stage

Data in the literature showed that characteristics of the adoption setting (districts in the study),

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[1]Ronald G. Havelock, "The Utilization of Educational Research and Development," British Journal of Educational Technology, II, No. 2 (May, 1971), 88-96.

characteristics of the innovation (metric system in the study), characteristics of organizational members (roles and role expectations of specialists and multipliers in the study), and diffusion strategies and tactics (multiplier approach in the study) act as interrelated factors associated with the diffusion process at the implementation stage.[2] The study described various aspects of each of the above factors. The following discussion comments on some of these factors.

The multiplier approach was used as an overall diffusion strategy and appeared to serve several functions in the diffusion process at the implementation stage. First, it was a strategy adopted by all districts in the study for metric staff development. As an inservice strategy, district metric specialists provided metric inservice education to intermediaries (multipliers) who, in turn, provided metric inservice education to teachers. All districts used some form of a multiplier approach, indicating that such an inservice strategy was feasible for providing metric inservice education to K-6 teachers in public school districts. All districts, except one, selected multipliers from building level sites, suggesting a

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[2]Henry M. Brickell, "Alternative Diffusion Strategies," Conceptual Strategies for Utilizing Research and Development Products in Education (Columbus, Ohio: The Center for Vocational Education, Ohio State University, 1971), pp. 2, 11, 18, 25; see also Joseph B. Giacquinta, "The Process of Organizational Change in Schools," Review of Research in Education, ed. Fred N. Kerlinger (Itasca, Ill.: F. E. Peacock Publishers, 1973), p. 179.

preferred application of the strategy. Significant metric cognitive and affective gains made by multipliers and experimental teachers over control teachers support the notion that a multiplier approach is an effective strategy for district metric inservice education.

A second function that the multiplier approach tended to serve in districts was its efficacy to provide an ad hoc organization structure. Organizational structure was described in the literature by Paul as coordination, hierarchical communication, specialization, and role clarity.[3] All districts in the study appointed a metric specialist to act in an ad hoc capacity at the district level to coordinate districtwide metric implementation plans, provide metric inservice education to multipliers, and coordinate and support teacher metric inservice education. All districts selected building level personnel to act as ad hoc metric multipliers. Roles and role expectations of specialists and multipliers were made explicitly clear in the written agreements between the districts and the Centre. Thus, each district created an ad hoc organizational structure which included staff specialization, hierarchical communications, coordination, and role clarity: elements that are considered important in the diffusion of innovations.

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[3]Douglas Paul, The Concept of Structure for Describing the Diffusion of an Innovation Through Interorganizational Linkages, U.S., Educational Resources Information Center, ERIC Document ED 102 706, April, 1975, p. 5.

A third function that the multiplier approach tended to serve in districts was its efficacy to provide an exponential growth in the number of organizational members trained. Data in the study indicated that eight district metric specialists provided metric inservice training to 103 multipliers. Seventy multipliers responding to the 1975-76 survey reported that they collectively provided inservice training to approximately 1,309 teachers, an average of 18.7 teachers each, during school year 1975-76. The potential of a multiplier effect to provide a critical mass of organizational participants in a relatively short time to generate what Bladridge called "a demand structure to facilitate innovation"[4] is apparent.

A fourth function that the multiplier approach tended to serve in districts was its efficacy to provide teacher inservice training keyed to local settings. McLaughlin indicated that workshops should be given by local personnel as opposed to outside sources.[5] Sarason explored the culture of the school and the problems of change. He described the modal way in which change is introduced and

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[4]J. Victor Bladridge, "Political and Structural Protection of Educational Innovations," What Do Research Findings Say About Getting Innovations Into Schools? A Symposium, eds. Sanford Temkin and Mary V. Brown, U.S., Educational Resources Information Center, ERIC Document ED 103 987, January, 1974, p. 45.

[5]Milbrey Wallin McLaughlin, Macro and Micro Implementation, U.S., Educational Resources Information Center, ERIC Document ED 118 477, May, 1975, p. 11.

effected in the school culture, the complex roles, the demands, the built-in conflicts, and the relationships of school personnel. He also discussed the importance of the principal in determining the fate of the change process and the variance in cultures among schools. He also expressed concern for meeting the differential needs of each school's culture during the change process.[6] In the study, the choice of building level representatives as multipliers was the preferred application of the multiplier approach. It was concluded that the choice of building level representatives as multipliers not only provides the capacity for inservice training to be keyed to local settings, but also implies that the change agent knows and understands the targets of change (e.g., principals, teachers, parents, and pupils) and their relationships.

Relative to characteristics of districts, Deal, Meyer, and Scott found that special administrative ratio, per pupil expenditure, and external funding related positively to innovation adoption and diffusion; while district size related negatively to innovation adoption and diffusion.[7] The current study described size of districts,

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[6]Seymour B. Sarason, The Culture of the School and the Problems of Changes (Boston: Allyn and Bacon, 1971), pp. 212-26.

[7]Terrence E. Deal, John W. Meyer, and W. Richard Scott, "Organizational Differences on Educational Innovation," Managing Change in Educational Organizations, eds. J. Victor Baldridge and Terrence E. Deal (Berkeley: McCutchan Publishing Corporation, 1975), pp. 111-12.

expenditures for instruction per ADA for districts based on their total budget and total ADA, and the external funding provided by the Regional Metric Resource Centre. The study also described the expenditures of districts for metric transition for each district. The findings of the study do not necessarily support those of Deal, Meyer, and Scott. While the findings do not deny the importance of district size, special administrative ratio, per pupil expenditure, and external funding to innovation adoption and diffusion, it was concluded that the multiplier approach and individual district commitments are factors that can override other characteristics of districts in the adoption and diffusion process for three reasons.

First, in spite of the fact that only three districts in the study had special personnel resources at the district level, the multiplier approach provided each district with an ad hoc special administrative ratio independent of district size or other factors. While these findings do not contradict that a special administrative ratio is important to innovation adoption and diffusion, they do indicate that a strategy can be used to create a special administrative ratio independent of district size and other district characteristics.

Second, findings in the study indicated that there was no relationship between districts' regular budget or normal expenditures for instruction per total ADA and their expenditures per pupil for metric transition. As an

example, District"H", the smallest of the districts with the smallest total district budget and the smallest expenditures for instruction per total ADA, provided the largest expenditures per pupil for metric transition over the two years the project was in operation. Districts treated metric transition as a special program, and their expenditures per pupil for metric transition tended to be more a function of their commitment to the program than a function of their normal budget expenditures for instruction per ADA.

Third, the external funding provided by the Regional Metric Resource Centre was the same for all districts independent of district size, special administrative ratio, or expenditures for instruction per ADA. External funding was intended and used by the Centre as seed money or as incentive for districts to participate in the Centre's program. While there may have been some advantage to smaller districts in the amount of external funding received, per pupil expenditures for metric transition, beyond that required by their agreement with the Centre, were unrelated to the external funding or to size of district and indicate a voluntary increase in commitment. Further, it is logical to assume that districts could self-initiate and self-implement metric transition independent of external funding if appropriate strategies and commitments are made at the initiation stage and implementation stage of the diffusion process as was indicated earlier in the discussion. It was concluded, therefore, that the two factors, multiplier

approach and district commitments, subsume or override district characteristics as factors in the adoption and diffusion process.

From the study, it was also concluded that the metric system is an innovation that is generally accepted by organizational members. Data indicated that districts' organizational members generally perceived the metric system as being better than the customary system of measurement (relative advantages); as being consistent with their existing values, past experiences, and needs (compatibility); and as being relatively easy to understand and use (complexity). Rogers and Shoemaker noted that such perceptions of an innovation facilitate its rate of adoption.[8] The metric system, however, was not generally perceived by district members as an innovation that could be tried or experimented with on a limited basis (trialability). Rogers and Shoemaker suggested that innovations that are divisible or can be tried on a limited basis will generally be adopted more rapidly than innovations that are not divisible. Thus, one attribute (trialability) of the metric system is negatively related to its rate of adoption, but this did not appear to be a critical factor when weighed against the positive attributes. District members were divided on their observation of the metric system in use (observability). Some felt

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[8]Everett M. Rogers and F. Floyd Shoemaker, Communications of Innovations: A Cross-Cultural Approach, 2d. ed. (New York: The Free Press, 1971), pp. 137-56.

the metric system was highly observable, while others did not. Rogers and Shoemaker defined observability as the "degree to which the results of an innovation are visible to others" and generalized that "the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption."[9] It was concluded that this attribute (observability) of the metric system had a neutral effect on its rate of adoption. Data indicated that there was a direct relationship between the level of organizational members' expertise or training and their perceptions of the various attributes. Multipliers were generally more positive toward those attributes of the metric system that facilitate its rate of adoption than experimental teachers, and experimental teachers were generally more positive toward those attributes of the metric system that facilitate its rate of adoption than control teachers. It was concluded that the attributes or characteristics of the metric system that facilitate its rate of adoption are generally more positively perceived by organizational members and that their positive perceptions can be improved through metric inservice education.

The study defined the implementation stage as the diffusion process internal to the school systems under study and

> . . . the process that, when successful, results in the alteration of organizational members' behavior and attitudes, so that they

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[9]Rogers and Shoemaker, pp. 155-56.

conform to the expectations of the innovation.[10] Data from the study indicated that there was a direct relationship between organizational members' training and their gains on cognitive and affective measures. Significant differences were found between posttest cognitive and affective scores of multipliers, experimental teachers, and control teachers. Multipliers' posttest scores were significantly greater than experimental teachers' posttest scores, and experimental teachers' posttest scores were significantly greater than control teachers' posttest scores. It was assumed that these differences were a result of differences in training. It was concluded that the multiplier approach is an effective inservice strategy to be employed in the metric education of local public school teachers.

Further, at the first, third, fourth, fifth, and sixth grade levels, multiplier pupils' and experimental teacher pupils' posttest scores were significantly greater than control teacher pupils' posttest scores. While there were no significant differences between groups at the kindergarten and second grade levels, the trend was evident: multiplier pupils and experimental teacher pupils made greater gains than did the control teacher pupils.

In summary, it was recognized that investigator

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[10]Joseph B. Giacquinta, "The Process of Organizational Change in Schools," Review of Research in Education, ed. Fred N. Kerlinger (Itasca, Ill.: F. E. Peacock Publishers, 1973), p. 197.

control in the selection and treatment of subjects was limited by the multiplier approach. It was assumed that specialists, multipliers, and teachers were diligent in carrying out the selection and treatment processes as prescribed by the investigator to the degree that the critical and essential aspects of selection and treatment were not lost. It was assumed that cognitive and affective changes in organizational members were a result of metric inservice education and instruction, that changes in multipliers were primarily a result of specialist' instruction, that changes in teachers were primarily a result of multipliers' instruction, and that changes in pupils were primarily a result of teachers' instruction. The investigator recognized that such changes may have occurred as a result of history, maturation, testing, biases of selection, instrumentation, statistical regression, experimental mortality, or combinations of such factors. It was assumed, however, that the quasi-experimental designs used in the study provided for reasonable control for such factors. It was concluded that a significant impact can be made in the metric cognitive and affective growth on teachers and the metric cognitive growth on pupils when: (1) strong district commitment to metric transition is made, (2) districtwide metric implementation plans are developed, (3) a multiplier approach to metric inservice training is used, (4) funds are provided for release of metric specialists and multipliers, (5) funds are provided for the

purchase or development of metric instructional materials, and (6) on-site staff support is provided for district metric program implementation.

IMPLICATIONS

Based upon the information gained from the study, the following implications and recommendations are presented for the profession and for further research.

Implications and Recommendations for the Profession

Data in the literature and in the study strongly indicated that school-based parent and community metric education programs are important components of metric transition in local public school districts. The findings implied that the elementary pupil belonged simultaneously to three general social structures that affect his or her metric learning. Figure 1 presents a paradigm of the three social structures: the school district, the home, and the community.

The paradigm implies that within each structure there are powerful forces and agents of change that affect the pupil's metric learning. Implications and recommendations relative to the school district structure and based on information gained in the study are proposed below. Implications and recommendations for the home and community structures lie beyond the scope of the study.

The school district in the paradigm relates to the

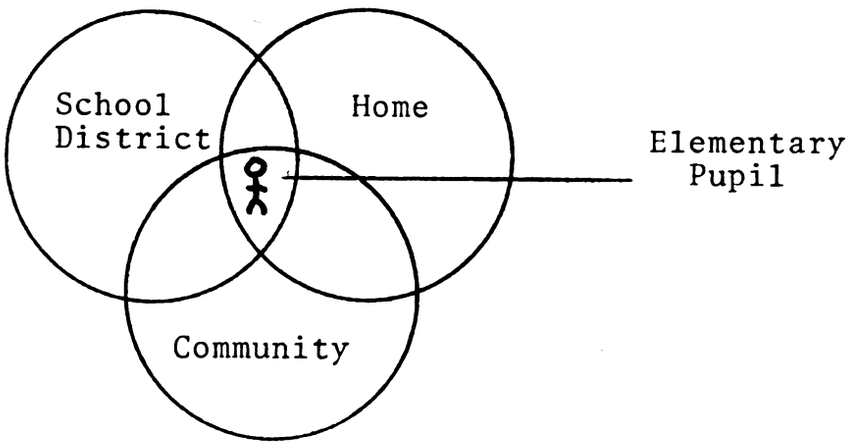

Figure 1

Three Social Structures Affecting Pupil
Metric Learning

formal learning environment of the pupil and, in this specific instance, refers to those elementary and unified districts responsible for the formal metric education of the K-6 pupil. A formal education system implies a need to identify what is to be learned by whom and what strategies, methods, and resources are needed to accomplish this. Data from the literature and from the study suggested important ingredients necessary for metric transition and metric education.

In school districts, the principal agent in affecting student change is the teacher. Teachers need metric inservice education and, in turn, teachers of teachers, team teachers, supervisors, coordinators, or other training cadre or intermediaries need updating or recurrent education in the SI metric system and the best known methods for teaching measurement to their specific learning audiences. Thus, staff development is an essential component of metric

transition in public school districts, and data support the notion that a multiplier approach is an effective strategy for providing staff development.

Besides staff development, there is the need to design, develop, and produce guidelines which include specifications indicating what is to be taught, by whom, to whom, when, where, and in what sequence or pattern. This is referred to as curriculum development and translates into scopes and sequences, instructional units, goals and objectives, courses of study, lesson plans, and activities. There is a need to adopt or develop metric curriculum for pupil instruction at each of the grade levels. There is also the need to develop curriculum for teacher inservice education, that is, to determine what knowledge and which skills and what attitudes are relevant and necessary for teacher metric inservice education. There is also the need to develop curriculum for the inservicing of teachers of teachers, that is, to determine what knowledge, skills, and attitudes intermediaries must have if they are to provide effective inservice programs.

There is the need to select or develop appropriate metric instructional materials to aid in the metric education of pupils, teachers, and teachers of teachers. This implies a need for commitment of funds and staff time for the review, analysis, purchase, or development of print, media, and manipulatives to aid instruction and learning.

Another ingredient in the metric transition process

that will be of concern to educators is evaluation. There are three areas of evaluation that may be of concern to most educators. As suggested above, there is materials evaluation. Educators may be called upon to establish criteria and guidelines for the evaluation and selection of instructional materials or, in the event of creating their own materials, providing some process for the validation of the materials they develop; to insure that these materials are appropriate or relevant for their specific learner audience. This again implies staff time and dollar commitments on the part of school districts.

Another kind of evaluation is process evaluation. Because metric education is a relatively new concept, there will be all the more pressure to evaluate programs, plans, strategies, or techniques--to see how things are working. There may be concern for measuring the diffusion rate, that is, for measuring the number of pupils and teachers who have received metric education--over time. This implies the need for planning and further commitment of funds and staff time.

Then, there is learner evaluation. Learner evaluation refers to the use of criterion referenced measures or achievement measures, whichever may be appropriate to a specific learner audience. Many educators may have a need, if not a mandate, to provide some kind of assessment of learner growth, mastery, or achievement. This implies the need for assessment and selection of appropriate instruments, district planning, and, again, a commitment of funds and

staff time.

Curriculum development, staff development, materials development or acquisition, and evaluation are not the only components of metric transition in public school districts. Metric transition in education will require financial support as has been suggested. Materials need to be purchased and staffs released for metric inservice training. District educators will be called upon to look for the redistribution of available funds or for developing strategies to find new sources of funding. Teachers and administrators will need to seek cost-beneficial ways to provide metric materials and metric inservice education. Some instructional materials can be locally developed, while others will have to be purchased. A multiplier strategy for metric inservice education has already been recommended as an efficient and effective strategy to staff development.

Metric transition will require time: time to hold the inservice, do the training, attend the meetings, provide the instruction, develop the materials, monitor and manage the program, and assess the learning. This requirement will raise questions as to where the time will come from when staff is already overburdened with responsibilities and when staff time is becoming more and more a negotiable matter. The need for time implies greater personal commitment and district commitment of funds for release time.

Data in the literature implied that commitment itself was an ingredient of metric transition; commitment is

implied in every component listed above. Questions will rise from districts' organizational members. How does one overcome institutional or organization inertia, sway the reluctant and unaware decision-maker, overcome the schisms brought about by territorial imperatives, or overcome the pervasive resistance to change, which appear to be a manifestation of change itself? Change may be perceived as a function of commitment, and it is suggested that individual personal commitment to metric transition can provide example, leadership, and initiative in soliciting commitment from others. Administrative commitment is essential.

Still other ingredients are required for the diffusion of metric education; and they are leadership, planning, organization, and coordination. Data from the study indicated that leadership and planning should be accomplished at the initiation stage and that the multiplier strategy is an effective vehicle for obtaining organization and coordination.

In summary, based upon the information gained from the study, the following recommendations are presented for the profession:

1. Metric transition in local public elementary schools is a change phenomenon and should be treated as a process of the diffusion and adoption of the metric system of measurement.

2. Strong administrative commitments should be made at the initiation stage.

3. Metric transition in local public school districts should include programs for teacher, parent, and community metric education.

4. A multiplier strategy should be used for teacher metric inservice education.

5. Regional metric resource centers initiating metric transition in local public school districts should include a written agreement between the center and the local districts at the initiation stage. An agreement should include provisions for:

a. District selection of a district metric specialist or coordinator.

b. Appointment of a district metric liaison administrator.

c. Development of districtwide metric implementation plans.

d. Seed money as an incentive.

e. District funds for implementation.

f. A multiplier strategy for teacher metric inservice education.

g. A support system for on-site multiplier and teacher training.

h. Evaluation plans to assess multiplier, teacher, and pupil metric mastery.

6. District organizational members attempting to initiate metric transition within local public school districts should seek school board approval at the

initiation stage to authorize the superintendent to:

a. Appoint a district metric specialist or coordinator to develop districtwide implementation plans in cooperation with an appointed district administrator.

b. Provide a definite allocation of funds for staff release time to carry out a multiplier approach; for the purchase and/or development of metric instructional materials; for providing on-site staff development support; and for providing evaluation of multiplier, teacher, and pupil metric achievement or mastery.

7. Multipliers should be building-level representatives and be released to receive an average of 14 hours of metric inservice education.

8. Teachers should be provided with an average of five hours of metric inservice education.

9. Metric inservice education for multipliers and teachers should include instruction to develop an awareness level of the metric system in the early hours of instruction, followed by a hands-on experience approach in the latter hours.

10. Metric education for pupils should include hands-on experience activities.

Implications and Recommendations for Further Research

The following suggestions are made for further research:

1. Studies should be conducted relative to the

interfaces between the home and the school district. The suggested paradigm (Figure 1) implies the need to understand something about each social structure, the relationships between structures, and how those relationships may affect both metric transition in local school districts and pupil metric learning. The metric literature suggested that the elementary school may have an expanded role in adult education during the metric transition process. Some questions that might be asked are: What is the role of the elementary school in providing direct metric instruction to parents? What effects do school-based parent metric education programs have on pupil metric learning and on parent-school relations? Does a metric environment or absence of a metric environment in the home affect pupil metric learning?

2. Studies should be conducted relative to the interface between the community and the school district. Some questions that might be asked are: What effects do differential rates of metric transition in the community and the school district have on pupil metric learning? What role can mass media play in reinforcing school metric learning? What is the elementary teacher's role in community metric transition?

3. Studies should also be conducted relative to the initiation and implementation of educational innovations and collective bargaining. The suggested paradigm for metric transition in local public school districts raises new and yet undefined areas and issues for public employee

collective bargaining. While the study indicated that the multiplier approach is a feasible and effective approach to staff development, it also raises potential negotiable issues relative to employee and administrative commitments, roles and role expectations, time, workload, and staff evaluation, to name but a few. The emergence of public employee collective bargaining implies a new factor in the adoption and diffusion process of educational innovations--a negotiation factor--suggesting a need for further research.

CONCLUDING REMARKS

A national transition to a new system of measurement is a unique and universal change phenomenon that lacks precedents in the United States. Its universality stems from the pervasive use of weights and measures throughout society. It affects the social, political, economic, and psychological orientations of our society and transcends all disciplines. Transition to the metric system of measurement offers scholars a unique area of study.

The investigator feels that other educational innovations can be implemented in a like manner with the paradigm used in the study. It is hoped that the reader will benefit from the experiences in this study and will be able to adapt the model to their unique setting.

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APPENDICES

APPENDIX A

METRIC EDUCATION AGREEMENT

METRIC EDUCATION AGREEMENT

THIS AGREEMENT is entered into as of the date of the last signature hereto by and between the Superintendent of Schools, Department of Education, San Diego County, hereinafter called the "Department," and the _____ School District, hereinafter called the "District."

I. REASON FOR AGREEMENT:

WHEREAS, the Superintendent of Schools, Department of Education, San Diego County, has been awarded a Title III, ESEA project known as Metric Education in San Diego County and further identified by the number 1601, and hereinafter called the "Project"; and

WHEREAS, the Project is designed to assist a specified number of school districts in developing and implementing district plans for student, teacher, and community metric education, and a support system for carrying out those plans during fiscal years 1974-75, 1975-76, and 1976-77; and

WHEREAS, selection of those districts will be based partly upon the Project evaluation design and partly upon the degree of interest and commitment demonstrated by districts seeking to participate during the life of the Project; and

WHEREAS, demonstration of district commitments and selection of participants will be based upon a written agreement between the Department and the

District,

NOW THEREFORE, the District and the Department agree as follows:

II. THE DISTRICT SHALL:

1. Appoint at least one (1) certificated person as a District metric "specialist" for each of the three years beginning with school year 1974-75.

2. Authorize this "specialist" to participate in a 40-hour training session for the purposes of developing District K through 6 metric implementation and inservice plans in fiscal year 1974-75. The District also agrees to release the "specialist" for an additional 40 hours in each of the subsequent project years for the purposes of being trained or training others. Training will be held inside San Diego County, but may be held outside of the District. Any costs for travel are to be assumed by the District.

3. Appoint a District Administrator to jointly review and critique the above plans with the metric "specialist" and Project staff for purposes of making recommendations to the District Superintendent and/or District Board for implementation with students during the school years 1975-76 and 1976-77.

4. Authorize the metric "specialist," in cooperation with the District Administrator, to identify and select at least six (6) teachers (K-6) each year who may act as metric inservice "multipliers."

5. Release each of the above identified teacher "multipliers" to:

   A. attend a 4-hour orientation during their first year of participation;

   B. attend 28 hours of instruction and hold a 4-hour (1/2 day) orientation for at least three classroom teachers during their second year of participation;

   C. train at least three (3) classroom teachers for a minimum of 16 hours during their third year of participation. "Multiplier" training will be held within San Diego County, but may be held outside of the District. Teachers' training will be held in the District. Any costs for travel to be assumed by the District.

6. Provide classroom instructional materials in support of trained classroom personnel each project year with reimbursement by the Department as specified in Section III.

7. Provide the Project with opportunities for administering pre- and post-measurement instruments according to the Project Evaluation Design for purposes of State Project Evaluation and developmental field testing of instruments.

8. The District shall continue its participation and commitments through years 1974-75 - 1976-77.

III. THE DEPARTMENT SHALL:

1. Provide 40 hours of training and staff support to the District metric "specialist" each year of the project for the purpose of developing and implementing inservice plans for grades K-6.

2. Provide Project staff for purposes of jointly reviewing and critiquing implementation and inservice plans with District Administrators.

3. Reimburse the District at the established district rate for employing substitute teachers as required to provide released time for "specialists," "multipliers," and teachers each project year as specified in Section II.

4. Reimburse the District for 100% of the costs for classroom instructional materials in school year 1974-75: 25% of the costs for classroom instructional materials in school year 1975-76.

5. The Project will provide a mobile resource unit for on-site support of district inservice and/or community programs for each year, Fiscal Year 1975-76 and 1976-77.

6. The Project will provide the District with all Project evaluation information, reports, and findings for Fiscal Year 1975-76 and Fiscal Year

1976-77.

IV. GENERAL PROVISIONS:

1. Net reimbursements as authorized shall be effected through transfer between the County School Service Fund and the District on or before June 30 of each year, or upon termination of Project and upon receipt of certified statements of actual expenditures and approval by the Department. Financial transactions shall be in accordance with the provisions of Attachment "A".

2. This agreement is contingent upon continued approval of the ESEA Title III Project #1601, Metric Education in San Diego County.

3. The period of this agreement shall be for the years of 1974-75, 1975-76, and 1976-77. Amendments or termination of this agreement may be made by mutual approval.

_____ School District	Superintendent of Schools Department of Education San Diego County
By: _____	By: _____
Title: _____	M. TED DIXON SUPERINTENDENT OF SCHOOLS
Authorized by the Governing Board on:	Authorized by the Governing Board on:
_____	_____

METRIC EDUCATION AGREEMENT

ATTACHMENT "A"

	1974-75		1975-76		1976-77	
	DEPARTMENT	DISTRICT	DEPARTMENT	DISTRICT	DEPARTMENT	DISTRICT
Materials' Cost	$350	$ 0	$ 300	$900	$ 0	$1,200
Release Time Expense	$455*	$ 0	$1,715*	$ 0	$2,345*	$ 0
Subtotal	$805	$ 0	$2,015	$900	$2,345	$1,200
TOTAL	$805		$2,915		$3,545	

*Amounts authorized are maximum. Costs will be reimbursed upon receipt and approval of certified statements of actual costs.

APPENDIX B

SPECIFICATIONS FOR DISTRICT PLANS FOR METRIC EDUCATION

SPECIFICATIONS FOR DISTRICT PLANS FOR METRIC EDUCATION

The following information is an attempt to provide some guidelines and standards for the development of district metric implementation and inservice plans. Project staff is available to provide assistance in the development of these plans at mutually agreed upon times and places. Please feel free to ask for their assitance.

GENERAL HEURISTICS AND EXPECTATIONS

1. The plans should: (a) meet the needs of the district, (b) be unique to the organizational and staffing patterns of the district, and (c) provide for the requirements of the Title III project.

2. The district implementation and inservice plans should be mutually beneficial to both the district and the project.

3. It is intended that the district specialist develop districtwide implementation plans; that multipliers develop building and/or teacher implementation and inservice plans; and teachers develop classroom or lesson implementation plans.

4. Plans should be revised each year to reflect adaptations or changes, and include the plans of multipliers and teachers so that by the end of the project, the district plan may be used as a model to another district of like characteristics.

DISTRICT PLAN SPECIFICATIONS

I. Needs and Rationale (Completed in 1974-75)

A statement of needs relevant to metric education and metric implementation

II. District Statistical Analysis (Completed in 1974-75)

A. Vital Statistics

B. District Personnel Resources

C. District Organizational Patterns

1. Number of schools, classrooms, teachers, etc.

D. Description of Student Population

1. General

2. Achievement levels

3. Racial and ethnic distribution

4. Social and economic information

III. Description of General Implementation Plan (Completed in 1974-75)

A. Describe strategy or implementation model to effectively train all district teachers (K-6) as efficiently and effectively as possible. Determine who is to be trained, when, where, and over what period of time.

B. Identify names and/or numbers of schools, multipliers, and teachers to be trained during each school year to effect total K-6 student instruction.

C. Describe minimum materials resources and costs required for effective pupil instruction (e.g.,

per classroom, per school, per pupil, and/or teacher--whichever best describes need). This should be the basis for predicting optimum (cost beneficial) materials support required to implement plan, when, where, and how used.

D. Describe personnel resources needed for implementation of district plans, e.g., release time of specialists, multipliers, teachers, etc. Determine hours of required training for multipliers and teachers, and how this is to be handled given the district organizational and staffing patterns and materials resources and commitments available.

E. Describe use or need of project staff and/or mobile metric support system (van)--when, where, and how, or other project or district support needs.

IV. Specialist Plans for Inservicing Multipliers (Completed 1974-75)

A. Describe audience: multipliers--their school, grade level, and additional district teachers.

B. Provide schedule of multiplier inservice: number and duration of meetings, when and where to be held, etc.

C. Develop inservice content to include:

1. Entry conditions: assess audience present or current knowledge and attitudinal level

2. Objectives: (skills, knowledge, and attitudes

by audience)

3. Strategies: include hands-on experience activities and strategies for parent and/or community involvement
4. Outcomes and Products: (outcomes by audience and Building Implementation Plan)
5. Evaluation: describe measures to be applied and how evaluation data are to be used (include pre/posttest data)

D. Materials needs, media, resources, and other support services related to IV, C, 3 above

V. Multiplier Plans for Inservicing Teachers (Completed 1975-76)

A. Describe audience: school, grade level, number of students.

B. Provide schedule for inservice of teachers: number and duration of meetings, when, and where to be held.

C. Develop inservice content to include:

1. Entry conditions: assess audience present or current knowledge and attitudinal level
2. Objectives: (including parent component, materials analysis, community component)
3. Strategies: include hands-on activities and all activities for training teachers
4. Outcomes and products: (skills, attitudes, knowledge, teacher classroom plans, parent

materials, and materials recommendations)

5. Evaluation: describe measures to be applied and how evaluation data are to be used (include pre/posttest data)

D. Materials needs, media, resources, and other support services related to V, C, 3 above

VI. Teacher/Classroom Plan for Teaching Students, Parents, and Community (Completed 1975-76)

A. Describe audience: pupil, parent, school, grade level, teacher, class list, age, and sex of children.

B. Provide schedule for instruction: approximate time and duration of instruction; over what period of time.

C. Develop classroom content to include:

1. Entry conditions: assess audience present or current knowledge and attitudinal level

2. Objectives: (skills, knowledge, and attitudes where applicable)

3. Strategies: (include strategies for any student, parent, or community education)

VII. Recommendations (Completed 1976-77)

A. Brief comments regarding those elements of the plan that were essential to success of the plan, areas of special success, innovative, serendipitous, or exemplary happenings that were particularly successful

B. Problem areas in implementation: what one should do differently or give special attention due to difficulties of implementation

C. Materials recommendations

D. Success, failures, or importance of parent and/or community education or awareness

E. Explicit recommendations for materials development, acquisition, and distribution by grade level and kind

APPENDIX C

MULTIPLIER'S METRIC INSTRUCTIONAL PLAN

METRIC EDUCATION IN SAN DIEGO COUNTY
AN ESEA TITLE III PROJECT

MULTIPLIER'S METRIC INSTRUCTIONAL PLAN

_____ _____ _____
(Name) (School) (Date)

_____
(District)

Inservice date(s) for staff:_____

Time of meeting(s):_____

Number of staff to be involved:_____

Names of staff to be involved (include grade level):_____

_____

_____

How did you choose the teachers with whom you'll be working?

_____

Where will inservice be held?_____

What knowledges/skills do you expect staff to gain from your instruction?_____

_____

What strategies will you use in teaching?_____

_____

What materials or resources will you use?_____

_____

_____

How are you going to evaluate teacher's learning progress?

_____

_____

APPENDIX D

SPECIALIST/MULTIPLIER METRIC ACTIVITY RECORD

SPECIALIST/MULTIPLIER METRIC ACTIVITY RECORD

The Metric Activity Record sheet should be completed and sent to the Metric Centre after each activity. Include the date, kind of activity, materials used, and approximate length of the activity. Indicate the kind of audience and check the rating scale. Have participants sign an attendance list and attach one copy to this form.

(NAME) Last First

(SCHOOL)

(DISTRICT)

RATING SCALE*				
1	2	3	4	5

Kind of Audience

☐ Community ☐ Administrator

☐ Teacher ☐ Other (explain)_____

Date	Kinds of Activities	Materials Used	Duration

*Use the Rating Scale (5 = most successful to 1 = least successful) for personal evaluation of the described activity(ies).