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ABSTRACT

The Oregon System in Mathematics Education (OSME) was a five-year "systems experiment" to improve matkematics education cn a statewide basis. The major purposes cf this present study were to determine the effectiveness and impact of OSME and a "systems" approach and to address questions of future replicability. The evaluation focused on three broad concerns: (1) to what extent did NSF funding of CSME result in an effective systems mcdel for achieving program improvement on a statewide basis?; (2) what was the impact of OSME on teachers and students?; and (3) what prcject elements had the greatest potential for transportability? The conclusions include: (1) OSME was a successful program improvement effort; and (2) the factors that made it work include its openness, inclusiveness, flexibility, and trust in prcject participants. (MP)

Final Report

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AN EVALUATION OF THE OREGON SYSTEM IN MATHEMATICS EDUCATION

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OCTOBER 15, 1978

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As with many summative studies of large scale projects, an underlying intent of the Capla Evaluation was to provide a Janusian view that looked ahead to future issues while looking back to assess the Project's accomplishments. This required the insights of many individuals who provided the varying perspectives needed to interpret the meaning and implications of the study findings.

First, a Review Panel of individuals with relevant and varying expertise made significant contributions to the study by providing methodological recommendations, report reactions, and interpretive conclusions. Their responsive participation was greatly appreciated.

The OSME staff and representatives of the National Science Foundation also provided ongoing reactive comment to clarify various findings. We are particularly grateful to Dr. Eugene Maier and Mr. Don Rasmussen from OSME; and Dr. David Churchman, Dr. Alphonse Buccino, Dr. Conrad Katzenmeyer, and Dr. Charles Wallace of NSF for their prompt and informative reactions.

The editing and production of the final manuscript involved the efforts of many Capla staff members. Ms. Jane Bundy and Ms. Adrianne Squeo deserve special recognition for their dedication.

Finally, our appreciation must be extended to all the teachers, administrators, and students in Oregon who cooperated in various data collection activities. It was their responses that enabled us to unfold the accomplishments and implications of OSME.

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REPORT SUMMARY

PURPOSE OF THE STUDY

The Oregon System in Mathematics Education (OSME) was funded by the National Science Foundation (NSF) as a five year "systems experiment" to improve mathematics education on a statewide basis. Over that five year period, the Project created a delivery system for upgrading teacher skills at the elementary, secondary, and preservice levels. This was accomplished through a variety of activities which were organized and coordinated through existing agencies and institutions.

As the Project drew to a close, many questions of impact and transportability needed to be resolved. On October 1, 1977, Capla Associates, Inc. was awarded a contract by NSF to conduct a summative third party evaluation of OSME. The major purposes of the study were to determine the effectiveness and impact of OSME and a "systems" approach and to address questions of future replicability. The Capla Evaluation thus focused on three broad concerns:

- To what extent did NSF funding of OSME result in an effective systems model for achieving program improvement on a statewide basis?
- What was the impact of OSME on teachers and students?
- What Project elements had the greatest potential for transportability?

THEORETICAL FRAMEWORK

To study these areas of concern, Capla conducted a systems-based evaluation. The theoretical framework that was used consisted of evaluation stages which could be directly related to the properties of a system as follows.

Stages	Properties
Design:	The conceptual definition of a system .Philosophy .Goals
Structure:	The input elements of a system .Agencies, institutions, and components which form the system boundaries .Role definitions and interrelationships
Operations:	The process elements of a system .Activities .Procedures (granting/local problem identification & monitoring) .Rewards and Sanctions .Communication
Impact:	The output elements of a system .Effects upon participants

METHODOLOGY

Data Collection Procedures

To gather information related to the above system properties, the research design incorporated several data collection methods and procedures, and relied upon the principles of replication and convergent validity. In all cases, the Evaluators made maximum use of available documents, logs, records and evaluation reports. Additional information was collected where necessary to expand upon the existing data, fill in information gaps, clarify discrepancies, and validate previously gathered information.

Data was gathered through five major activities. Document/record review, interviews and a system questionnaire were used to assess OSME system properties related to the design, structure and operation. A teacher survey and a student survey provided data on OSME's effect upon students and teachers.

Data Sources

The data sources for viewing OSME as a system included 184 OSME system members who were identified as having had a major participatory role in the Project. The pool included the OSME central staff, members of participating agencies, workshop leaders, local project directors and consultants. All system members received the System Questionnaire (70% response) and 20% of them were interviewed (N = 36).

Data sources for determining OSME impact included 293 teachers and 521 students. The sampling design for assessing OSME's effect upon teachers and students was influenced by two factors: the difficulty of finding a true control group, and the inability to randomly sample. Because of these factors, the Evaluators limited the study to districts where there had been extensive OSME activity. High-involvement schools and low-involvement schools within these districts were selected and all teachers and fourth grade students within these schools were sampled.

To create a comparison group, the Teacher Survey included participation variables to classify teachers along a continuum of project system involvement. Students were classified based upon the degree of their teacher's involvement. The sampling inference was thus not to generalize to the entire population, but to look at OSME's "best chances." It was assumed that within this framework, the more exposed teachers (and their students) would demonstrate improved attitudes and skills related to mathematics education.

Findings and Conclusions

The Capla Study revealed the following:

System Effectiveness

- OSME did indeed achieve the "systems" approach to program improvement envisioned by NSF -- "an effort to sharpen the focus of state and local government and private agencies, now engaged in educational activities more or less independently, to deal with the mathematics needs of a region or state." Almost every major agency and institution in the state involved with mathematics education played a role in the Project. Moreover, in terms of the stronger criteria of "systemness" imposed in the Capla study, the results produced impressive evidence of OSME's effectiveness. The goals of the system were understood and valued by system members. Structural relationships were broad and well integrated. Although evidential data on the effects of individual projects were not gathered systematically during the course of the Project, there was concrete evidence that change was effected within Oregon educational agencies through participation in OSME activities. Furthermore, there was evidence of institutionalization of some of these changes: At the SEA level, as a result of involvement with OSME, the role of the Mathematics Specialist changed from that of a direct consultant to a facilitator and resource linker. Mathematics professional organizations in Oregon flourished as a result of support and influence. At the LEA level, elementary resource centers funded by OSME were maintained, and the Project's "circuit rider" programs were continued through local support in Harney, Lake, and Eugene counties. Higher education institutions were also influenced. OSME methods were adopted in the pre-service training programs at all major schools of education in the state, and these institutions are maintaining the instructional resource centers initiated through OSME funding.

- Certain features appeared to be essential to the success of OSME and might be termed the System's strengths. These were:

    - A consensus-based philosophical orientation toward program improvement which was exemplified by the developmental problem-solving approach to learning;

- A sanctioning organization which integrated OSME with the state leadership in mathematics education--the Oregon Mathematics Education Council. This might be considered a device for sustaining an operational level of consensus.

- A leadership team and staff committed to: (a) advocacy of the philosophical orientation; (b) confidence in local professionals, and (c) a general posture of stimulation and support rather than specification and control.

- An inclusive program approach, with activities spanning elementary through collegiate levels and involving all concerned state agencies.

- An overall change strategy which did not impose programs or solutions, but sought to accept individuals and agencies as they were and support their growth through various avenues of Project participation.

- Procedures which were consonant with the emphasis on stimulation and support: (a) a proactive staff traveling throughout the state to stimulate interest in the Project; (b) a personalized granting process which minimized red tape and was designed to help rather than judge submitters of proposals; (c) a flexible financing structure; and, (d) an informal reward system.

- One feature of the system which could be construed as its major weakness was a lack of formal documentation and monitoring procedures combined with an internal evaluation component which was not well integrated with system activities. This resulted in little written documentation of Project activities. Thus, there is much that will never be known about projects that were implemented at the local level, and it was virtually impossible in the summative phase of the Project to determine the real impact of OSME on teacher behavior in the state.

However, it must be noted that the nature of how systems operate complicates the process of classifying characteristics as either strengths or weaknesses. Elements are integrated within a system and manipulations to remedy an apparent weakness might provoke unanticipated consequences in other areas. It is not at all obvious that if OSME had remedied its most visable weakness in evaluation, documentation, and monitoring procedures, it could still have retained its flexibility, responsiveness, informality and confidence in local professionals. The components of a dissemination/training system such as OSME are probably best viewed as a series of trade-offs rather than a list of strengths and weaknesses. The low level of OSME functioning in evaluation and monitoring may have been necessary to the maintenance of other positive system features.

Participant Involvement

- The level of teacher involvement stimulated by Project activities was remarkably high. For example, OSME's varied component projects reached an estimated 61% of Oregon's elementary teachers and an estimated 71% of its secondary teachers. Moreover, active system members expressed uniformily positive perceptions of and satisfaction with OSME programs and activities.

Teacher and Student Impact

- Available evidence did not support the contention of impact by OSME on either the classroom behavior of teachers or on the attitudes of students toward mathematics except in the area of computer use. However, this conclusion must be examined in light of certain factors. The dearth of summative impact data cannot be interpreted as a totally negative judgment of the Project's efforts in Oregon. As mentioned earlier, there is much that can never be determined about OSME's impact on teachers and students because of weaknesses in the internal monitoring and evaluation procedures. Also, in light of the large numbers of teachers that had been reached by OSME, it is not definite that the OSME and the non-OSME comparison teacher groups in the current study were substantially different in terms of their exposure of OSME. The fact that some teachers had not participated directly in OSME projects does not rule out strong contamination factors. It is also important to note that the absence of pre-post measurements obviated the possibility of establishing changes in the behavior of OSME teachers. The comparison of post-treatment findings for OSME and non-OSME teachers does not of itself attest to the fact that gains had not occurred in the OSME group as a result of participation. In terms of student impact, this outcome was not overtly specified by OSME as a direct consequence to be expected from the Project. Since direct student results had not been built into the Project design, OSME cannot be judged a failure in this respect.

Transportability

- Many factors complicate an assessment of OSME's potential for transportability to other states. These include: the state's past program improvement efforts in mathematics; the configuration of education organizations and agencies within states; and, the size and complexity of states. Thus, in terms of replication, it is more meaningful to conjecture about the features of OSME which seem worthy of future exploration and experimentation in other states. These are:

- Few change agencies have adopted the posture that educational agencies and individuals have self-improvement agendas of their own, and that supporting their ideas and programs will cumulate efforts. This posture deserves further exploration.

- OSME balanced a sense of direction against overdirectedness. Perhaps this was achieved by avoiding a traditional needs survey and concentrating instead on establishing goals consensus. This approach merits further use as an alternative goal-setting process in large scale projects.

- The concept that grants can be viewed as mutually developed performance contracts, and that the role of the change agent is to stimulate, foster, and refine rather than judge ideas, is worthy of further study.

- Although OSME's philosophical orientation placed some broad boundaries on participation, the Project's success can be traced to its inclusiveness. This approach is certainly worthy of replication. All educational agencies within the State were encouraged to participate in the program, and no one organization dominated or constrained others by such processes as approval or sanction.

- OSME achieved communication among professionals across agency lines at a level that is rarely discovered in the evaluation of program improvement efforts. This seems to have been achieved by avoiding the error of compelling individuals and agencies to submit joint projects or to work together. Again the concept of allowing agencies and agents to work at their own program improvement efforts may be the best way to foster interagency communication.

In conclusion, the overall impression of the Evaluation staff and Review Panel of the Capla Study is that OSME was a successful program improvement effort. What made it work seems to have been its openness, inclusiveness, flexibility, and trust in Project participants. Those very features provoke an anomaly for most funding agencies which are required to demonstrate accountability, prudence, and solid evidence of effectiveness. We may have to learn slowly from the incomplete documentation of many OSME-like programs, that effective change systems rely on less stringent management structures than have been considered tolerable in the past.

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INTRODUCTION

The Context for the Project

The National Science Foundation's Role in Education

For the past quarter century the National Science Foundation has played a major role in ensuring the capability of science to serve as a vital resource to the Nation. Created in 1950, NSF was organized in the wake of the technological advances of World War II. These technological successes had impressed upon the Nation the importance of science to the well-being of the country. Within this context, NSF was charged with improving the potential of science in the areas of research and education.

NSF's initial efforts in education were concerned with improving science teaching at the college level. These efforts were barely underway however, when the launching of Sputnik shocked the United States into actions to acquire and maintain scientific and technological superiority over the Soviet Union.

A variety of federally supported programs emerged from this era. At NSF, one response was to increase the budget for improving high school science teaching (natural science, physical sciences, physics, chemistry, mathematics, biology, botany, and the social sciences). While NSF had already shown concern for this level of science education, a Congressional mandate solidified the precedent for the Foundation's subsequent involvement in precollege science education efforts. By 1960, NSF's budget for the improvement of high school teaching was over $35 million, and in 1972, Congress amended the National Science Foundation Act of 1950 to give NSF responsibility for research and development in science education at all levels. (Library of Congress Report, 1976).

Early NSF strategies in this area were organized around the concept of training institutes that were offered primarily to secondary level teachers during the summer and academic year. The general goals of these institutes were to broaden the mathematics and science knowledge base of teachers as well as sharpen their methodological insights and skills. However, Higher Education Institutions were given considerable latitude in formulating the content and methodology of particular institute programs.

This reflected an administrative policy at NSF which respected local initiative in running institute programs. While these institute programs were well received by secondary teachers, it soon became evident to the Foundation that the goal of improving science at the high school level was seriously impeded by the poor quality of science education at the elementary level. NSF was then faced with the complex problem of dealing with an enormous target population of educators. Their response was to sponsor more broad based institutes:

> Eventually the Foundation began to support institutes that would (1) teach administrators about available choices for new and improved curricula, (2) train selected teachers in a school or district in a curriculum to be tested, and (3) then instruct teachers in a school or district to teach other teachers to use the new curriculum. In addition, the Foundation expanded its program to support development of new and improved curricula for instruction at all levels.
> (Library of Congress Report, 1976, p.15)

These institutes created unprecedented linkages and communication between graduate school research faculties and those who taught at the lower levels. In fact, some of the top research scientists in the Country turned their attention to the needs of science education at the elementary level.

As with many other programs that released federal dollars to agencies and institutions to promote change and improvement, the NSF Institute efforts underwent sharp scrutiny in the late 1960's. With little solid data to justify the teacher institutes in terms of impact on science education in the schools, NSF began to question the wisdom of this approach and explored alternative funding strategies.

The Comprehensive Grant Program of 1969 was one alternative which integrated NSF projects within a single institution into a single proposal with a unified financial commitment. It was hoped that this approach would lead to better coordination and more innovative program offerings. By the beginning of the 1970's, neither the Comprehensive Grant Programs nor the training institutes were considered to be effective strategies by NSF. However, they had provided the groundwork for what became a major new thrust for NSF: an experimental statewide systems approach.

The "systems" approach as defined by NSF was to be developed as "an effort to sharpen the focus of state and local government and private agencies, now engaged in educational activities more or less independently, to deal with the mathematics (or science) needs of a region or state." Within this context, a 'system' was defined as 'an integrated group of interacting agencies designed to carry out cooperatively a predetermined function." Two statewide systems were funded in this approach: The Oregon System in Mathematics Education (OSME), and the Delaware Model System in Science Education.

The Oregon System in Mathematics Education -- Background

NSF funding of the systems approach to mathematics education in Oregon evolved out of an intensive history of institute activity in the State. Essentially, the systems concept provided a means for converting the State's extensive network of institute programs into a unified systems project.

Oregon formally accepted the systems concept at an NSF supported conference in the fall of 1970. This conference was attended by a broad representation of individuals associated with Statewide activities in mathematics education. In 1971, at a second conference at Salem, Oregon, a governance group, the Oregon Mathematics Education Council (OMEC) was created. It consisted of 18 representatives from various organizations and institutions concerned with mathematics education in the State. Dr. Eugene Maier was appointed Director and charged with preparing the systems grant proposal which initiated Project funding in 1972.

Over a five year period, the Oregon Project created a delivery system for upgrading teacher skills at the elementary, secondary, and preservice levels. It did this through a variety of activities organized and coordinated through existing institutions and agencies: school districts, the State Department of Education, the Oregon Council of Teachers of Mathematics (OCTM), and Oregon's colleges and universities. It was designed to generate ideas from within the educational system that it served, rather than to impose programs upon that system. Emphasis was placed upon personal contact, a responsive management structure, minimum bureaucratic red tape, and a grass roots problem-solving approach to identify needs and fashion solutions. It was hoped that these approaches would result in a flexible service delivery system that would focus sharply on both the needs and talents of its users.

Focus of the Evaluation

Over a five year period ending in 1977, approximately 3.8 million dollars had been provided to OSME by the National Science Foundation. This brought the Oregon system's experiment to a point where its effectiveness, along many variables, needed to be examined by NSF to resolve questions of impact and transportability. Thus, NSF saw the need to conduct a summative third party evaluation of the Project that would have three major objectives: (1) to validate information previously collected; (2) to collect additional information; and (3) to provide an authoritative judgment on the value of a systems approach and its impact.

On October 1, 1977, Capla Associates, Inc., was awarded the contract by NSF to conduct this evaluation. In accordance with the RFP, the Capla study would address the following broad areas of concern:

1. What was the background for the "systems" approach in Oregon?

2. How was OSME designed in terms of its philosophy and goals?

3. What was the system's structure?

4. How did the system operate?

5. What evaluative judgments could be made about the design, structure, and operations of OSME?

6. What was the impact of OSME Elementary Programs upon teachers and students?

7. What was the impact of the OSME "Math for the Uninvolved" programs upon teachers?

8. What was the impact of OSME Computer Education programs upon teachers?

9. What Project elements had the greatest potential for transportability?

10. What were the overall implications for future systems planning and implementation efforts?

A Systems Perspective

To study these broad areas of concern the Evaluators based their approach upon the premise that the Project should be viewed and evaluated in terms of its properties and accomplishments as a system. System properties which were relevant to the concerns of the study are described below.

Systems Properties

Over the past decade, general systems theory has emerged as a broad framework of thinking. It has helped to explain a wide range of phenomena in the organizational structures which constitute a society. These structures are considered to be permanent systems, and consist of a set of components organized to accomplish the purposes for which the system exists.

Permanent systems vary in size and complexity. Schools, for example, exist as systems with interdependent parts or subsystems. Likewise, national networks of interrelated agencies may also be viewed as systems.

Within the network of agencies, institutions, organizations, and groups which function as the permanent systems of a society, a large number of temporary structures exist. These temporary systems operate within and between the permanent organizations. From the start, their members operate on the basic assumption that at a clearly defined point in time, the system will cease to exist. Moreover, as many writers point out, the central purpose of most temporary systems is to bring about the changes in persons, groups, and organizations that are so difficult to achieve in permanent systems. (Miles, 1964; Argyris, 1970; Rogers, 1962; Abbott, 1969).

Temporary systems have the same properties or elements as permanent systems. However, as described below, unique features characterize how these properties are actualized in temporary systems.

System Properties	Features in a Temporary System
Philosophy and Goals	The intents of a temporary system are sharply focused. Goals are specifically defined and philosophical attitudes bind members together toward a commonly understood purpose.
Boundaries	In most temporary systems, the classes of individuals or agencies who may enter the system for its limited life are quite clear. Very often a high degree of self-selection takes place which minimizes conflict and increases future goal focus.
Role Definition and Socialization	Temporary systems can free participants from their usual role conflicts and provide them with the freedom to experiment. This leads to the possibility of role redefinition for them as a result of their tenure within the temporary system.
Communication and Power	Communication is generally encouraged in temporary systems, and a common language with special meanings tends to grow among participants. New channels of communication develop between people whose roles in permanent systems kept them apart. There are strong tendencies for information sharing, openness, and trust. As a result, equal status relationships tend to occur. Since there is a tendency toward egalitarian notions, a single person's influence can be substantial. Moreover, productive work does not usually occur until the power structure is clear.
Activities and Procedures	Activities and procedures have high importance for achieving the goals of the temporary system. The procedures (management/monitoring) within a temporary system are usually structured to provide an environment which meets personal needs and reduces defensiveness, thus releasing the potential for activities to be carried out with creativity and innovation.

System Properties	Features in a Temporary System
Rewards and Sanctions	The rewards and sanctions which govern behavior in a temporary system may be specific or very general. However, participants tend to internalize them and value them. Typical norms for temporary systems emphasize equal-status relationships, openness and trust, problem-solving and innovation.
Impact of Change	Temporary systems are organized to produce change. Some system outputs involve changes in ongoing aspects of people's knowledge, attitudes, or behavior. Others can significantly alter the quality of pre-existing relationships among system members; finally, other outputs of temporary systems may involve future actions on the operations of permanent organizations.

The Oregon System in Mathematics Education, inasmuch as it was defined as an "integrated group of interacting agencies working cooperatively to carry out a predetermined function" for a defined period of time, represents a temporary system. The evaluation of OSME presented in this report thus gives attention to its conceptual definition, its unique features and evolution as a temporary system, and the major accomplishments of its five years of existence.

EVALUATION DESIGN

Two features central to the quality and usefulness of an evaluation effort are: a) the soundness and explicitness of a theoretical framework which guides the research; and b) the comprehensiveness of a research design which systematizes data collection procedures, data analysis, and related methodological issues. The systems-based approach used to study OSME, therefore, incorporated both a conceptual framework and a research design tied to NSF's broad areas of concern.

Theoretical Framework

Given the scope of issues to be addressed and the need for a systems orientation, the Evaluator's initial task was to provide a relevant theoretical perspective for organizing the study. The framework that was developed consisted of evaluation stages that could be directly related to the properties of a system. These relationships are depicted in Figure 1, and are described below.

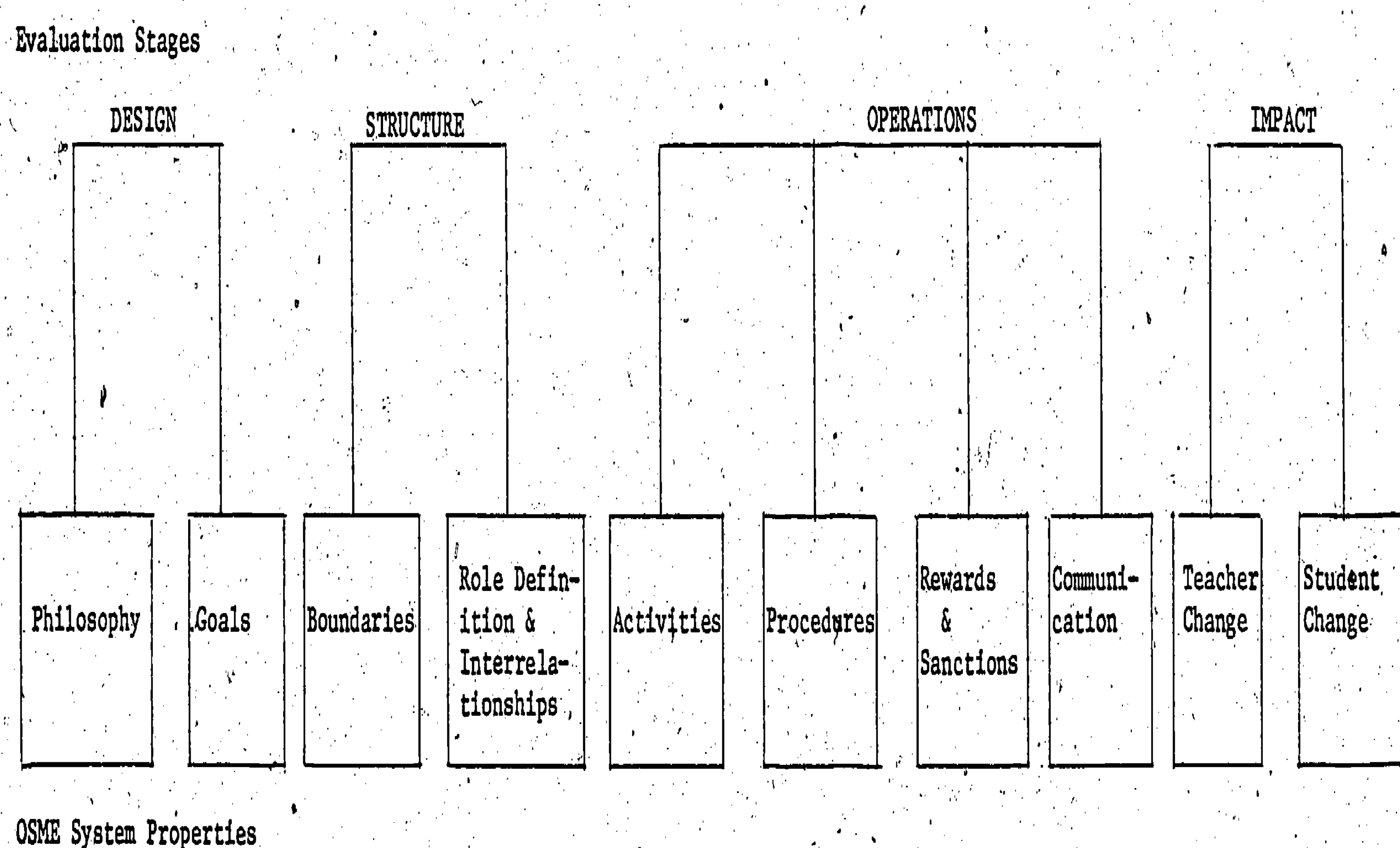
Stages	Properties
Design:	The conceptual definition of a system . Philosophy . Goals
Structure:	The input elements of a system .Agencies, institutions, and components which form the System boundaries .Role definitions and interrelationships
Operations:	The process elements of a system .Activities .Procedures (granting/local problem identification and monitoring) .Rewards and Sanctions .Communication
Impact:	The output elements of a system .Effects upon participants

Research Design

The research design relied on the principles of replication and convergent validity, incorporating several data collection methods and procedures to obtain information related to the concerns of the National Science Foundation. Essentially, the thrust was two-fold: a) to validate previously existing data; and b) to provide an authoritative judgment regarding Project impact.

Figure 1

THEORETICAL FRAMEWORK FOR OSME EVALUATION



In all cases, the Evaluators made maximum use of available documents, Project logs, records, and previous evaluation reports. Additional information was also collected to expand upon the existing data base where there were gaps or discrepancies, and to validate the previously gathered information.

Data was gathered through five major activities:

1. Document/Record Review and Informal Interview
2. Follow-Through Interview
3. System Questionnaire
4. Teacher Survey
5. Student Survey

Figure 2 summarizes how the data collection activities relate to the areas of concern addressed in the evaluation. The activities are described in detail in the sections of this report which deal with OSME As A System and the Impact of OSME.

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Figure 2: FOCUS OF EVALUATION AND DATA COLLECTION PLAN

FOCUS	METHODS OF DATA COLLECTION: Document Review & Informal Interviews	Follow-Through Interviews	System Questionnaire	Teacher Survey	Student Survey
System					
nd: The historical context of em.	X				
pecifications of OSME in terms criteria as goals and operational hy.	X	X	X		
e of OSME in terms of agencies, ions, and component parts as well unctions of each.	X	X	X		
nal characteristics of OSME in such criteria as communication and monitoring procedures, re- d sanctions, component activities.	X	X	X		
OSME					
ry Education attitudes toward teaching tics om practices lum development attitudes				X	X

Figure 2: FOCUS OF EVALUATION AND DATA COLLECTION PLAN Continued

FOCUS	METHODS OF DATA COLLECTION: Document Review & Informal Interviews	Follow-Through Interviews	System Question-naire	Teacher Survey	Student Survey
the Uninvolved				X	
attitudes toward teaching ics					
n practices					
Education				X	
attitudes toward teaching education					
n practices using the					

ORGANIZATION OF THE REPORT

The report has three major sections. Section I is concerned with OSME as a system and deals with questions related to the Project's design, structure and operations. Section II addresses OSME's impact on teachers and students. Within each of these sections are presented the study's data collection activities, the context for evaluating specific variables, the results and a discussion of the results. Finally, Section III presents the study conclusions.

SECTION 1

OSME AS A SYSTEM

DATA COLLECTION ACTIVITIES

Three major data collection activities were conducted to assess OSME as a system: Document/Record Review and Informal Interview, Follow-Through Interview, and a System Questionnaire. These activities are described here in terms of purpose, sample, instrumentation, procedures, and analysis.

Document/Record Review and Informal Interviews

Purpose

The purpose of the Document/Record Review and Informal Interview Analysis was:

- To respond to the NSF mandate to validate existing data;
- To establish a comprehensive and reality based data bank for constructing the system questionnaire and attitude surveys;
- To set the stage for subsequent data collection activities by identifying areas where information was inconsistent, unclear, or lacking; and
- To provide a descriptive account of system properties related to Design, Structure, and Operations, which would "feed-in" to further data collection activities as well as the final report.

Document Review Materials Acquisition and Procedure

Document/record review entailed the coding and analysis of the existing Project data base. This data base included Project proposals, general publications, evaluation reports, flyers and brochures, conference reports, component project reports, and correspondence. This material was released to the Evaluators by the National Science Foundation and by the OSME staff.

Informal Interviews Sample and Procedure

Informal discussions were conducted with 22 individuals associated with OSME during an October 1977 visit to Project sites in Portland, Salem, and Eugene, Oregon. Individuals were selected on the basis of their extensive involvement in Project activities and included members of the OSME staff, recipients of OSME grants, advisors to the Project, and OSME workshop leaders.

No formal interview schedules were used during the discussions. However, the Evaluators focused the discussions on the Project's history, major purposes, organization, major strategies, key actors, and perceived successes and problems. Where discussions were held in confined areas such as classrooms or offices, they were tape-recorded with the consent of the respondent. Twelve meetings with fifteen individuals were tape recorded. These discussions and the Evaluator's taped notes and impressions were then content analyzed.

Content Analysis

All document and interview transcriptions were content analyzed using coding categories associated with the following system properties:

DESIGN	Philosophy Goals
STRUCTURE	Boundaries: Agencies, Institutions and Components Roles and Interrelationships
OPERATIONS	Project Activities Procedures (Granting/local problem identification and monitoring) Rewards and Sanctions Communication

The unit of analysis was the declarative sentence and enumeration was in the form of frequency counts.

Two coders were involved in the analyses; each was given eight hours of training prior to coding. Interrater reliability using a kappa coefficient (Cohen, 1960) was found to be .93.

Follow-Through Interview

Purpose

Follow-through interviews were conducted to verify the data obtained from the initial onsite discussions and the document review. The information was used to describe system properties related to Design, Structure and Operations.

Sample

Since a major focus of the interviews was to verify preliminary findings and to clarify areas where information was unclear or lacking, the sample was restricted to those who were thoroughly familiar with the OSME Project. This included the Project Director, Component Project Directors, and workshop leaders from areas in which there was extensive OSME activity--Portland, Salem, Eugene, Albany, Medford, Lebanon, Ashland, and Klamath Falls. A total of 16 individuals were interviewed.

Procedure

The follow-through interviews took place during an onsite visit in March, 1978. No formal interview schedules were used. However, the Evaluators focused discussions on the issues raised by the existing data base regarding aspects of OSME Design, Structure, and Operations. All discussions were tape-recorded with the consent of the respondents; the transcriptions were then content analyzed using the schema described in the previous section.

System Questionnaire

Purpose

The System Questionnaire was designed to provide a comprehensive assessment of OSME system properties. Specific areas addressed included: 1) goal clarity, acceptance, appropriateness, and achievment; b) functions of agencies and system members; c) monitoring procedures; d) rewards and sanctions; and e) satisfaction with system activities. In addition, the Questionnaire probed the quality and intensity of the communication network established by OSME.

Sample

The System Questionnaire was sent to all available OSME members who were identified as having played a major participatory role in the Project (N = 184).[1] The pool included OSME central staff members, members of the Oregon Mathematics Education Council (OMEC) and other advising agencies, workshop leaders, individual project directors, and participating consultants, still living in Oregon. The individuals were identified through preliminary onsite interviews with Project staff and through Project proposals and mailing lists.

Of the 184 system members sent the questionnaire, 130 or 70 percent responded. A categorization of the respondents according to position/job title is found in Table 1.

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[1]Note: Originally 216 system members were identified, but 32 either relocated or died. Thus, at the time of measurement, 184 system members existed.

TABLE 1

NUMBER AND PERCENTAGE OF SYSTEM

MEMBER RESPONDENTS BY JOB TITLE

(N = 130)

Job Titles	N	Relative %
. OSME Staff	5	3.8
. School Administrators	12	9.2
. Elementary Teacher	19	14.6
. Middle School Teacher	10	7.7
. High School Teacher	17	13.1
. College Faculty	33	25.4
. Other	33	25.4
. Missing	1	0.8
TOTAL	130	100.0

Note: The job titles for the intended population were not known. Hence nonrespondent data could not be included in Table 1.

Instrument Development

Several procedures were undertaken in the construction of the System Questionnaire.

First, the Evaluators content analyzed a variety of OSME documents and transcripts of onsite interviews to generate the precise language for the instrument, as well as to frame questions in terms relevant to OSME program efforts.

Second, a draft version of the Questionnaire was submitted to the Evaluation Review Panel for comments and suggestions; revisions were incorporated through group consensus.

Third, the revised instrument was pilot tested with a sample of OSME respondents (N=8) to determine appropriateness of language and content as well as response time; and,

Finally, the instrument was submitted to the Office of Management and Budget (OMB) for approval; certain changes were made as a result of OMB suggestions.

The approved version of the System Questionnaire (OMB Approval #99-S78006) consists of several scales as follows:

1. Network Analysis -- This was the primary scaling methodology used to evaluate structure. The analysis required individuals to specify the frequency of their communication with other system members related to three topics:
   a. OSME Approaches
   b. OSME Operations
   c. Non-OSME/OMEC Professional Discussions

2. Activity Satisfaction Scales -- These scales were developed during the previous evaluation of the OSME system by Stufflebeam and Bunda. The scales consisted of eight 5 point Likert-type items. Each item required respondents to indicate how much the OSME program affected them. The items are listed below.

a. The activities in which I participated responded to my professional needs.

b. I have been able to utilize the ideas presented in the project(s) in my work.

c. The activities in which I participated met my expectations.

d. I would welcome the opportunity to participate in additional similar activities.

e. I would recommend the same experience to a colleague.

f. Participation in the project(s) has led to a change in my teaching/administrative style.

g. Participation in the project(s) has led to expanded communication with other professionals.

h. Noticeable changes have occurred in my students because of my involvement with the project(s).

A factor analysis performed on the scale items revealed that all items loaded on a single factor. Thus, they were treated as if they were measuring a common underlying dimension, i.e., the degree to which OSME activities were seen as having affected the professional life of respondents. Factor loadings and inter-item correlations for these scale items are found in Tables A and B, respectively, in Appendix A.

3. Participation Variables -- Participation variables were simply binary choices as to whether or not a respondent received one or more of the rewards available to OSME system members. Scales are listed below:

a. Did you ever receive a fee or honorarium when you conducted workshops or inservice courses?

b. As a result of your OSME activities, did you ever attend an out-of-state convention?

c. If yes, what percent of your expenses were ever paid by OSME?

d. Did you ever make a formal presentation at an out-of-state convention (e.g., led a workshop)?

e. Did you ever have an opportunity to speak before a group as a result of OSME-related activities?

f. Did your participation in OSME provide you with an opportunity to publish your thoughts or views?

g. Did you ever receive financial support from OSME or OMEC?

h. Do you provide leadership in mathematics education at your job or local district?

i. Do you annually upgrade and/or change program material you use in providing service to your students?

As described earlier, the selected items resulted from a content analysis of OSME documents including the proposals, reports, correspondence, etc. The items were verified by comparing them to opportunities for rewards described by interview respondents.

4. Other scales included in the questionnaire described system process and strategies. These were:

a. Goals -- a rank ordering of twelve goals both in terms of the importance for the OSME system and the importance for the individual respondent.

b. Goal Attainment -- a listing of respondents' first, second, and third choices as the goals which came closest to being attained.

c. Goal Failure -- an analysis of listed goals which respondents felt were not attained.

d. Groups and Agencies -- a listing of OSME/OMEC related organizations. This is a measure of the penetration of OSME personnel into a wide variety of statewide educational agencies.

e. Communication Methods -- a ranking of frequency and preference for six communication media. These scales were designed to provide an understanding of how information flowed around the system.

f. Monitoring -- a number of times a respondent had a project monitored, and the methods employed.

g. Finally, a small amount of descriptive data were gathered. These included positions, education level, and number of workshops conducted.

Procedure

OSME members were sent the Questionnaire in April 1978. Twenty days after the initial mailing 111 (60%) of the members returned the Questionnaires. Follow-up letters were then sent to the 73 nonrespondents. Based upon the letters, an additional 19 individuals returned the surveys. Since the initial mailing and follow-up letters produced the desired response rate (i.e., 70%) for accurately estimating the population response, no further follow-up procedures were utilized.

Analysis and Synthesis

A variety of statistical procedures were used to analyze System Questionnaire data including frequency distributions, measures of central tendency, correlational measures, chi square, and analysis of variance. Network Analysis data were analyzed using an advanced network algorithm. This procedure allows for the classification of individuals into informal structural roles, identification of opinion leadership, and influence, and the structural graphing of the system. In short, analysis enables the examination of a system as a whole in terms of the communication among its members.

SYSTEM DESIGN

Design refers to the conceptual definition of a system in terms of its philosophy and goals. These provide the control mechanisms which should guide system structure, operations, and ultimate impact. In temporary systems such as OSME, design is especially important as it lends credibility and focus to activities, and binds system members in a commonly understood purpose.

PHILOSOPHY

Context

A system's philosophy is the foundation of values and beliefs which serve to orient the actions of system members. Essentially, these beliefs provide important perspectives for operationalizing the system. Whether a system is rigidly structured or flexible, whether trust or control prevails, and whether communication is open or closed can be considered aspects of its philosophical orientation. The orientation which motivated OSME efforts to improve mathematics education was clearly set forth in Project literature.

Results

Philosophically, OSME was designed to generate program ideas from within the educational system it served, rather than to impose programs upon that system. Emphasis was placed upon personal contact, responsive management, and minimum bureaucratic red tape. The following beliefs were illustrative of the Project's philosophy:

- mutual respect for one another in the mathematics educational community should guide efforts toward improvement
- a cooperative and coordinated effort achieved through personal contact with educators throughout the state is fundamental to improving mathematics education on a statewide basis
- it is more important to identify people with ideas rather than to develop procedures for reviewing proposals
- a rapid response to local needs requires a minimization of bureaucratic red tape
- flexibility should characterize the development and coordination of various OSME projects
- the most effective solutions to solving local district problems are those which are developed at the local level by the people who must implement them

- direct personal contact, trust, open communication, and cooperative relationships with individuals expressing a need are the best approaches to funding and monitoring projects
- teachers should be provided with opportunities to grow professionally in order to become leaders of their peers.

Concisely, the OSME philosophy can be characterized as personalized, grass roots, flexible, responsive, and humanistic. More importantly, as will be described in subsequent sections of this report, OSME represented a rare instance where a Project actually operationalized philosophical beliefs.

GOALS

Context

For a temporary system to function effectively, certain quality indicators related to its goals should be evident. Goals should be reasonably clear, and acceptable to system members since ambiguity and diffuseness diminish effectiveness and impede change (Halpin, 1962, Miles, 1969; and Sieber, 1968). They should be appropriate and achievable, (Miles, 1969), credible in terms of the expert evidence that supports their value, and relevant to the solution of persistent concerns, (Rogers, 1962; Glaser, 1973). Information related to OSME goals was determined through document review, onsite interviews, and questionnaire.

Results

The development of OSME's goals can be traced through a series of events which involved a broad sampling of individuals representing every aspect of mathematics education in Oregon. During the planning stages of the "system experiment," no formal Statewide needs assessment for mathematics education was available. To close this gap in the planning process, NSF provided the impetus for two Statewide conferences which were held in 1970 and 1971. Participants included educators from all areas of the state, public school administrators, curriculum supervisors, and mathematics teachers, as well as college and university professors of mathematics and mathematics education.

During intensive work sessions at the two conferences, the participants defined the future thrust of the Project through a series of need statements and possible solutions. Their recommendations consistently emphasized the need to upgrade teacher knowledge and skills through locally-based inservice opportunities, improved preservice training, workshops, and conferences which would reach teachers in every corner of the State. Improving Statewide communication among mathematics educators was cited as a primary need, as well as providing direct assistance to local districts. The need statements and recommendations developed by the Oregon mathematics community at these conferences were the basis of the goal statements found in OSME proposals and other documents.

Table 2 lists the overall goal statements revealed in the OSME documents as well as interviews with key members of the Project system. They have been paraphrased to reflect information obtained from these sources.

TABLE 2

OVERALL OSME GOALS OBTAINED FROM

DOCUMENT AND INTERVIEW ANALYSIS

Goals[a]
. To improve mathematics education in the State of Oregon
. To improve teacher attitudes toward mathematics by creating awareness of alternative teaching methods
. To develop mathematics education leaders
. To develop illustrative mathematics programs in elementary and secondary schools
. To improve communication about mathematics education among educators and various organizations
. To strengthen and assist professional organizations
. To improve student attitudes toward mathematics
. To improve student performance in mathematics

[a]Goals are listed in rank order according to frequency of citation.

OSME documents also revealed a set of sub-goals which were extensions of the overall goals and provided a focus for subsystem (component) activity. These goals contributed to a broader definition of the Project's purpose; they are presented in Table 3.

Given the fact that goals provide the definitions for a system's intents, the statements in Tables 2 and 3 reveal several important factors:

. OSME can be classified as service oriented rather than research, development or diffusion based;

TABLE 3

OSME COMPONENT GOALS - OBTAINED FROM DOCUMENT AND INTERVIEW ANALYSIS

Elementary In-Service

- To improve elementary mathematics programs in schools
- To broaden elementary teachers' concept of mathematics
- To increase teacher awareness of more varied teaching strategies
- To enhance the identification and development of "math enthusiasts"

Leadership

- To develop modes and/or personnel for providing leadership in mathematics education
- To help bridge the communication gap that traditionally separates elementary and secondary teachers

Secondary and College Curricula

- To change the philosophy and methodology of secondary teachers who teach general mathematics courses (math for the uninvolved)
- To develop a network of interrelated mathematics resource centers
- To identify mathematical needs and objectives for vocational and technical training programs
- To develop teaching strategies and curricula as possible alternatives to the usual lecture courses in algebra and trigonometry

Computer Science Education Projects

- To improve the instructional use of computers
- To broaden students' knowledge regarding computers (computer literacy)
- To provide coordination for planning and development of computer-related education programs
- To maintain communication among those involved in computer activities in the state
- To establish curricular guidelines for computer education
- To compile comparative data for various alternatives for obtaining computer services

Communications

- To collect, classify, and store data for the State Department of Education
- To distribute publications regarding OSME activities
- To conduct conferences on topics concerning mathematics education

- OSME focused on the strengthening of teacher skills at all levels, with primary emphasis at the elementary level;

- OSME represented a system orientation with respect to its emphasis upon communication as well as agency linkage throughout the State;

- OSME did not emphasize a direct impact upon student cognitive skills, but reference was made to changes in teacher and student attitudes toward mathematics as a result of system efforts.

While broad goal statements lend purpose and credibility to a project's activities, their true value lies in the meaning they convey to those individuals affected by the activities. Therefore, it is important to determine the congruency between a project's stated goals and how people perceive and value those goals.

The Evaluators examined this relationship in OSME through the Systems Questionnaire in which 130 respondents were asked to rank 11 goal statements in terms of their importance to OSME and in terms of their importance to themselves. (The goal statements listed in the questionnaire were based upon documents and interview data.)

The results of the rankings based upon mean responses are found in Table 4.

As can be seen, there was high congruency between how system members valued the various goals and their perceptions of OSME's emphasis upon the goals. A Spearman rho yielded a reliability coefficient of .93. Moreover, there was congruency between the highest ranked goals and those which had been cited most frequently in Project documents. Thus, system members also perceived OSME as a service-oriented Project which emphasized the improvement of elementary mathematics and the development of mathematics leaders in the State.

However, a significant finding is that while OSME documents and the OSME central staff did not emphasize the improvement of student cognitive skills as a direct result of the Project, the majority of system members cited this goal as being important to OSME as well as to themselves.

System members were also asked to indicate which goals they felt came closest to being attained, and which goals OSME failed to attain. Regarding attained goals, the following were most frequently cited:

- Develop mathematics education leaders

- Improve teacher attitudes toward mathematics

- Improve elementary mathematics education

- Improve communication among mathematics educators and various organizations

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This finding is significant in that the goals the system members felt had been achieved by OSME were also those goals which had been ranked highest in importance.

Less than one-third of the respondents felt that OSME had failed to achieve any of the goals. However, there was little agreement within this group as to which goals were not achieved.

TABLE 4

SYSTEM MEMBERS PERCEPTIONS OF OSME GOALS RANK ORDERED ACCORDING TO IMPORTANCE TO OSME AND IMPORTANCE TO "ME"

(N = 130)

Goals	Ranks[a] Important To OSME	Important To "Me"
. Improve elementary mathematics education	1	3
. Improve teacher attitudes towards mathematics	2	2
. Develop mathematics education leaders	3	5
. Improve student attitudes toward mathematics	4	1
. Improve student performance in mathematics	5	4
. Improve communication among mathematics educators and various organizations	6	7
. Improve secondary mathematics education	7	6
. Develop illustrative mathematics programs	8	8
. Build and strengthen professional organizations in mathematics education	9	10
. Improve the instructional use of computers in the schools	10	9
. Strengthen and assist professional organizations	11	11
. Other	12	12

[a]The final ranks were based upon mean responses of participants.

SYSTEM STRUCTURE

Structure refers to those dimensions of a system which define participants as well as the nature of participation. Specific properties to examine within structure include: a) boundaries which delineate the classes of individuals or agencies who will enter the system; and b) roles which define the specific functions of participants and their interactions. Structural properties are especially noteworthy. They are potentially transportable to other states and represent working relationships that may affect a project long after the termination of funding.

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BOUNDARIES AND ROLES

Context

The literature on systems and organizations cites a number of factors which should be examined when judging structural effectiveness. Integration is one such factor. Blau and Scott (1960), and Thompson (1961), among others, contend that for systems to work properly, there must be integration. That is, system members must associate with the structural parts, and the parts must relate to the whole.

Degrees of formality or informality are also considered important criteria in assessing system structure. Many of the findings in this arena suggest that looser, flexible, and open structures tend to make systems more effective (Thompson, 1965; Abbott, 1969; Bell, 1969; Bennis, 1971). Another factor related to structure is the distribution of influence. Strauss (1969) and Miles (1969) write that in healthy organizations, the distribution of power must be recognized and accepted by members so that productive work can occur and conflicts can be avoided.

In systems which are specifically concerned with innovation and change, several authors cite the influence of personality characteristics. Such writers as Havelock (1969), Sieber (1972), Glaser (1973), and Hall and Alford, (1976), emphasize the importance of the personal qualities associated with leaders who direct change efforts. Qualities which they link to effectiveness include:

- competence - perceived expertise and reliability of professional credentials
- autonomy - is self-directed
- reputation - previous history of success
- trustworthiness - perceived sensitivity to needs and interests of others
- integrity - displays a concern for justice
- openness - ability to communicate in an open, straightforward and candid manner
- compatibility - displays social behaviors appropriate to the system

Information related to the OSME structure was obtained primarily through document review and interviews, although certain data was gathered via the System Questionnaire.

Results

The structure of OSME involved the cooperative interaction of a group of agencies. OSME's general organization is shown in Figure 3.

ECC, OMEC, and OMSI

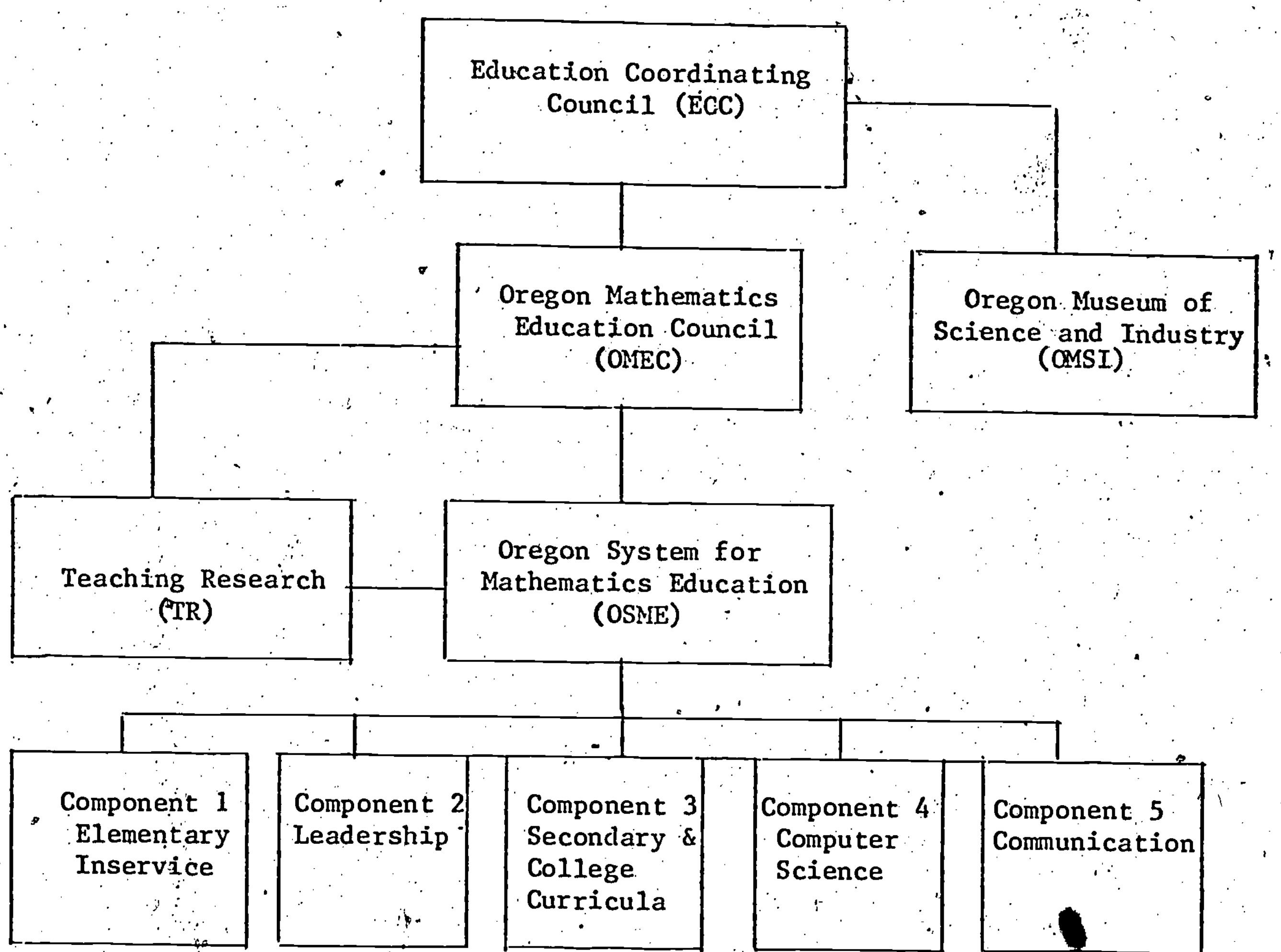
The Education Coordinating Council (ECC), the grant recipient for the Project, was a statutory body established by the Oregon state legislature to coordinate all educational activities in the state. ECC functioned only as the recipient of NSF funds, perfunctorily approving the Project proposal each year. Formal control for the Project was assumed by a governance group created at the outset of the Project, the Oregon Mathematics Education Council (OMEC).

OMEC functioned as the coordinating, policy-making agency for the system. It consisted of 18 representatives from various organizations and institutions concerned with mathematics education in the State, as well as three ex-officio members. The functions of OMEC were well defined in early Project documents. OMEC was to: set the goals of the system, establish operational policies and procedures, assist in developing program proposals, approve all funded projects (except in the case of small amounts wherein the OMEC Executive Committee, or the System Director could approve funding without advice from the total group); act as an advisory committee to ECC; and, select a system Director and staff to operate the Project.

While ECC was the grantee, the Projects' fiscal administration was performed by the Oregon Museum of Science and Industry, (OMSI), under subcontract to OMEC. There were several considerations that resulted in the selection of OMSI as fiscal agent. Overhead rates associated with universities, as well as possible negative perceptions of elementary teachers toward a university-administered project were felt to be major disadvantages regarding a university role as fiscal agent for the system. Regulatory practices of the State Education Department were also viewed as disadvantages which would complicate the Project in fiscal administration. OMSI was an existing agency in Oregon with a history of funding success and fiscal responsibility. These factors, in addition to a minimal service charge and its neutral position relative to both public and private educational institutions in the State, contributed to its selection as the agency which held and disbursed project funds.

Figure 3

AN ORGANIZATIONAL CHART OF OSME



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OSME and OMEC

The project was administered by a central OSME staff who reported directly to OMEC. This staff consisted of a System Director, two Associate Directors, an Assistant Director for the computer component of the system, and a public relations specialist.

This central staff's major responsibilities were to carry out policy, develop Program proposals for submission to OMEC, prepare and submit funding proposals, coordinate various component Project activities, authorize the expenditure of grant funds according to grant terms, and select component directors in conjunction with OMEC.

> Onsite discussions with 38 individuals who had functioned in a variety of ways within the Project system provided many insights about the leadership qualities of the Project staff. From respondent reactions, the following characteristics emerged which provide a profile of the leadership within OSME.
>
> - highly competent and respected
> - self-directed and strong
> - concerned with the needs and interests of those who were served
> - supportive of the creative efforts of system participants
> - flexible
> - trustworthy
> - open and friendly

While these characteristics elicited very positive reactions from most of those interviewed, other evidence indicated that the system was not without conflict. Project documents, evaluation reports, and interview transcripts revealed that tensions emerged between the central Project staff and certain members of OMEC as the Project progressed. These problems seemed to be a direct result of the gradual erosion of OMEC's decision-making power as a total group, and the concomitant increase in the roles which OMEC's Executive Committee and the OSME staff played in decision-making related to project funding.

The personal interaction of OSME staff members with individuals developing proposals at the local level led to situations where OSME staff members acted as Project advocates in the review process. This resulted in a reduction of OMEC's role to one of concurrence. OSME thus changed from a proactive decision-making body at the inception of the Project, to a reactive group which provided approval and support.

Teaching Research and Evaluation

Teaching Research (TR), an agency of the Oregon State System of Higher Education, functioned as the internal, but independent, evaluation agent for the Project. Its role was to: 1) provide ongoing evaluative information regarding how OSME functioned as a system; 2) conduct studies to assess impact in pertinent areas of interest; 3) provide direct assistance to local projects in evaluating their objectives, and; 4) provide assistance to the OSME staff in data interpretation. While these were the functions intended for TR, a retrospective view of the relationship between TR and OSME revealed that as the Project progressed, the evaluation component became less and less integrated into the mainstream of Project activities.

Project documents and the interview transcripts alluded to dissatisfaction on the part of NSF, OSME, and TR itself regarding TR's role in Project evaluation. At the outset, NSF had not specified the key questions they wanted answered as a result of the "system experiment." There was thus no mandate from the funding source to dictate the course of the internal evaluation.

OSME was equally nonspecific with respect to the types of data they hoped to obtain from evaluation efforts. Moreover, OSME neither established systematic internal documentation procedures, nor requested evaluation designs as a requirement of local project funding.

TR operated at a level of utmost flexibility at the outset of the Project, and could have influenced the course of data collection tremendously. However, TR neither developed rigorous evaluation designs, nor appeared to be successful in convincing OSME of the value and the need for systematic data collection. TR did visit many projects throughout the state, and attended a wide range of project activities for which descriptive accounts were provided. In this sense, it genuinely sought to meet general types of evaluation needs. However, its attempts to provide technical assistance to local projects in evaluating their objectives were often met with resistance.

By mid-Project, NSF was expressing dissatisfaction with the evaluation studies conducted by TR. Also a formative evaluation of the project conducted by the Evaluation Center of Western Michigan University, criticized TR's lack of concise methodology.

TR responded to mid-project requests by NSF for impact studies. By June 1978, it had completed four impact studies related to the effects of OSME on teachers and students.

Component Clusters

For management purposes, projects funded through the system were clustered into a component structure, each having a Director and reflecting broad areas of emphasis. These components included: Elementary Inservice Projects, Leadership Projects, Secondary and College Curricula, Computer Science Education Projects, and Communications.

Briefly, the elementary inservice projects involved college credit workshops as well as subgrants to local school districts aimed at strengthening teachers' knowledge and skills. The Leadership component trained individuals to become workshop leaders and resource persons and also provided math specialists to certain schools in remote areas (Circuit Riders). In the Secondary and College Curricula component, inservice activities were provided to secondary teachers for teaching math to the "uninvolved" preservice programs for prospective mathematics teachers were redesigned, and mathematics resource centers were established at colleges and universities. Computer Science Education projects provided workshop opportunities to increase teachers' computer literacy and motivate the instructional use of computers. The project's Communicatons component coordinated various publications activities, and generally functioned to strengthen information linkages among math educators in the state.

Linkages with Other Agencies

In addition to the relationships created through the internal structure of the system, OSME established important linkages with other agencies in Oregon which were concerned with mathematics education. Pertinent aspects of these linkages are discussed below.

The State Department of Education. For all of the disciplines, the common pattern at the Oregon State Department of Education was to provide one specialist and some type of statewide general assistance, coordination, and supervision. Historically, this resulted in very thin coverage for mathematics education from a state department perspective.

OSME provided a means for greatly extending services to mathematics educators throughout the state; recognizing this, the State Mathematics Specialist worked closely with the Project Staff. Cooperative activities included conferences, workshops, technical assistance to local projects, and the development of a Mathematics Guide which was published by the State Department. As a result of involvement with OSME, the role of the State Mathematics Specialist changed from that of a direct consultant to a facilitator and resource linker. That is, rather than functioning as a workshop consultant for a very small part of the potential universe of clients in Oregon, the Math Specialist began to directly help districts identify needs and to subsequently link the districts to mathematics leaders in the State who could meet those needs.

The Oregon Council of Teachers of Mathematics (OCTM). OCTM was established as a professional organization to increase communication among mathematics educators in Oregon. OCTM and OSME mutually benefitted from their association over the course of the Project. Interviews indicated that OCTM membership increased, especially with elementary teachers. However, in subsequent inquiries, the evaluators were unable to determine the extent of the membership increase due to the lack of record keeping. OSME also supported OCTM in terms of administrative funding. On the other hand, OCTM publications and activities provided visibility for OSME projects and heightened awareness of the problems the projects were seeking to address.

The Oregon Council for Computer Education (OCCE). Established on a small scale basis prior to OSME funding, OCCE provided leadership, planning, and information dissemination functions for computer science educators in the state. OSME funding support for administrative and publication costs helped to promote an increase in the organization's membership from less than 25 members to approximately 250 members.

Teachers of Teachers of Mathematics (TOTOM). TOTOM was established as an organization to link the efforts of all community colleges, colleges, and universities, both public and private, in Oregon that were involved with teacher preparation in mathematics. It came into existence through planning conferences cooperatively sponsored by OSME and the State Department of Education. The group become self-sustaining through support from the participating institutions. Its major activities were to sponsor conferences and develop position papers.

Colleges and Universities. While OSME did not seek specific commitments from institutions of higher education, all major colleges and universities in the state were active within the project system in some way. These institutional roles included sponsoring inservice workshops for teachers and establishing resource centers containing a variety of hands-on activities and materials.

System Members

The distribution of positions among OSME system members was presented earlier in Table 1. The Table indicated that members held a variety of positions including OSME staff members, school district administrators and teachers, and college faculty members.

Since one of the goals of OSME was to effect interaction among individuals in a range of positions, the broad representation of roles suggests success, at least among operating system members. Moreover, this representation suggests a wide range of input into the Project system.

An analysis of the educational qualifications of system members indicated that the system was characterized by a high level of educational attainment. This is shown in Table 5.

TABLE 5

NUMBER AND PERCENTAGE OF SYSTEM MEMBERS

ACCORDING TO EDUCATIONAL LEVEL

(N = 130)

Education Level	N	Relative %
1. Bachelor's Degree	7	5.4
2. Bachelor's Degree + 45	21	16.2
3. Master's Degree	20	15.4
4. Master's Degree + 45	46	35.4
5. Doctorate	24	18.5
Other	7	5.4
Missing	5	3.8
Total	130	100

Note: The mean educational level was 3.5 or greater than a Master's Degree.

The fact that system members had an average educational level that was above the Masters Degree suggests high professional motivation among system members; this may also be an important aspect of leadership.

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System Members and OSME Agencies

While the relationship which exists among the parts of a system are important to an understanding of its structure, it is equally important to know the scope and extent of system members' association with the structural parts. The Evaluators examined this aspect of the OSME structure by asking system members to indicate the OSME agencies with which they associated as mathematics educators. The results in terms of percentage of respondents indicating an association are found in Table 6. The data reveal that for all agencies except ECC, forty-five percent or more of the system members indicated an association. Also, eighty-four percent or more of the respondents stated that they had associated with OMEC, SDE, and OCTM, the three major agencies by which program improvement on a statewide basis in mathematics could have taken place. These findings indicate a great deal of interaction among the people and components of OSME.

TABLE 6

PERCENTAGE OF SYSTEM MEMBERS ASSOCIATED WITH VARIOUS OSME AGENCIES

(N = 130)

Agency	% Indicating an Association
.Oregon Mathematics Education Council (OMEC)	96
.State Department of Education (SDE)	88
.Oregon Council of Teachers of Mathematics (OCTM)	84
.Oregon Museum of Science and Industry (OMSI)	62
.Teaching Research (TR)	56
.Teachers of Teachers of Mathematics (TOTOM)	46
.Oregon Council of Computer Education (OCCE)	45
.Education Coordinating Council (ECC)	26

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SYSTEM OPERATIONS

System Operations refer to the process elements of a system. These include the activities which are implemented to achieve the system's goals, the procedures which are used to manage the system, the communication flow which characterizes linkages among parts of the system, and the rewards and sanctions which motivate and guide the participation of system members.

ACTIVITIES

Context

The activities of a system represent the energies which are expended to achieve its goals. In systems which are involved with bringing about change, the most common types of activities relate to: <u>helping</u> clients identify problems and initiate solutions; <u>training</u> clients to solve problems and use new ideas and technologies; and <u>conveying</u> to clients information which may be of interest to them (Paul, 1977).

When examining how such activities are carried out to achieve change, the literature points to a number of considerations. Initially, the orientation which guides the selection or rejection of activities is important. Whether a system is inclusive or exclusive in the views or perspectives it supports is fundamental to an understanding of the activities it conducts. In terms of effectiveness on a process level, however, the activities themselves must be judged in terms of such indicators as coverage, appropriateness, salience, compatibility, acceptance, and utility (Rogers & Shoemaker, 1971; Hull & Kester, 1974; Brickell, 1971, Hall & Alford, 1976).

Information related to the nature, scope, and quality of OSME on the activity level was obtained through the document review, interviews, and the System Questionnaire.

Results

<u>The OSME Approach to Mathematics Education</u>

On the activity level, OSME can be thought of as a comprehensive training and technical assistance delivery system which was organized to improve mathematics education on a Statewide basis. In attempting to achieve this Statewide mission, it is important to note that OSME could have been organized to support activities reflective of the variety of theories and approaches available today in mathematics education. A broad orientation would have made the system inclusive of a number of theoretical alternatives. This was not the case.

OSME Project literature clearly indicated a commitment to an activity based developmental problem-solving approach which the OSME staff linked to the cognitive theories of Piaget and Bruner should be noted, however, that OSME's connection to these theorists was by association only. They based this connection on their developmental and experiential view of learning as well as their use of instructional material which exemplified this approach.

The Project did not develop its own developmental sequence as a basis for articulating, testing, and refining the implications of the cognitive theories of Piaget and Bruner.

Articles by the Project staff, workshops, inservice brochures, and informal discussions conducted by the Evaluators with individuals in various parts of the State provided many illustrations of the OSME approach to mathematics.

In particular, the writings of the Project Director stressed the use of mathematics in real life problem-solving situations. Maier emphasized an active process involving mental computations and estimations, with calculators and computers serving as the logical tools for extending the process. The major goal of mathematics education for the general citizenry, Maier felt, should be the development of each person's ability to recognize, formulate, and solve mathematically-related problems that are inherent in his/her setting (Maier, 1976).

In Maier's view, students should be provided with a mathematically rich environment which would encourage them "to formulate, attempt to solve, and communicate their discoveries about mathematical questions arising in their classrooms, their play yards, their homes" (Maier, 1976, p.6). Thus, according to Maier, mathematics education should be creative, interesting, even joyful, and reflective of student's cognitive stages as well as their inherent abilities. It should not propagate those learning encounters which seem designed solely for acquiring mastery of page after page of textbook problems.

This view was operationalized through OSME-sponsored workshops, inservice courses, and demonstrations. Here, teachers had direct experiences with problem-solving activities, manipulatives matched to levels of development, math games, puzzles, simulations, calculators, and computers. Essentially, these encounters aimed at strengthening teacher skills in a context that would help them recognize the active and creative elements in math related problems that arise in everyday life. Publications and conference programs were also used to spread ideas about the activity-based developmental approach to teachers throughout the State.

The developmental view of learning promoted by OSME was disseminated on a Statewide basis by the Oregon State Department of Education in <u>Math in Oregon Schools</u>, (1976), a curriculum guide based largely upon OSME approaches. The guide stressed the following:

- Sensory learning is the foundation of all experience and thus the heart of learning.

- Learning is a growth process, developmental in nature and characterized by distinct, developmental stages.

- Learning proceeds gradually from the concrete to the abstract, hence formulation of a mathematical abstraction is a long process.
- Concept formation is the essence of learning mathematics.
- Learning is based on experience.
- Learning is enhanced by motivation.
- Learning requires active participation by the learner.

The guide also emphasized mathematics activity stages reflective of a developmental view of learning as shown in Table 7.

TABLE 7

MATHEMATICS ACTIVITY STAGES PRESENTED IN MATH IN OREGON SCHOOLS

Three Stages of Math Activity		
Preoperational	Concrete Operational	Formal Operational
Students are able to manipulate physical objects representing the environment	Students are able to give simple or multiple classifications for objects conserve (recognizing constants among apparent differences) length, area and occupied volume order objects with respect to one or more attributes deal with number ideas and operations	Students are able to initiate thought by systematically listing possibilities reason with premises not necessarily true use proportions. design experiments to control variables

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Most writers of this guide were individuals who had become recognized as mathematics leaders in the State as a result of their involvement with OSME. The guide from its inception was thus reflective of the instructional philosophy and practices emphasized by OSME.

OSME Component Project Activities

To organize activities, OSME created a component structure related to five broad areas of emphasis: Elementary, Leadership, Secondary and College Curricula, Computer Science Education, and Communications.

Activities in the first four components were funded through a variety of projects which were implemented by the agencies participating in the system (local school districts, colleges, etc.). The fifth component, Communications, provided a dissemination vehicle for all of the others.

During the five years of OSME funding, a total of 154 different projects were funded within the Elementary, Leadership, Secondary and College, and Computer components. This figure does not include projects which were funded for more than one year. When those projects are included in the total, over 260 projects were funded during the five year period. Table 8 partitions these figures according to major component type and year. It should be noted that the Leadership component was principally targeted at the elementary level. Thus, the Table indicates that the majority of local projects were funded for elementary teachers, an observation which is certainly consistent with OSME goals.

The Elementary Component

The Elementary Component aimed at improving mathematics programs in the schools, broadening teacher's concepts of mathematics, increasing teacher awareness of varied teaching strategies, and identifying and training individuals who could function as peer trainers. As Table 8 reveals, during the five year course of the Project, OSME funded 49 different elementary projects. These projects in conjunction with other OSME activities reached an estimated 6500 (61%) of the State's elementary teachers.

Many of these elementary projects were "Math Lab" workshops offered through a school district or college/university, and carried college or in-district credit. ("Math-Lab" can be characterized as an activity-based instructional approach.) Through these workshops, which typically consisted of a series of all-day Saturday sessions, teachers experienced how the use of manipulatives, games, and problem solving activities could be used to facilitate cognitive development in mathematics. These workshop topics dealt with measurement and metrics, art and mathematics, developing mathematics interest centers, and the use of calculators in the classroom.

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TABLE 8

NUMBER OF OSME FUNDED PROJECTS PER YEAR CATEGORIZED ACCORDING TO COMPONENT TYPE

Year	Elementary	Leadership	Secondary & College Curricula	Computer
1972 - 73	6	10	7	6
1973 - 74	10	5	7	5
1974 - 75	13	4	9	8
1975 - 76	12	3	6	16
1976 - 77	8	3	5	11
TOTAL	49	25	34	46

Another elementary level thrust was the "Math Enthusiast" workshop. This was designed to provide special training in innovative techniques for teachers who enjoyed mathematics and wanted to help others teach it more effectively.

Interested math enthusiasts could also become active in additional training activities provided through the Leadership Component of the Project. Thus, the math enthusiasts were viewed as potential workshop leaders, as well as individuals who could lead future efforts to improve mathematics education. During the five years of the Project, these workshops involved 350 (3%) of the State's elementary teachers. By the final year of funding, forty of these teachers were functioning as OSME workshop leaders and consultants as a result of their additional participation in Leadership Projects as described under the next Component activity area.

Project funding for the Elementary Component also established mathematics resource centers in twelve elementary schools in different sections of the State. Organized and maintained by teachers, these centers housed a variety of materials which teachers could borrow for classroom use. Costs for maintaining these resource centers were absorbed by the local district after OSME funding ceased.

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The Leadership Component

The goals of the Project's Leadership Component were to develop modes and/or personnel to provide leadership in mathematics education, and to bridge the gap that traditionally separated elementary and secondary teachers. Table 8 indicates that 25 projects were funded to achieve these ends.

The most unique projects, and perhaps the best illustration of the grass roots nature of OSME, were the three "Circuit Rider" projects.

These projects provided math specialists (circuit riders) to schools in the urban area of Eugene (Lane County) as well as to schools in the isolated and sparsely populated desert region of eastern Oregon's Harney and Lake Counties.

> Many of the 3,000 children scattered over this region attend one room schools 100 miles from any town of over 2,000 population. Understandably, teachers in such schools often feel isolated and forgotten. They have nowhere to turn if the youngster in the corner flatly refused to learn subtraction. The math consultant is the needed link with the outside world. (Mitzman, 1976, p. 14).

Visiting individual schools once every two weeks, the circuit rider helped teachers with particular math concepts, introduced them to teaching strategies such as the Math Lab approach, and gave classroom demonstrations. The circuit riders also conducted workshops and inservice courses in each of these counties, drawing upon materials from the Math Resource Centers which had been established at the offices of the counties' Intermediate Education Districts. Teacher and administrative support of the circuit rider program in all three counties had led to the transfer of program costs to the local districts after OSME funding ended.

Other Leadership Component projects were conducted in conjunction with a Leadership Training Program to reinforce the skills of potential math leaders in the State, many of whom had been identified through the "Math Enthusiast" activity of the Elementary Component. By the last year of the Project, sixty individuals were functioning as a pool of resource personnel for both the secondary and elementary levels.

Onsite visits conducted by the Evaluators with 18 of these individuals indicated that they had become recognized as curricular leaders in mathematics education within their school districts or Intermediate Education Districts as a result of their association with the Project. In some cases, this had led to their advancement to a new position.

Secondary and College Component

The primary aim of this Component was to effect major curricular changes at the secondary and college levels. Its underlying intent was to make various course and program activities more relevant to student needs and interests. The projects which were funded addressed four major areas: (1) secondary school general mathematics courses; (2) pre-service elementary mathematics programs; (3) technical-vocational programs; and (4) pre-calculus college mathematics courses for teachers.

Secondary School General Mathematics. OSME inservice projects which sought to improve general mathematics at the secondary level were popularly referred to as "Math for the Uninvolved" workshops. Their specific aim was to help teachers become more aware of the special needs of students who were "turned off" by mathematics and to implement ideas and materials appropriate to those needs. According to Project documents, uninvolved students included those with low ability, those preparing for a profession that did not require mathematics, and those who simply did not like the subject.

Specific workshops encouraged teachers to develop a personal instructional approach which responded to both the affective and cognitive needs of students. Participants were introduced to problem solving strategies, applications of mathematics to science and society, and such instructional materials as manipulatives, games, puzzles, and simulations. In addition, they were presented with ideas regarding the self-concept and attitudes of the uninvolved student.

Over the course of the five Project years, 20 "Math for the Uninvolved" workshops were funded. These included projects targeted at specific regions in the State and funded for one or two years -- LaGrande, Portland, Salem, Corvalis, Parkrose, Silverton, Wasco-Hood Counties -- as well as eight-week summer workshops sponsored for four years which attracted teachers from all areas of the State. By June, 1977, approximately 500 secondary teachers (36% of the total secondary math teacher population) had attended one or more of the workshops, or had participated in a local district project.

Pre-Service Teacher Training. OSME Pre-Service Projects focused on broadening the mathematics content in teacher-training courses, and introducing activity-based teaching methods and motivational techniques. These methods included: (1) the laboratory approach to teaching mathematics; (2) applications as a way of teaching mathematics; (3) problem-solving experiences; and (4) the use of manipulative materials. As a result of OSME projects, major institutions of higher education in the State adopted these methods in their pre-service programs. These include Pacific University, Eastern Oregon State College, Southern Oregon State College, Oregon College of Education, Portland State University, Oregon State University, and the University of Oregon.

In addition, with OSME assistance, these institutions established resource centers which became major vehicles for conducting the pre-service programs. These resource centers provide a place for students to share experiences and give them access to a wide variety of instructional resources.

Technical-Vocational Programs. Document review indicated that the intent of OSME-sponsored activities in this area was to identify the mathematical needs of vocational-technical training programs and to prepare instructional packages for specific occupational programs.

In preparing the curricular material, the project received close cooperation and financial support from the Career Education and Manpower Training Section of the Oregon State Department of Education. After initial materials preparation activities had been completed for this area, OSME involvement diminished. Subsequent activities related to the development of materials for teaching mathematics in vocational and technical courses were refunded through support from the State Department of Education. These materials are currently being used in several community colleges and high schools in the State.

Pre-Calculus College Mathematics. The major emphasis in this area of the Secondary and College Component was on the development of teaching strategies and curricula to be used as alternatives to the traditional lecture approach in teaching algebra and trigonometry. A series of conferences on this topic were sponsored for community and four year college teachers. However, activities in this area did not progress to a stage where either teacher training materials or curricular materials were developed.

Computer Science Education Component

OSME's Computer Science Education Component was concerned with computer literacy for Oregon students. However, as with other OSME projects, the direct target of extensive workshops and inservice courses was the teacher. This project Component helped teachers to broaden their knowledge of computers and to explore their instructional use. One approach emphasized teaching computer literacy through existing science, social science, and mathematics courses. Another approach related to the development of specific computer literacy courses for various student populations.

The various workshops, inservice courses, and local district projects funded through this Component directly involved over 400 secondary teachers (28% of all secondary math teachers). As with other OSME programs, the Computer Component emphasized specific training for individuals who could emerge as future leaders in computer science education. Approximately 15 teachers received further leadership training through the project. This prepared them to carry out teacher training workshops and inservice programs in their own districts.

Two additional aims of the Computer Component involved: (1) coordinating planning and development activities for computer-related education programs in the State; and (2) maintaining communication among educators involved in computer education activities.

A major vehicle for achieving these aims was the Oregon Council for Computer Education (OCCE) which received funding support from OSME. During the five years of the Project, OCCE coordinated information dissemination, as well as planning and leadership functions for computer science educators.

Communication Component

The Communication Component coordinated the Project's various publications activities, and generally functioned to strengthen information linkages among mathematics educators in the State. This Component subsidized the publications of the Oregon Council of Teachers of Mathematics (OCTM), and provided the Council with an administrative assistant. As a result OCTM was able to implement conference programs for Oregon teachers and consolidate several publications into a major journal, The Oregon Mathematics Teacher.

The Communications Component also disseminated information about Project activities throughout the State and sponsored regional conferences and programs for teachers on topics of interest.

System Member's Perceptions of Activities

The effectiveness of OSME activities must ultimately be examined in terms of changes in teacher attitudes and classroom practices. However, other factors which merit examination relate to the extent and nature of activity involvement by key participants in the system and system member satisfaction with participation.

These issues were explored in the System Questionnaire which, as noted under data collection procedures, was mailed to all of the individuals who had been identified as major actors in the Project system.

System members' participation in OSME activities was examined on two levels: (1) their level of workshop participation; and (2) the extent to which they functioned as workshop leaders. In the first case, participants were asked to provide a raw estimate of their participation in workshops over the course of the Project. In the second case, respondents were asked to check a category representing a leadership estimate. (The Pearson correlation between level of workshop participation and extent of workshop leadership was .59).

In terms of workshop participation, the findings revealed that the average system member participated in 9.6 workshops, with 48% participating in four or less, and 52% participating in five or more. Related to workshop leadership, the results indicated that 46% of system members had led one or fewer workshops, and 54% had led two or more.

It is not surprising that system members would be divided in terms of workshop participation and workshop leadership. Many of them entered and maintained roles within the system as a result of various workshop activities conducted through the Project. Other members, however, were not so closely linked to workshop activities, i.e., members of OMEC, OMSI, etc. The data related to workshop participation and workshop leadership is important to note, however, as it shall be subsequently related to other variables which are analyzed in this report.

Related to satisfaction with participation in OSME activities, respondents were asked to rate evaluative items using a five point Likert-type scale with "1" representing "Strongly Agree" and "5" representing "Strongly Disagree". (These items were obtained from a scale used in the 1974 Stufflebeam evaluation of the Project). The mean ratings for each item are presented in Table 9, and indicate that system members were very positive about their participation in Project activities. These findings confirm the results of the survey conducted by Stufflebeam and Bunda (1974). The pattern of responses in the earlier questionnaire also indicated that system members viewed OSME's effects positively.

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TABLE 9

MEAN RATINGS AND STANDARD DEVIATIONS OF SYSTEM MEMBERS' RESPONSES TO ACTIVITY SATISFACTION SCALES

(N = 130)

Items	Mean Rating[a]	Standard Deviation
The activities in which I participated responded to my professional needs.	1.4	.73
I have been able to utilize the ideas presented in the project(s) in my work.	1.4	.70
The activities in which I participated met my expectations.	1.5	.79
I would welcome the opportunity to participate in additional, similar activities.	1.4	.75
I would recommend the same experience to a colleague.	1.3	.68
Participation in the project(s) has led to a change in my teaching/administrative style.	1.9	1.08
Participation in the project(s) has led to expanded communication with other professionals.	1.4	.68
Noticeable changes have occurred in my students because of my involvement with the project(s).	2.0	.86

[a]Responses to items were on a five-point Likert scale where 1 indicated "strongly agree" and 5 indicated "strongly disagree".

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PROCEDURES

Context

In temporary systems such as OSME, procedures represent efficacious means for achieving time-limited goals, and constitute standards for assuring reasonable uniformity in the performance of tasks. Together, with the structure of a system, they allow for the management and coordination of activities, and for the continuity of the system's operation regardless of changes in personnel (Abbott, 1969, Miles, 1969). According to Havelock (1974), judgments about the effectiveness of procedures in a system concerned with innovation and change must take the system's perspective into account, i.e., RD&D perspective, problem-solving perspective, open advocacy perspective. For systems grounded in a problem-solving perspective, Miles (1969) and Havelock (1974) cite the following factors as indicators of procedural effectiveness:

- maximizing chances of participation by many groups
- finding shared values as a basis for working
- providing a climate conducive to sharing ideas and mechanisms for evaluating their effectiveness
- stressing self-help by users in the system

This section will describe OSME granting and monitoring procedures. Information was obtained primarily through the document review, interviews, and the System Questionnaire.

Results: Granting Procedures/Local Problem Identification

An important consideration in viewing OSME on a procedural level is the manner in which grants were distributed. The specific granting procedures which the OSME staff used were not tied to a rigidly defined competitive proposal process. Rather, the application process was deliberately made simple so as to be available to all. OSME staff perspectives regarding granting procedures can be summarized from the following views expressed by the Project Director:

> --Who gets funded and who does not? We have an idealistic view. If someone in the field has a need, we try to respond to it.

--The proposal procedure is not particularly effective... it favors those who have learned to play the proposal game and eliminates those who are not skilled in proposal writing but who may be quite effective in bringing about changes.

--Proposal writers write what they think will get funded and not necessarily what they intend to do... (they) are forced to spell out specifics... long before it is logical to do so-- it is much easier to find out what people have in mind by talking to them rather than reading a proposal.

--The proposal process hinders projects in districts where no one can or will prepare such a document.

--Almost every idea has merit and almost every person or agency has some need consistent with the goals of OSME---thus, when ideas are submitted it should be an uncommon occurrence for them to be rejected out of hand.

Given these beliefs, the OSME staff implemented a granting process with the following characteristics: (1) short proposals of two pages or less were requested from individuals interested in implementing a project; (2) the OSME staff used a cooperative informal style of reviewing potential projects--they went into the field and talked with people about their ideas rather than setting up a highly formalized review process; (3) ideas were evaluated mainly in terms of whether they reflected some aspect of OSME's goals and were congruent with the mathematics approaches the system was seeking to promote.

With respect to how the granting process actually worked, the documents and onsite discussions revealed that originally the OSME staff played a proactive role in generating ideas for funding. In this sense, they traveled extensively throughout the state, discussing math education with individuals in both urban and outlying districts. They elicited local perceptions of needs and helped to clarify needs and devise strategies to meet them. However, over the course of the project, the staff's stance became more reactive. That is, instead of helping districts to formulate ideas for grants, they responded to the ideas presented by the districts. While in neither their proactive nor reactive roles did the OSME staff ever impose solutions upon districts, they did have definite ideas about which solutions would be more effective and they were not hesitant to "argue forcefully for their point of view" (Mitzman,1974, p.7). Thus, ideas were only approved if they fell into OSME areas of concern, if they were congruent with OSME's approach to mathematics education, and if the proposed solutions had local district support and held some promise of success.

Once initial ideas for projects were approved by the OSME staff, the districts (or in some cases university personnel applying for funds) were asked to submit a one or two-page "proposal". This proposal merely provided an outline of activities and estimated costs; no evaluation design or anything resembling evaluation was required. An OSME staff member would ordinarily approve the proposal and refer it to the OMEC executive committee for final approval and costs negotiation. Final contract approval could only be issued by OMEC, but in most cases, this approval was pro-forma. Onsite respondents indicated that OMEC rarely rejected applications.

Results: Monitoring Procedures

It is often the case, especially when dealing with experimental projects, that internal monitoring procedures are created to provide feedback on the operating aspects of various project components. This is an important dimension of project management. When information is collected systematically over the course of project development, the feedback enables key decision-makers to take corrective action in the case of program "malfunction." Monitoring is also important at the implementation level of a project system. Individuals who are responsible for implementing project activities can benefit from information regarding the effects of their efforts.

In viewing OSME operations, the documents and interviews revealed very few, if any, formal internal monitoring procedures. Once local projects were funded, they were fairly autonomous in operation. System Questionnaire results substantiated the absence of formal monitoring procedures.

While respondents to this questionnaire represented the most active members of the system, 55% of those who responded to this question (N = 87) reported two or fewer instances of monitoring/evaluation per year; 80% reported four or fewer. (43 respondents did not answer the question.)

More suggestive of the Project's monitoring procedures were the methods identified by the respondents as being the most commonly used by OSME staff to determine the status of their projects/programs. Table 10 presents the percentage of respondents who indicated that a particular monitoring procedure was "most commonly used." As the Table reveals, telephone and on-site visits were selected most frequently by system members. Thus, OSME built a system which did not rely upon formal proposal mechanisms and formal monitoring procedures to acquire evaluative feedback on its effectiveness. Reducing red tape and administrative burden at the local school level appeared to be more important considerations as discussed previously.

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TABLE 10

PERCENTAGE OF SYSTEM MEMBERS INDICATING MONITORING METHODS "MOST COMMONLY USED" BY OSME STAFF

(N = 130)

Method	% Indicating "Most Commonly Used
. Telephone	32.5
. Site Visits	29.8
. Mailed Questionnaire	21.1
. Free Form Written Material	11.4
. Other	5.3

The document review and informal interviews revealed several factors which contributed to the lack of formal monitoring procedures. First, the Project Staff felt that formal monitoring procedures were antithetical to the Project's operational mode. Second, there was no mandate from the funding source to dictate the course of internal evaluation. Finally, Teaching Research, the independent evaluation agent for the Project did not develop a rigorous formative evaluation design, and did not appear to be successful in convincing OSME staff or local project personnel of the value and need for systematic data collection. The end result was that little written documentation exists related to local project activities or impact.

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REWARDS AND SANCTIONS

Context

An integral aspect of a system's operation is the reward structure-- that is, the level of reinforcement that is provided to individual members. Simon (1957) indicates that all rational systems (i.e., systems that are goal-directed) function as a result of the balance between contributions (output by system members) and inducements (contingencies to perform). Therefore, managers of systems usually recognize the need to build a mechanism of rewards and sanctions for system members in order to achieve a level of desired output.

Information related to rewards and sanctions in the Project system was obtained from the document review, interviews, and the System Questionnaire.

Results

In viewing the OSME operations, document review and interview analysis provided clear evidence that the system had a reward structure. While the OSME staff may not have identified planned reinforcements as such, indeed, a number of these existed for teachers who participated in project activities, especially those who were identified as "math enthusiasts". The types of reinforcements that were identified in project literature as well as the interviews were:

- Serving as a workshop leader
- Participating in leadership conferences
- Having the opportunity to travel to other educational settings
- Publishing in mathematics magazines and journals
- Giving speeches
- Receiving approval from the Project Director
- Satisfaction from working with others
- Receiving college credits
- Receiving additional grants to develop/implement ideas

- Getting experience which resulted in professional growth

- Getting released time to work on problems at the local level

Interestingly, only one sanction was mentioned by individuals--"grants not being given to those who were uncooperative". Given the operational philosophy of OSME, the fact that there were many more positive rewards given for s[illegible]sful performance than there were sanctions to "bring people [illegible]nto line", is not surprising.

The extent to which system members were "rewarded" through the Project was determined through the System Questionnaire. Respondents were asked to answer "Yes" or "No" to certain items which were illustrative of rewards. The percentages of respondents who answered in the affirmative to these items are presented in Table 11.

TABLE 11

PERCENTAGE OF SYSTEM MEMBERS INDICATING THAT THEY HAD RECEIVED AN OSME REWARD

(N = 130)

Item	% Indicating "Yes"
Did you ever receive financial support from OMEC or OSME?	71
Did you ever have an opportunity to speak before a group as a result of OSME-related activities?	67
Did you ever receive a fee or honorarium when you conducted workshops or inservice courses?	52
Did your participation in OSME provide you with an opportunity to publish your thoughts or views?	48
As a result of your OSME activities, did you ever attend an out-of-state convention?	32
Did you ever make a formal presentation at an out-of-state convention?	31

As the Table shows, over 70% of system members received financial support (grants) through the system and over 50% had received fees or honorariums for conducting workshops. Thus, monetary considerations must be viewed as important aspects of the reward structure that motivated involvement in activities. However, close to seventy percent (67%) of the respondents were also provided with the opportunity to speak before groups as a result of their association with OSME, and close to 50% had their ideas published. These factors indicated that professional recognition was used as a reinforcement in the system.

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COMMUNICATION

Context

No analysis of a system is complete without an examination of its communication patterns. Communication determines how information is shared within a system and influences the distribution of power (Abbott, 1969). In temporary systems, communication is generally encouraged and there are strong tendencies for information sharing and openness. Moreover, new channels of communication tend to develop between people who are usually kept apart because of their roles in permanent systems (Miles, 1964). The influence of communication in temporary systems created to promote innovation and change has been discussed extensively in the literature. Many authors agree on the importance of high levels of communication, person-to-person contact, and collaborative information sharing (Havelock, 1973; Havelock & Lingwood, 1973; Rogers & Shoemaker, 1971, and Glaser & Taylor, 1969).

Information pertaining to the OSME communication patterns was obtained through two System Questionnaire scales: a) mode of communication scale and, b) network analysis. The latter method is an innovative approach to the study of communication in large social systems.

Results

Modes of Communication

As noted throughout this report, OSME emphasized a personalized grass roots approach. In order to determine if this approach was congruent with the modes of communication that were actually used in the Project system, respondents to the System Questionnaire were asked to rank order six modes of communication in terms of a) frequency of use in OSME activities; and 2) their own personal preference. The results of the rankings are presented in Table 12.

Two findings are evident in examining the Table. First, OSME's communication modes were consistent with its philosophical orientation. That is, the most frequently used modes were those which can be characterized as personalized. Second, there was a great degree of congruency between system members' overall communication preferences and the modes used most frequently by OSME.

TABLE 1[illegible]

SYSTEM MEMBERS' RANK ORDER OF COMMUNICATION METHODS ACCORDING TO FREQUENCY OF USE IN OSME ACTIVITIES AND THEIR OWN PERSONAL PREFERENCE

Communication Method	OSME Frequency	Personal Preference
Telephone	1	2
Face to Face	2	1
Group Meeting	3	3
Personal Letter	4	4
Newsletter	5	5
General Memo	6	6

Network Analysis

Network analysis was conducted primarily to describe the OSME communication structure and to test the hypothesis of whether OSME was or was not a system. To study OSME communication patterns, the System Questionnaire asked respondents to indicate how frequently they communicated with all other identified system members listed individually on the form (N = 216), with respect to three topics:

1. OSME APPROACHES - How often members discussed OSME educational approaches with their colleagues;

2. OSME OPERATIONS - How often members discussed OSME operating procedures with their colleagues; and

3. NON-OSME/OMEC PROFESSIONAL DISCUSSIONS - How often members had professional discussions with their colleagues not related to OSME.

Members were asked to indicate the frequency of their contact using the following scale:

1 = a little communication

2 = average communication

3 = a lot of communication

The values of 1-3 represent the relative strength of a communication contact or link -- the higher the number, the greater the strength. If no communication took place either with an individual or about a given topic, the respondents were asked to leave the space blank.

Two analyses were undertaken to determine communication structure. The first involved the original data set of 216 individuals identified as being system members.[2] The second analysis involved the 184 individuals who could have possibly completed the System Questionnaire at the time of measurement.

For the first analysis, three types of communication contacts or links were considered:

- Reciprocated Links -- Person A reports talking to person B and B reports talking to A;
- Unreciprocated Links -- Person A reports talking to person B, but B does not report talking to A;
- Added Links -- Person A reports talking to a questionnaire nonrespondent.

For the second analysis, only reciprocated links were considered.

Findings Related to Structure. The number of communication links were computed for the three communication topics (i.e., OSME Approaches, OSME Operations, Non-OSME Approaches) and thus comprised three separate network analyses. Table 13 presents the findings for the analysis which involved the 216 individuals.

[2] Note. The 32 system members who were not present in the system during the time of measurement were included in this analysis since during a three-year time-frame other system members could have been in contact with these individuals.

TABLE 13

NETWORK ANALYSIS RESULTS FOR THREE COMMUNICATION TOPICS

USING THE ORIGINAL DATA SET OF 216 OSME SYSTEM MEMBERS

Structure Variables	Communication Topics: OSME/OMEC Approaches	OSME/OMEC Operations	Non-OSME/OMEC Professional Topics
Maximum N	[illegible]	216	216
Real N[a]	206	201	204
Number of Links	6,022	4,926	5,810
Average Links per Individual	29	25	28
Average Link Strength	1.8	1.8	1.8
Number of Reciprocated Links	1,602	1,186	1,526
Percent Reciprocated Links	26.7	24.1	26.3
Number of Unreciprocated Links	4,420	3,740	4,284
Percent Unreciprocated Links	73.3	76	73.7
Number of Added Links	2,210	[illegible]	2,142

[a] Individuals within the data set for whom a communication link was indicated.

From the Table it can be seen that on the average, an individual had between 25 and 30 contacts related to each of the communication topics; the most frequent contact involved OSME/OMEC approaches. These data suggest that not only did system members communicate at a high rate about OSME approaches and operations, but there was substantial spill-over to other professional topics. Related to the type of communication link, Table 13 indicates that nearly three-quarters of links for all communication topics were unreciprocated. This is not an unusual finding since it is nature of network analysis to produce a large number of unreciprocated links (Farace, Richards, Monge, & Jacobson, 1973). More importantly, the level of reciprocation (26%) suggests that OSME was a system, as this level is characteristics of formal organizations (Farace, et. al., 1973). In past experiences with this procedure, the Evaluators rarely found systems which exceeded 27 percent reciprocation.

The results of the second analysis are presented in Table 14. Here, to reiterate, the maximum N was based upon the number of system members who could have completed the questionnaire; the real N was the number of subjects who returned the questionnaire and who had reciprocated contacts. It should be noted that in general, network data using reciprocated links are much more reliable since reciprocated data require two independent consistent reports. As Table 14 indicates, the average link strength was slightly above average (i.e., above 2) which is unusually high for systems. Moreover, the average number of links per individual was quite high.

TABLE 14

NETWORK ANALYSIS RESULTS FOR THREE COMMUNICATION TOPICS USING A DATA SET OF 184 OSME SYSTEM MEMBERS

	Communication Topics		
	OSME/OMEC Approaches	OSME/OMEC Operations	Non-OSME/OMEC Professional Topics
Maximum N	184	184	184
Real N	102	86	103
Number of Reciprocated Links	1,602	1,186	1,526
Average Reciprocated Link per Individual	16	14	15
Mean Link Strength	2.1	2.0	2.1

Was OSME a System? One aspect of network analysis which directly tests the hypothesis that a system exists gives consideration to the density of communication. Density is a function of the number of observed links to possible links (possible links= $\frac{N(N-1)}{2}$

Table 15 gives the structure calculations for the various topics of communications. The first row considers the ratio of observed links to all possible links, while the second row considers the ratio of observed links to all possible connected links (the latter computation of density is fairer to use in considering "systemness" since it depends on the real N for both reciprocated and unreciprocated data). As Table 15 indicates, with the exception of reciprocated data for all possible links, all values were above .10. Generally in evaluating systems of this size, .07 is considered a statistically significant F value for system density. Thus, these data suggest that OSME was a system.

TABLE 15

OSME SYSTEM DENSITY --

RATIO OF OBSERVED LINKS TO POSSIBLE LINKS

	OSME/OMEC Approaches		OSME/OMEC Operations		Non-OSME/OMEC Professional	
	Recip.	Unrecip.	Recip.	Unrecip.	Recip.	Unrecip.
Density (All Possible Links)	.03	.13	.03	.13	.03	.11
Density (Only Possible Links)	.15	.14	.16	.14	.14	.12

An additional test of systemness relates to the question of a system core, that is, whether or not an organization contains a highly-ranked group of individuals who are accorded informal status. Table 16 provides a breakdown of the average number of links and average link strength for OSME system roles, related to OSME approaches and operations. The results clearly demonstrate that those closest to the formal center of the system had the largest number of contacts. More significantly, however, was strength and frequency of workshop leader contacts. Again these data substantiate that OSME was indeed a system.

TABLE 16

LINKS BY FORMAL ROLE

Role	N		$\bar{X}$ Links		$\bar{X}$ Strength	
	Approaches	Operations	Approaches	Operations	Approaches	Operations
OSME Staff	5	5	44.8	43.2	2.1	2.1
OMEC Member	7	7	11.7	12.6	1.9	2.0
Workshop Leader	54	46	15.9	12.2	2.0	2.0
(others not included)						

DISCUSSION

The collective findings which portray the nature of OSME as a system were impressive. They provided convincing evidence that NSF funding of this Project did result in a "systems approach" to improving mathematics education on a statewide basis. Moreover, in light of certain quality indicators which the literature associates with structural and operational effectiveness, the findings revealed OSME was a very strong system. These results are discussed below as they relate to the various system properties.

Philosophy

One of OSME's strongest characteristics was its commitment to a philosophical mode of operation throughout the Project. From its inception, OSME, as a system, had a philosophical sense of identity which stressed personal contact, humanism, grass roots problem-solving, and minimum bureauratic red tape. OSME's central staff consistently exemplified this philosophy at all levels of the project's operations (granting procedures, monitoring procedures, etc.) The result was a recognizable management philosophy which guided the actions of system members and which individuals in Oregon associated with the Project--an important aspect of "systemness."

Perhaps the most salient features of the OSME philosophy were its openness and flexibility. The literature indicates that these features tend to make temporary systems which are involved in the change process more effective. However, it must be noted that systems involve complex interactions which may require varying levels of flexibility and openness. Thus, as will be discussed later, the system's flexible orientation had a positive influence on some operations, e.g., local problem identification and granting procedures, but was less effective for others, e.g., monitoring.

Goals

The literature on change suggests that inappropriate, ambiguous and diffuse goals tend to diminish effectiveness and impede change. OSME goals, however, could never be described as inappropriate, ambiguous or diffuse. On the contrary, the goals were rooted in need statements and recommendations developed by a broad spectrum of Oregon educators, thus they were appropriate. In addition, system members clearly understood the intents of the goals and correctly perceived OSME as a service oriented Project. More importantly, the goals that were emphasized by OSME were also those which were personally valued by system members. These findings all tend to point to cohensiveness, an attribute which is associated with a healthy system.

An interesting finding that merits comment is the apparent incongruency of system members' emphasis on the goal related to the improvement of student cognitive skills and OSME's lack of emphasis on this goal. While this might be construed as a serious discrepancy by some, the writers feel that this is a common phenomenon. It is often the case that large scale delivery systems which have teachers as their primary target group do not emphasize student outcomes as a direct output of their efforts. Users of these delivery systems, however, such as teachers and administrators who are faced with student accountability issues on a daily basis are more likely to keep in mind the question of student impact. Since Project training activities consistently emphasized certain types of instructional approaches for students, there was strong reason for system members to feel that the improvement of student performance was an OSME goal.

The findings also revealed positive responses regarding system members' perceptions of goal attainment. Thus on a system level, positive attitudes were operating about OSME's performance related to goal achievement. Considering the fact that the system members consisted of close to 200 of the leading mathematics educators in the state, one can conclude that the system was viewed in Oregon as a credible, effective, and acceptable mechanism for improving mathematics education.

Structure

In reviewing the findings related to the OSME structure, it is clear that the system was reasonably well integrated from both an agency as well as system member perspective, that the system was flexible and open, and that the core staff possessed personality traits which are associated with good leadership.

System Integration

The relationship of ECC, OMSI, and OSME, the relationship of external agencies with internal structure, and the affiliation of system members with structural parts can be considered positive dimensions of OSME functioning. On the other hand, however, the relationship between OSME and OMEC and between TR and OSME can be considered somewhat negative dimensions of the system structure.

ECC, OMSI, and OSME. The roles played by ECC, OMSI, and OSME with respect to fiscal administration were very well integrated with the system. At the Project outset, the need for an established fiscal agency to administer Project funds was a major consideration which influenced system structure. ECC provided an existing structural mechanism which could function as the grant recipient in the state. OMSI was selected as the active fiscal agent. In retrospect, the choice of OMSI had a positive effect on structural relationships associated with fiscal policies and procedures. This respected independent agency provided fiscal accountability as well as flexibility and neutrality in the disbursement of Project funds. OSME thus recognized and avoided some of the drawbacks that might have occurred if fiscal administration had been associated with agencies such as the State Department of Education or a university. The writers consider the implications of OSME fiscal arrangements important for questions of future replicability.

Integration of External Agencies with Internal Components. The results indicated that the scope of OSME integration with agencies outside of its internal structure was extensive. Linkages were established with almost every agency in the state that played some role in mathematics education. Moreover, the linkages influenced how the agencies functioned relative to mathematics education. For example, at the State Department Level, the Math Specialist was able to broaden his role with school districts in the state as a result of the cadre of mathematics leaders created through the Project. Professional organizations such as OCTM, OCCE, and TOTOM grew and flourished as a result of their association with OSME. Finally, all major colleges and universities became involved in Project activities, and many modified their preservice and inservice programs for teachers as a result of this involvement. Thus, it can be concluded that OSME was structurally integrated with major agencies and institutions associated with mathematics education in the state. This level of integration is significant. It reflects a broad representation, suggests a high level of system credibility, and demonstrates the potential for the continuance of Project-related activities after the termination of funding.

System Member Integration with Structural Parts. Another finding which merits discussion relates to the degree of system member integration with various agencies/institutions in the system. As the data revealed, close to 50 percent of all system members indicated an association with seven of the eight agencies/institutions which were linked to the Project system (exclusive of colleges and universities). Moreover, over 80 percent indicated an association with OMEC, OCTM, and the State Department of Education, the three major agencies through which program improvement on a statewide basis could have taken place over the past five years.

The integration of individuals indicates a high level of system cohesiveness. Thus, not only did OSME achieve integration among the internal and external structural parts, but also among individuals interacting with the structural parts.

OMEC and OSME. The data revealed that while at the outset of the Project, the functions of OMEC as the governing policy-making body were well integrated with the functions of OSME as the agency which carried out policies and procedures, as the Project progressed, OMEC's role became increasingly diffused. Essentially, OMEC's role changed from one of involved decision-making to one of concurrence. It should be noted, however, that this type of shift is not unusual in a temporary system where balance of power is a phenomenon that is highly sensitive to situational constraints and personality factors.

OSME's growth of power was influenced by the fact that OMEC members had other full time jobs and could not devote extensive personal time to reviewing Project proposals. An adage tells us that knowledge is power, and OMEC was dependent upon the recommendations and judgments of OSME staff who had become most familiar with the local Projects seeking funding approval.

In addition, both OMEC and OSME members had emerged from a tradition of strong relationships among mathematics educators in the state. They were colleagues and friends, and the system brought them together with a renewed sense of purpose. OMEC thus operated on the basis of trust and respect for the competence of the OSME staff. It is therefore not surprising that OSME's decision-making power could gradually increase with little initial reaction from OMEC.

The strong leadership style of the System Director, Gene Maier, also helped to shift the balance of power to the operational

(OSME) rather than the policy (OMEC) level of management structure. Ultimately, policy was formulated at the operational level. It should be noted that the influence of the Director was a functional aspect of decision-making in OSME. In temporary systems where there is a tendency toward egalitarian views, a single person's influence can be substantial. Until that influence creates a clear proven structure, productive work does not occur.

Unfortunately, OMEC's gradual detachment from what was perceived as real decision-making power resulted in dissatisfaction among some members of the mathematics community in Oregon regarding the future of system-type activities in the state. Some feel that OMEC should continue to function as a representative policy-making body to guide the extension of system related strategies. Therefore, these members do not support the Math Learning Center -- a recently formed non-profit organization created through OSME staff efforts as a potential vehicle for continuing some system activities after the termination of NSF funding. Thus, the breakdown of system integration between OMEC and OSME could have a negative influence on future program improvement efforts in mathematics education.

Regarding this aspect of system integration, the writers feel that system planners who hope to operate on a personalized, flexible basis, should not negate the value of some formalized mechanisms of checks and balances. These keep the parts of a system in harmony. Formalized processes which provide for recognized transfers of authority can contribute to the structural integration of even the most informal system.

TR and OSME. Feedback is an important ingredient of a viable system. This function is most often carried out by an evaluation unit, and should be integrated with the various levels of decision-making that are needed to manage the system effectively. A variety of findings clearly indicated that the system's evaluation component became less integrated into the mainstream of the system as Project activities progressed.

The relationship between TR and OSME was not unique. Communication gaps between evaluators and Project staff are common in Project evaluations. Yet, the relationship is illustrative of how evaluation efforts lose focus when the dialogue concerning evaluation intents is ambiguous.

In summary, the lack of a well defined evaluation plan, as well as the lack of clear mandates from NSF or OSME regarding evaluation, set the stage for weak system integration with the evaluation agency. Ultimately, this reduced the internal feedback mechanism to more of a reporting function than a decision-making function which could bring about corrective change in the system.

Structural Openness

Reference has been made throughout this report to the flexible and open nature of OSME and the fact that the literature associates these qualities with system effectiveness. In terms of structure, the findings also suggested that OSME was open and flexible.

One aspect of openness relates to the roles of agencies and institutions. The data showed that within OSME, such roles were not rigidly defined; rather, they emanated from the nature and level of participation that the agencies/institutions chose. The open evolving quality allowed agencies/institutions to grow and change within themselves as a result of participation in the Project. For example, revisions were made in the preservice programs of certain major colleges and universities because of Project involvement. Also, the role of the Math Specialist at the State Department of Education was affected positively by the Project.

A second aspect of structural openness relates to the roles of individuals within OSME. The data revealed that the Project allowed system members to grow in a way that was congruent with their professional needs and interests. Specifically, individuals from different educational backgrounds and professional roles expressed satisfaction with project activities.

Leadership Qualities

In viewing a system such as OSME, one must raise the question of whether the system could work without the particular individuals who were responsible for leading the Project. The focus, however, should not be on the individuals themselves, but on the qualities they represent. The literature informs us that systems which are concerned with innovation and change operate more effectively if leaders are perceived as competent, self-directed, trustworthy, open, and sensitive to the needs and interests of others. These qualities certainly characterized the OSME Director as well as the central staff, and OSME must be judged effectively in this respect. The implications for future system planners is that these leadership qualities may be necessary for success.

Approach to Mathematics Education

While OSME was conceptualized as a comprehensive statewide systems approach, at the activity level, the results showed that it was not open to all learning alternatives. Specifically, the Project's delivery system was strongly tied to a developmental activity-based problem-solving approach to mathematics education to the exclusion of other approaches. While this orientation provided a clear focus for integrating a great range of Project-sponsored activities, it also provided implicit standards for the selection and rejection of individual projects.

It is not the purpose of this evaluation to make judgments about the particular approach to mathematics education which was propagated by the Project. There are many mathematics educators who would applaud this orientation, and there are others who would take issue with it. However, it must be noted that the Project's ties to a particular approach exerted a positive influence for the most part.

On the positive side, OSME's commitment to the developmental approach provided a common language and a common educational perspective for system participants. This established a strong thrust for improving mathematics education in Oregon based upon a unified view of how children learn. The evaluation findings provided evidence that this approach was consistently articulated through Project publications as well as through the developmental nature of teacher training activities.

The central Project staff was committed to the conceptual approach and was able on a personal basis to communicate this orientation to the field. Moreover, the mathematics "leaders" who emerged as a result of participation in Project activities also carried the message to school districts throughout the State. Whether one examines the basis of preservice or inservice courses offered through colleges, regional workshops offered for local school districts, resource centers established at the college or local level, or classroom demonstrations by circuit-riding math specialists, one finds the same theoretical foundation. Even activities offered through the computer component reflected an experimental problem-solving emphasis. However, it must be recognized that the approach was not translated into a K-12 developmental sequence. Nor did the Project emphasize the establishment of evaluation procedures at the local level to test the efficiency of this approach in actual classroom situations.

OSME's commitment to a single orientation did limit participation in the system in that it influenced the acceptance or rejection of proposals. Moreover, in terms of replicability in another state, commitment to a single educational approach which stands untested in terms of its efficacy for widely varying student populations might represent an unacceptable mechanism of reform.

Activities

Organization and Scope

With respect to activity organization, OSME funded programs in five general areas: Elementary, Secondary and College Curricula, Computer Science, Leadership, and Communications. Of these, projects focused at the (including leadership) elementary level received the greatest concentration of resources and appear to have had the greatest involvement from the mathematics community in the state.

The component structure provided a relevant basis for organizing projects, but for the Leadership Component particularly, the organizational scheme was not so clear. Leadership projects were not easily distinguishable from the projects within the Elementary, Secondary, and Computer Science Components which emphasized the development of leaders. Also, the Circuit Rider Projects of the Leadership Component could easily have been subsumed under the Elementary Component. Thus, in terms of exportability, the Leadership Component may be an overlapping and unnecessary element in the component structure.

Component project activities were consistent with the Project's overall goals as well as component sub-goals. In terms of specific component project activities, several observations can be made. The Project staff attempted to optimize both breadth and depth in its training and developmental efforts. Its extensive program of workshops and inservice courses produced a large number of teachers with exposure to the OSME philosophy and its associated math learning constructs.

Specifically, the Project directly reached 61 percent of Oregon's elementary teachers and 71 percent of the State's secondary mathematics teachers. The indirect fallout from this population may also have influenced many other teachers in the State. At the same time, OSME provided concentrated leadership opportunities for individuals who displayed leadership potential. One of the long term outcomes of the project may well be the informal opinion leadership which this group can generate in the state.

Satisfaction

System members felt very positive about their participation in Project activities. Their responses indicated that they felt the activities met their expectations, were relevant to their needs, were applicable to their professional work situations, and had led to expanded communication with other professionals. These responses confirmed the results of the Stufflebeam/Bunda survey related to the same scale items.

Procedures

At the procedural level, OSME was characterized by a problem-solving perspective rather than an RD&D perspective. As a result of this orientation, OSME stressed self-help, and sought to establish a climate that was conducive to the sharing of ideas. In light of this perspective, a number of observations can be made related to local problem identification, granting procedures, and monitoring procedures.

Local Problem Identification

It was evident from the findings that the strategies that the OSME staff used in identifying problems were consistent with the operational philosophy which stressed informality, cooperativeness, and a "grass roots" approach. These strategies, as indicated previously, were both proactive and reactive, and seem commendable from several respects.

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In terms of the proactive stance, by traveling extensively throughout the state and discussing mathematics education with teachers, administrators, and the like, the OSME staff was able to reach many districts and teachers who normally might not have taken advantage of the Project. Particularly in the outlying districts, where one room school houses are the norm rather than the exception, it is unlikely that a formalized non-personal process of problem identification would have resulted in similar coverage. Even in the more geographically a[illegible]le areas, the proactive process seemed to broaden the [illegible]f project funding

Related to the reactive strategy of vesting [illegible]oblem identification in individual teachers, OSME was a[illegible]get "grass roots" problems directly addressed by those who [illegible]o deal with the problems. Moreover, the reliance on individ[illegible]input from teachers seemed to function as an informal reward [illegible]stem by acknowledging the "professional judgment" of teachers.

While the personalized grass-roots nature of problem identification appears to have broadened district and teacher participation, certain issues have to be raised when considering exportability. A proactive needs sensing strategy requires a staff which is not only well versed in specific content areas, but also skilled in communication and problem solving techniques. The OSME staff fortunately possessed these skills. The successful implementation of the problem identification strategy in other states would require similar levels of competence and commitment.

With respect to the reactive strategy, the nature of the OSME Project limited "needs" to the content area of mathematics. Within this single content scope, an informal needs assessment by teachers or administrators was probably as accurate as a formalized process.

Granting Procedures

OSME granting procedures were uncomplicated and were designed to be responsive to participants in the system. The pre-proposal discussion of ideas coupled with the short written "proposal" minimized the amount of red-tape in the funding process and resulted in a quick turnaround time between submission and funding.

Moreover, the process encouraged an equitable distribution of monies since districts which lacked personnel with proposal writing skills could apply for and subsequently receive funds.

While on the surface the procedures seemed very informal, there were implicit criteria which ensured a congruency between local project activities and OSME concerns.

The staff was also fairly insistent that ideas be approved only if they had local district support. In some cases local funds were used in conjunction with OSME funds at the start of projects. More importantly, in certain instances, local funds have maintained projects after the termination of OSME funding. Unfortunately, it was not possible to determine precise figures concerning the number of local projects assimilated into district programs due to the lack of records on these projects and the costliness of contacting all of the projects to obtain documentation data at this time.

Related to the issue of exportability, an informal and personalized granting process requires that system participants as well as the prime funding agency have confidence in the integrity of the decision process. In this case, confidence in the granting recommendations made by the OSME central staff was essential. There were times when members of the advisory group (OMEC) questioned certain granting decisions; but, for the most part, confrontations were rare because individuals "had a sense of trust about the staff". Given another setting with different personality types, it is not so clear that the results would be the same. However, it must be stressed that in examining the advantages of the process in light of possible disadvantages, it would appear that the granting process was indeed effective and could be exported.

Monitoring Procedures

Key elements in the flow of Project management are the monitoring procedures which provide for documentation, accountability, and an accurate assessment of impact. Mention has already been made regarding the lack of integration between the Project and its evaluation component. Related to this, the monitoring procedures implemented by the Project staff were inadequate.

While a personalized informal approach may be an effective strategy with respect to local problem identification and granting procedures, it did create monitoring and evaluation problems. Accountability may not have loomed as a problem in the internal operation of a Project with strong leadership. However, the non-existence of individual project records and local impact data impedes a true assessment of OSME's accomplishments. There is much that will never be known about projects that were implemented at the local level, and it is the type of data that is much too costly to gather on a retrospective basis. In addition to this, the individuals who served as project leaders at the local level never acquired the monitoring skills that might have helped them assess their own efforts nor did they benefit from evaluative findings that might have enhanced their programs.

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Rewards and Sanctions

Systems managers usually recognize the need to build a mechanism of rewards and sanctions for system members in order to motivate participation. The findings indicated that OSME operated on the principle that rewards are more motivating than sanctions. These rewards consisted of grants, professional recognition, and opportunities to function as leaders. The absence of sanctions within the system was consistent with operational procedures which valued people, acknowledged their ideas, and encouraged their growth. This is also consistent with research findings which emphasize the importance of positive reinforcements as motivational factors in systems or organizations. The writers thus conclude that OSME made provisions for a rewards structure that was powerful in providing incentives for educators to become involved in system activities.

Communication and Systemness

Communication is one of the most important dimensions of a system's properties and is a critical aspect of evaluating the extent to which a system actually exists. OSME emphasized personalized communication modes, a finding which was consistent with the philosophical orientation of the system and another indication of cohesiveness. Most impressive, however, was the remarkable level of communication that existed among system members. Communication channels developed among individuals who normally might have been separated by their professional roles, i.e., university professors and local school district personnel. The data also indicated that not only did these individuals communicate at a high rate about OSME educational approaches and operational procedures, but there was substantial spill over into other professional topics. Thus, collaborative information sharing which cut across professional roles and was inclusive of a variety of professional topics was an important and positive characteristic of OSME. Moreover, communication among a central core of individuals who functioned as informal opinion leaders in the system was especially strong. This finding is pertinent in that these communication links may have long lasting effects upon future interactions among leading mathematics educators in the State. In conclusion, the findings related to communication in OSME particularly substantiate the achievement of a dynamic systems approach to improving mathematics education in the State of Oregon.

SECTION II

IMPACT ON TEACHERS AND STUDENTS

Data Collection Activities

Effects on Teachers

Effects on Students

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DATA COLLECTION ACTIVITIES

Two major data collection activities were conducted to assess the impact of OSME: Teacher Survey and Student Survey. These activities are described here in terms of purpose, sample, instrumentation, procedure, and analysis.

Teacher Survey

Purpose

The Teacher Survey was the primary data source for measuring OSME's impact upon teachers. The specific variables assessed included: a) teacher skills and b) teacher classroom practices.

Sample

The sampling design for determining impact upon OSME teachers was strongly, and perhaps negatively influenced by two factors. First, the Evaluation Staff was confronted with the difficulty of identifying a "true" control group. OSME had been in existence for five years, and during that time was the subject of considerable discussion within the Oregon educational community. It could not be assumed, therefore, that an uncontaminated control group was present among Oregon mathematics teachers, particularly at the grade levels of interest.

Second, the Evaluation staff was faced with an inability to randomly sample either districts or teachers with the entire mathematics teaching population as the sample pool. A key element of the OSME program was the identification of mathematics leaders or "math enthusiasts" (individuals who enjoyed mathematics and could lead future efforts to improve mathematics education) as targets for developmental efforts. Using random methods there was a high probability of failing to incorporate these individuals in the subject pool.

Because of these factors, the Evaluation Team made certain sampling decisions. First, given the random sampling constraint, the Evaluators asked the OSME staff to identify 30 districts as well as schools within the districts where they perceived the possibility of impact in elementary education, computer education, and math for the uninvolved. Their perceptions of impact were to be based upon the number of OSME exposed teachers in the district and upon a belief that OSME-type instructional activities were being implemented. From the list of 30 districts, the Evaluators selected nine divided among the three areas of impact (elementary education, computer and math for the uninvolved). Within each district, impact schools were also identified; "comparison" schools were then selected on a random basis from schools within the nine districts which were not identified as "impact" schools by the OSME staff. Table 17 contains specific information related to district and school selection. The table shows that 49 different schools were used in the study, with elementary schools outnumbering math for the uninvolved and computer.

TABLE 17

DISTRICTS AND SCHOOLS USED TO MEASURE IMPACT OF ELEMENTARY, MATH FOR THE UNINVOLVED, AND COMPUTER PROGRAMS

District	Areas of Program Impact -- Number of Schools Elementary	Math for the Uninvolved	Computer
.Parkrose	6		
.Klamath Falls	6		
.Albany		3	
.Salem		6	
.Medford		3	
.Ashland			7
.Lebanon			2
.Eugene	4		
.North Clackamas	6		6
TOTAL	22	12	15

A second decision related to the sampling plan involved the question of a control group. As discussed earlier it could not be assumed that identified schools presented an uncontaminated comparison group. Thus, for comparison purposes, the Teacher Survey included a participation variable whereby respondents could be classified according to whether or not they had ever participated in an OSME workshop. The variable was a yes/no response to the question, "Have you ever participated in an OSME workshop or inservice course?"

Description of Teacher Sample. All mathematics teachers from the 49 schools within the nine districts were administered the survey (N = 300). Two hundred and ninety-three (293) or 97.6 percent responded. A categorization of respondents according to program component is found in Table 18.

TABLE 18

RESPONDENTS TO TEACHER SURVEY

CATEGORIZED ACCORDING TO PROGRAM COMPONENT

Program Component	N	% of Sample
Elementary	191	65%
Math for the Uninvolved	62	21%
Computer	40	14%
TOTAL	293	100%

The relatively sparse number of math for the uninvolved (MAUN) respondents and computer respondents reflected the OSME program emphasis at the elementary level as well as the difficulty of identifying affected teachers for the computer and math for the uninvolved areas.

Impact and Comparison Groups. A classification of respondents according to whether or not they had participated in OSME workshops is shown in Table 19 for all three program components.

As noted before, the Participation variable was generally the variable used to split the teacher sample for comparison purposes. Fortunately, Table 19 indicates a near even distribution in the MAUN and computer groups where the overall N was small.

With respect to the extent of participation, the teachers within all three components spent an average of 12 days in training.

TABLE 19

NUMBER OF PARTICIPANTS AND NONPARTICIPANTS IN OSME WORKSHOPS ACCORDING TO PROGRAM COMPONENT

Participation Variable	Total N	Elementary	MAUN	Computer
Participants	111 (38%)	63 (33%)	30 (48%)	18 (45%)
Nonparticipants	167 (57%)	115 (60%)	31 (50%)	21 (53%)
Missing[a]	15 (5%)	13 (7%)	1 (2%)	1 (2%)
Total	293	191	62	40

[a]This refers to individuals who did not respond to the participation item.

Instrument Development

Several Procedures were undertaken in the construction of the Teacher Survey.

First, the Evaluators content analyzed a variety of OSME documents and transcripts of onsite interviews to generate the precise language for the instrument, as well as to frame questions in terms relevant to OSME program efforts;

Second, a draft version of the Survey was submitted to the Evaluation Review Panel for comments and suggestions; revisions were incorporated through group consensus;

Third, the revised instrument was pilot tested with a sample of OSME teachers (N=8) to determine appropriateness of language and content as well as response time; and,

Finally, the instrument was submitted to the Office of Management and Budget (OMB) for approval; certain changes were made as a result of OMB suggestions.

The approved version of the Teacher Survey (OMB Approval # 99-S78006) consisted of several scales as follows:

1. Math Scales -- Two scales were used to evaluate teacher skills and classroom practices. The scales were comprised of 23, five-point Likert-type items. In Tables 20 and 21 an appropriate label and explanation are provided for each of the math scale variables. Table 20 presents the math scale variables related to teacher skills. For these variables, respondents were asked to rate themselves as being: Highly Skilled, Quite Skilled, Somewhat Skilled, Slightly Skilled, or Not at All Skilled.

   The next set of items were designed to measure teacher's actual application of certain classroom practices as an estimated frequency. These items were adapted from items used in a Teaching Research Survey (Haladyna, 1975). Respondents were asked to indicate whether they used a particular technique: Daily, Several Times a Week, Once a Week, Less Than Once a Week, or Never. This set of variables is presented in Table 21.

   A factor analysis was performed on the Math Scales using a principal components analysis with Varimax rotation and Kaiser Normalization. Four factors emerged -- one consisting of computer scales, a second consisting of teaching strategies, a third related to learning centers, and the fourth related to the use of computers. Appendix C presents the factor loading for specific variables on the Math Scales; in addition, intercorrelation matrices for the variables for each program component are found in Appendix C.

2. Participation Scales -- Teachers were classified into exposure and nonexposure to OSME groups based upon their responses to workshop participation (PARTIC variable). Additional participation variables were listed on the survey as binary choices as to whether or not a respondent received one or more of the rewards available to OSME teachers.

3. Other items requested certain descriptive data and information related to association with statewide mathematics agencies.

Procedures

Teacher survey data were gathered in April 1978, by a trained on-site collector. Prior to distributing the Survey in the targeted school, the Evaluators met with people from each of the nine school districts to obtain necessary clearances.

TABLE 20

TEACHER SKILL VARIABLES

MATHLAB:	Teaching Mathematics through a math lab approach. The Math·Lab approach was promoted by OSME as a way of providing students with direct experiences in manipulatives and problem-solving activities emphasizing the utility of mathematics in daily life.
SELFDEV:	Developing self-made mathematics instructional materials. Through inservice course, OSME math leaders emphasized the importance of teacher-developed instructional aids.
PROBSOL:	Evaluating students through problem-solving methods. OSME staff attempted to train teachers to use problem solving techniques in evaluating student behavior.
DIVERSE:	Making use of a great diversity of mathematics teaching materials. OSME staff indicated that variation was the 'spice' of mathematical life. They emphasized in their training, the need for teachers to use individualized approaches which provided tailored solutions to the needs of particular students.
MATFIND:	Identifying general or remedial mathematics materials and methods. This scale measures a teacher's perceived ability to find appropriate materials for motivating the involvement of students who are placed in remedial or general mathematics classes.
LEARNC:	Setting up mathematics learning centers. OSME trained teachers to establish mathematics learning centers which could function as both a resource center where material were stored, and an instructional area for students.
PERSONL:	Individualized Instruction in Mathematics. Based on the analysis of OSME philosophical and operational objectives, individualizing instruction was the central premise from which all instructional modalities seemed to stem.
GAMES:	Using models, games, and a variety of manipulatives for teaching mathematics. This was another key OSME objective. It related directly to individualizing curriculum and to the objective of providing students with real-life problem solving opportunities.
CALCU:	Using electronic calculators as teaching devices. In emphasizing the importance of the calculator to mathematical training, OSME staff emphasized that real math literacy requires an understanding of the calculator, its functions and its operational modes.
COMPUTER:	Making use of computer applications in mathematics instruction. This is a scale of particular interest to the computer oriented OSME programs.
COMPMAT:	Using computer related instructional material. This variable both follows from and extends the previous two. This scale raises the issue of not only the applicability of machines to mathematical problem solving, but the use of computer related materials.
COMEQU:	Using computer equipment in the mathematics instructional program. This scale measures the skill teachers have in the actual "hands on" use of computer hardware in math programs.
BASIC:	Using a programming language such as BASIC, FORTRAN, or FOCAL. This scale measures teacher skill at training students in software language.

TABLE 21

VARIABLES FOR CLASSROOM PRACTICES

NORML:	Do seatwork using commercially-prepared materials such as handouts or workbooks. This is a negative item. OSME emphasized mobility and tried to minimize constraint on student learning strategies. The teacher was expected to attend to individual student needs rather than allow the material to do the work of teaching.
PROJECT:	Work on projects that may take several days to complete and may involve one or more students. This is a correlate of both the concept of self-made instructional materials and using the math lab approach. The OSME student was encouraged to take on problems which extended over a period of time and involved more than one person.
MAGAME:	Use math games. This measures the frequency with which teachers use the math game approach.
CENTERS:	Work at learning centers. This variable was designed to measure the degree to which students work at learning centers.
HMMADE:	Use teacher-made instructional materials. This variable is the behavior indicator for SELFDEV.
CALCU2:	Use electronic calculators as part of your classwork. This is the behavioral correlate of teacher skill at introducing calculators into the mathematics curriculum.
COMREL:	Use computer-related materials. This is the behavioral correlate of the variables, "COMPUTER," and "COMPMAT."
MODELS:	Work with physical models and manipulatives. This is the behavioral correlate of the variable, "GAMES" and its assocaited constructs.
COMP:	Use computers. This is the behavioral correlate of the computer variables and particularly, "COMEQU" and "BASIC."
ALONE:	Work on independent projects. This is the behavioral measure of student independence. It ought to be associated with "PROJECT," "MATFIND," and "PERSONL."

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Analysis and Synthesis

A variety of statistical procedures were used to analyze the Teacher Survey data including descriptive statistics, chi-square, and *t*-tests. The latter three statistics were the principal procedures used to compare OSME and non-OSME teachers in order to answer certain key questions related to impact. (Appendix D contains a copy of the Questionnaire.)

Student Survey

Purpose

The Student Survey was designed to assess student attitudes towards mathematics, student attitudes towards their teachers, and student preference for mathematics curriculum.

Sample

Assessment of OSME effects upon students was limited to the elementary level[3]. These students were selected from intact classrooms in the four elementary school districts from which teachers participating in the study were selected. A total of 521 fourth grade students were administered the survey from 22 separate schools within the districts. The average school provided 20 students and the largest provided 38. Table 22 presents a description of the student sample for the four districts. The average age of students was 9.6 years.

TABLE 22

DISTRICTS AND NUMBERS OF STUDENTS USED TO MEASURE IMPACT

District	Number of Students
Parkrose	122
Klamath Falls	139
Eugene	144
North Clackamas	103
Missing	13

[3]Note: Because of the diffuse nature of the computer programs and math for the uninvolved programs, it would have been difficult to identify students directly affected by either program. The difficulty of identification led to a collaborative decision by the Evaluators and NSF to only assess program effects at the elementary levels, and in particular the fourth grade level.

Classification of Students. Students were grouped into one of three levels of treatment as follows:

Group 1: (Non-Osme) Students having no teacher in the past two years who was regarded as having participated in OSME workshops.

Group 2: (Low-OSME) Students who met one of three possible conditions:

a. either the most recent teacher was OSME trained and the previous teacher was not OSME trained;

b. either the previous teacher was OSME trained and the present teacher was not OSME trained;

c. the present teacher was OSME trained and the student had transferred into the measured school or the student provided an unrecognized teacher's name.

Group 3: (High-OSME) Students for whom both this year's teacher and last year's teacher were OSME trained.

Originally, the Evaluators intended to classify students by matching them to teachers who had been classified into high and low OSME groups based upon the scales in the Teacher Survey. Unfortunately, most teachers did not sign the questionnaire and so defeated this end. Instead, the OSME math leader for the specific school district classified teachers as either participants or nonparticipants in OSME workshops. Since students were requested to provide the names of current and past teachers on the Student Survey, it was possible to match students to teachers. Understandably, using the math leader to identify teachers poses some difficulties; however, given the way OSME functioned, and given the math leaders' certainty in classifying the various teachers, it is felt that the analysis was an appropriate sort mechanism.

Table 23 provides a categorization of respondents by participation level. As indicated in Column I, 205 students were instructed by high OSME teachers and 316 by non-OSME teachers. Ninety-five students changed schools or gave a teacher name that was unrecognizable. Separate tests were run on all variables to determine whether or not the absence of these 95 students affected group means and standard deviations. Since no differences were obtained the students were included in the analysis as part of GROUP 2 or 3. In addition, tests were run to determine whether or not there was a primacy or recency affect for GROUP 2 students. Again, there was no difference among students whose present teacher was OSME trained and students whose past teacher was OSME trained. Thus, these groups aggregated.

TABLE 23

NUMBER OF STUDENT RESPONDENTS CLASSIFIED

ACCORDING TO TEACHER PARTICIPATION LEVEL

	Column I 77 - 78 School Year	Column II 76 - 77 School Year
High-OSME Teacher	205	224
Non-OSME Teacher	316	202
Changed School or Teacher Not Codeable		95
TOTAL	512	521

Table 24 provides a classification of treatment group sizes. As can be seen, 101 students were high-OSME (Group 3), 227 students were low-OSME (Group 2), and 193 students were non-OSME (Group 1). (Note that it was possible for a student with missing data in the 1976-77 school year to be classified non-OSME. If a student provided a teacher's name or a district which was unrecognizable, then both their present teacher and their prior teacher were considered non-OSME trained. A separate analysis on these individuals revealed that they were homogeneous with other non-OSME students.)

TABLE 24

A CATEGORIZATION OF STUDENTS ACCORDING TO THREE TREATMENT GROUPS

	Number
High-OSME	101
Low-OSME	227
Non-OSME	193
Total	521

Instrument Development

The procedures undertaken in the construction of the Student Survey were similar to those utilized in the development of the Teacher Survey. That is, OSME documents and onsite interviews with teachers were content analyzed to generate appropriate language; the Survey was reviewed by the Evaluation Review Panel and OSME staff, and the instrument was informally pilot tested with a group of fourth grade children. The approved version of the Student Survey (OMB Approval #99-S78006), consisted of the following scales:

1. Math Scales -- The math scales were used to evaluate student attitude towards mathematics and towards their teachers. The scales consisted of 10 items in the form of a sentence and a drawing of a "thermometer" adjacent to each sentence. Students were asked to indicate how much they agreed with each sentence by drawing a line across the thermometer. Instructions directed them to place the mark high if they thought the sentence described them and low if they thought that the sentence did not describe them.

   Items were coded by overlaying an interval graded template over the thermometer. The scale ranged from zero to ten. Any mark falling in the "bulb" of the termometer was coded a zero. Inter-judge reliabilities were analyzed by comparing the judgment on fifty randomly selected questionnaires. This produced a pool of 500 judgments, and excepting 14 missing items, only 22 errors were observed. Of the 22 errors, 14 were "Judgment calls" due to an angular line across the thermometer. The inter-judge reliability coefficient (Pearson's r) is equal to .97.

   It should be noted parenthetically that this method, originally developed by Market Opinion Research Corporation, proved to be very effective. Nearly all students completed all items. Scale ranges indicated that all values were utilized. Truncated ranges were found where expected. Also, no teachers complained that their students were unable to perform the task. Table 25 provides a label and an explanation for each of the Math Scale Variables.

2. Paired Comparisons -- The paired comparison scale was used to assess student preference for math curriculum. The scale consisted of 15 paired items using six subjects:

   1. spelling
   2. writing
   3. reading
   4. gym
   5. math
   6. art

TABLE 25

STUDENT SURVEY MATH SCALE VARIABLES

LMATH	I like to study my math. This was a direct operationalization of the liking for math concept.
HOMEWRK	I like my math homework. This variable was assumed to measure students' preference for math materials in a traditionally negative context.
MATHFUN	I think math is fun measured the degree to which students enjoy their math course.
LTEACH	I like my teacher. This item was the simple estimation of students' affiliative impulses with respect to their teachers.
THELPS	My teacher helps me when I am stuck. This item was designed to measure the extent of teacher intervention in student work.
GRADEHS	I need math to get good grades in high school. Given OSME's orientation to the practical importance of math learnings, this seemed to be a reasonable operationalization.
MATHJOB	I need math to get a good job when I grow up. This variable was related to the preceding items. Again, the use of demonstrations, and practical problem solving, should have produced differential understandings of the importance of math to "real life" as a function of OSME conditioning.
PARMATH	My parents want me to do well in math. This item was designed to tap into the consequences of student interaction with their parents about mathematics.
MOMDAD	I talk with my mom and dad about my math class. This was designed to tap into students' interactions with their parents.
DLTEST	I don't like to come to school when there is a math test. This variable was supposed to be a negative item measuring student perceptions of the least liked classroom event. In all frankness, this was an unfortunate operationalization. Since OSME emphasized individualization in criteria referencing, there is no reason to expect that OSME students would like math tests any more or less than other students, particularly since the question refers to a finite set.

Students were asked to select the subject they liked most within each pair. Pairs were then coded "checked" or "not checked" (1, 0). A composite score was constructed for each subject by adding the number of 1's or the number of times it was checked. The scale, therefore, ranged from 0 to 5 for each school subject.

3. Other Scales included the following:

a. Occupation -- Students were asked to indicate their occupational choice when they grew up. Occupations were coded for "math content." An occupation was coded a "1" if there was no apparent relationship between knowledge of math and the occupation (e.g. stewardess, basketball player). If there was some relationship between the occupation and math (for example, airline pilot, nurse), the occupation was coded "2." The occupation was coded "3" if there was a clear and important relationship between the occupation and math (e.g. scientist, math teacher). Inter-judge reliabilities were calculated on a sample of fifty responses. (Inter-judge $r = .74$.) Unfortunately, among fourth graders, there is a tendency to select glamorous occupations such as movie star, professional basketball player, and stewardess, over more conventional occupations. Because of these predilections the data were difficult to interpret and were not included in the analyses.

b. Performance in School -- Finally, students were asked to indicate how well they usually did in school subjects and how well they did in mathematics on their last report card. Students responded to these items with either "very well," "about in the middle," or "poor." These items were seen by the researchers as a check against a loaded sample consisting largely of successful students.

Procedure

Student Survey data were gathered in April, 1978. Data were collected in the presence of the students' regular teacher.

Analysis and Synthesis

Data were analyzed using chi square, analysis of variance, and rank ordering. (See Appendix E for Survey.)

EFFECTS ON TEACHERS

Context

Implications for system effects on teachers can be found throughout OSME literature. Goals and activities clearly suggested the improvement of teacher skills and changes in classroom practices as a result of OSME participation.

For elementary teachers, OSME emphasized the use of individualized and highly active learning approaches. Teachers were trained to incorporate games and manipulatives into their classroom repertoire, and to relate mathematics exercises to real world applications. They were also encouraged to seek out a broad range of instructional materials, to make their own materials, and to avoid narrow pedagogical approaches which relied solely upon textbooks.

The orientation for teachers of the "uninvolved" at the secondary level was pedagogically similar to what OSME had stressed at the elementary level. In this case, highly active individualized approaches were related to the need to motivate "turned off" students in general and remedial mathematics.

Finally, an OSME focus on computer literacy involved familiarizing teachers with computer languages, and training them to make use of computer applications, computer-related instructional materials, and computer equipment in the teaching of mathematics.

In light of the emphasis reflected in the teacher training activities sponsored by the Project, the following key questions were formulated with respect to impact on teachers:

1. Did teachers who participated in OSME activities rate themselves higher in skill areas emphasized by the Project than teachers who did not participate?

2. Did teachers who participated in OSME activities implement classroom practices emphasized by the Project more frequently than teachers who did not participate?

The questions were addressed through the math scales and are presented separately for the elementary, math for the uninvolved, and computer components.

1. Elementary

As noted in the description of the teacher sample, sixty three respondents indicated that they had participated in OSME/OMEC sponsored workshops, and 115 respondents indicated they had not. Table 26 provides means for the skill and classroom practice variables as well as variables associated with educational level attained, level of teaching, and years of teaching.

Comparison of the two groups on level of teaching, years of teaching, and educational level attained revealed that they were very compatible. Both samples could be characterized as having attained the Bachelors Degree +45 level of education. More importantly, the average teacher in both samples had more than ten years of teaching experience and taught at the third grade level.

In terms of the math scale variables, the differences between the two groups were slight. (Note: five point Likert-type ratings were used for the scale items, with "1" being the most positive response; thus, the lower the mean, the better.) It is important to point out that the mean ratings for most of the scale items were very low. This means that both OSME teachers and non-OSME teachers rate themselves as being skilled in instructional approaches which were valued by the Project and indicated that they utilized classroom practices emphasized by OSME. The items which received higher mean ratings, indicating a negative response, were related to computer skills and practices -- areas which were not emphasized at the elementary level and where one would not expect to find high skill levels among teachers.

Means were statistically compared using t tests. The results are found in Table 27. In terms of the skill variables (MATHLAB through BASIC), the data revealed no significant differences with the exception of the DIVERSE variable. In this case, OSME teachers considered themselves more skilled in using a diversity of materials then non-OSME teachers. Related to the classroom practice variables, no significant differences were found.

The lack of statistically significant results is consistent with earlier evaluation findings reported by Teaching Research. As noted in the instrumentation discussion of the Teacher Survey, the classroom practice scales were adapted from TR, thus making the above comparison possible.

TABLE 26

ELEMENTARY TEACHER SAMPLE

SIZES AND MEANS FOR SELECTED VARIABLES:

WHOLE SAMPLE, PARTICIPANTS AND NONPARTICIPANTS

Variable*	Whole Sample Mean	Whole Sample N	Participants Mean	Participants N	Nonparticipants Mean	Nonparticipants N
Level Taught	3.2	156	2.9	53	3.0	100
Years Teaching	12.6	189	13.4	61	11.6	115
Education Level	2.1	189	1.98	61	2.11	114
MATHLAB	2.6	189	2.5	62	2.7	114
SELFDEV	2.4	189	2.5	63	2.4	115
PROBSOL	2.5	188	2.6	63	2.5	113
DIVERSE	2.2	189	2.0	63	2.4	114
MATFIND	2.3	187	2.2	63	2.4	112
LERNC	2.8	187	2.7	62	2.8	113
PERSONL	2.4	186	2.3	63	2.4	114
GAMES	2.2	189	2.1	63	2.2	114
CALCU	3.9	186	3.9	60	3.9	115
COMPUTER	4.3	186	4.3	60	4.2	115
COMPMAT	4.3	188	4.3	62	4.2	115
COMEQU	4.4	185	4.4	61	4.3	113
BASIC	4.8	80	4.6	29	4.7	47
NORML	2.0	186	2.0	62	1.9	113
PROJECT	3.7	181	3.8	61	3.7	109
MAGAME	2.7	187	2.8	63	2.8	113
CENTERS	3.6	179	3.6	61	3.6	109
HMMADE	2.3	177	2.3	63	2.2	113
CALCU2	4.7	184	4.6	60	4.7	113
COMREL	4.6	183	4.8	60	4.6	113
MODELS	2.8	184	2.8	63	2.9	111
COMP	4.9	180	4.9	59	4.9	111
ALONE	3.5	184	3.5	62	3.4	112

TABLE 27

ELEMENTARY DATA

t TESTS: PARTICIPANTS BY NONPARTICIPANTS

Variables	Participants N	Participants Mean	Nonparticipants N	Nonparticipants Mean	DF	t Value	Probability
MATHLAB	62	2.5	114	2.7	174	-1.03	.30
SELFDEV	63	2.5	115	2.4	176	.56	.58
PROBSOL	63	2.6	113	2.5	174	.66	.51
DIVERSE	63	2.0	114	2.4	175	-2.58	.01*
MATFIND	63	2.2	112	2.4	173	-1.55	.12
LEARNC	62	2.7	113	2.8	173	- .82	.41
PERSONL	63	2.3	111	2.4	172	- .53	.59
GAMES	63	2.1	114	2.2	175	- .98	.32
CALCU	60	3.9	115	3.9	173	- .08	.94
COMPUTER	60	4.3	115	4.2	173	.48	.63
COMPMAT	62	4.3	115	4.2	175	.98	.33
COMEQU	61	4.4	113	4.3	172	.61	.54
BASIC	29	4.6	47	4.7	74	- .80	.42
NORML	62	2.0	113	1.8	173	1.33	.19
PROJECT	61	3.8	109	3.7	168	.75	.45
MAGAME	63	2.8	113	2.8	174	- .11	.91
CENTERS	61	3.6	109	4.6	168	- .33	.74
HMMADE	63	2.3	113	2.2	174	.14	.89
CALCU2	60	4.6	113	4.7	171	-1.52	.13
COMREL	60	4.8	113	4.6	171	1.31	.19
MODELS	63	2.8	111	2.9	172	- .22	.83
COMP	59	4.9	111	4.9	168	- .01	.99
ALONE	62	3.5	112	3.5	172	.18	.86

*$p < .01$

2. Math for the Uninvolved

Related to this program area, 30 respondents were OSME participants and 31 were not. The characteristics of these respondents in terms of educational level, years of teaching, and the skills and classroom practice variables are found in Table 28. As with the elementary sample, the two groups were comparable on the descriptive variables; for both groups, the average educational level was the Masters Degree and the average number of years in teaching was 12.4 for the OSME group and 13.4 for the Non-OSME group.

In terms of the math scale means, the figures for the math for the uninvolved groups are higher than those for the elementary groups, indicating lower self ratings for skills and classroom practices. Given that secondary level instructional approaches tend to be more structured and less individualized, this finding is not surprising.

A t Test was used to compare the means of the OSME and Non-OSME teachers. The findings are shown in Table 29. As with the elementary findings, the groups did not differ significantly for most of the variables. However, the two instances where significant differences did occur, merit comment. Unexpectedly, in terms of the skill variable concerned with evaluating students through a problem solving approach (PROBSOL), Non-OSME teachers expressed higher confidence. On the positive side, however, the OSME teachers indicated more frequent use of math games (MAGAME) than Non-OSME teachers

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TABLE 28

MATH FOR THE UNINVOLVED TEACHER SAMPLE

MEANS FOR SELECTED VARIABLES:

WHOLE SAMPLE, PARTICIPANTS, AND NONPARTICIPANTS

Variable	Whole Sample		Participants		Nonparticipants	
	Mean	N	Mean	N	Mean	N
Level Taught [a]	-	-	-	-	-	-
Years Taught	12.8	62	12.4	30	13.4	31
Education Level	2.8	62	2.7	30	2.8	31
MATHLAB	2.9	61	3.2	30	2.8	30
SELFDEV	2.5	62	2.4	30	2.6	31
PROBSOL	2.7	61	3.0	29	2.4	31
DIVERSE	2.4	62	2.5	30	2.3	31
MATFIND	2.2	62	2.1	30	2.3	31
LEARNC	3.6	61	3.6	30	3.5	30
PERSONL	2.6	61	2.8	30	2.6	30
GAMES	2.8	62	2.8	30	2.8	31
CALCU	3.0	60	3.3	29	2.8	30
COMPUTER	3.5	60	3.5	29	3.5	30
COMPMAT	3.5	61	3.6	29	3.4	31
COMEQU	3.7	62	3.6	30	3.6	30
BASIC	3.4	51	3.4	26	3.5	25
NORML	2.1	59	2.1	30	2.0	28
PROJECT	4.0	62	4.0	30	4.1	31
MAGAME	3.4	59	3.2	28	3.7	30
CENTERS	4.7	61	4.6	30	4.8	30
HMMADE	2.4	60	2.6	30	2.3	29
CALCU2	4.0	59	4.2	29	3.9	29
COMREL	4.4	61	4.4	29	4.4	31
MODELS	3.8	58	3.8	27	3.8	30
COMP	4.4	62	4.4	30	4.5	31
ALONE	4.1	60	4.0	30	4.2	29

[a]Insufficient responses for calculation

TABLE 29

MATH FOR THE UNINVOLVED

t TESTS: PARTICIPANTS BY NONPARTICIPANTS

Variables	Participants N	Participants Mean	Nonparticipants N	Nonparticipants Mean	DF	*t* Value	Probability
MATHLAB	30	3.2	30	2.8	58	1.48	.14
SELFDEV	30	2.4	31	2.6	59	- .63	.53
PROBSOL	29	3.0	31	2.4	58	2.50	.01**
DIVERSE	30	2.5	31	2.3	59	.60	.55
MATFIND	30	2.1	31	2.3	59	- .75	.46
LEARNC	30	3.6	30	3.5	58	.27	.78
PERSONL	30	2.8	30	2.6	58	.66	.51
GAMES	30	2.8	31	2.8	59	- .29	.77
CALCU	29	3.3	30	2.8	57	1.66	.10
COMPUTER	29	3.5	30	3.5	57	.19	.85
COMPMAT	29	3.6	31	3.4	58	.96	.34
COMEQU	30	3.6	30	3.6	58	0.00	1.00
BASIC	26	3.4	25	3.5	49	- .25	.80
NORML	30	2.1	28	2.0	56	.34	.74
PROJECT	30	3.9	31	4.1	59	- .77	.45
MAGAME	28	3.2	30	3.6	56	- 2.38	.02*
CENTERS	30	4.6	30	4.8	58	- 1.47	.15
HMMADE	30	2.6	29	2.3	57	.95	.35
CALCU2	29	4.2	29	.39	56	1.15	.26
COMPREL	29	4.4	31	4.4	58	- .27	.69
MODELS	27	3.8	30	3.8	55	.40	.67
COMP	30	4.4	31	4.5	59	- .48	.63
ALONE	30	4.0	29	4.2	57	- .83	.41

*$p < .05$
**$p < .01$

3. Computer

The computer sample consisted of 39 respondents, of whom 18 were OSME teachers and 21 were Non-OSME teachers. Descriptive data related to years of teaching and levels of education, found in Table 30 reveal that the groups were comparable. The average level of education for both groups exceeded the Masters Degree level, and the average number of teaching years was 15 for the OSME group and 12 for Non-OSME teachers.

TABLE 30

COMPUTER TEACHER SAMPLE

MEANS FOR SELECTED VARIABLES:

WHOLE SAMPLE, PARTICIPANTS AND NONPARTICIPANTS

Variable	Whole Sample Mean	N	Participants Mean	N	Nonparticipants Mean	N
Level Taught[a]	-	-	-	-	-	-
Years Teaching	13.6	40	15.1	18	12.0	21
Education Level	3.1	40	3.2	16	3.4	19
MATHLAB	2.8	39	2.7	18	2.9	21
SELFDEV	2.5	39	2.4	18	2.5	21
PROBSOL	2.3	39	2.1	18	2.5	21
DIVERSE	2.3	39	2.1	18	2.5	21
MATFIND	2.4	39	2.4	18	2.3	21
LEARNC	3.3	39	3.3	18	2.2	21
PERSONL	2.7	38	2.8	17	2.6	21
GAMES	2.5	39	2.2	18	2.8	21
CALCU	2.6	39	2.3	18	2.9	21
COMPUTER	3.2	39	2.8	18	3.5	21
COMPMAT	3.3	39	2.9	18	3.7	21
COMEQU	3.2	39	2.9	18	3.4	21
BASIC	2.7	24	2.2	12	3.0	12
NORML	2.5	37	2.7	17	2.2	20
PROJECT	3.9	39	3.8	18	3.9	21
MAGAME	3.6	39	3.6	18	3.6	21
CENTERS	4.6	39	4.3	18	4.8	21
HMMADE	2.2	39	4.3	18	4.8	21
CALCU2	3.6	38	3.1	17	3.9	21
COMREL	4.0	39	3.7	18	4.3	21
MODELS	3.5	39	3.0	18	3.9	21
COMP	4.0	38	3.7	18	4.2	20
ALONE	3.8	38	3.5	17	3.9	21

[a]Insufficient response rate for calculation

With respect to the math scales, there were five skill variables and three classroom practice variables that were of particular interest for determining impact with the computer sample. The five skill variables were: 1) using electronic calculators as devices for teaching mathematics skills (CALCU); 2) making use of computer applications in mathematics instruction (COMPUTER); 3) using computer-related instructional materials (COMPMAT); 4) using computer equipment in the mathematics instructional program (COMEQU); and 5) using a programming language such as BASIC or FOCAL (BASIC). The three classroom practice variables related to the actual use of electronic calculators (CALCU2), computer-related materials (COMREL) and computers (COMP) in the classroom.

In general, the lower means found in Table 30 for the OSME teachers indicate that they were more likely to see themselves as skilled, and to use computer-related classroom practices more frequently than the Non-OSME teachers.

Table 31 presents t test results for the math scale means. The data indicates that in almost every instance the direction of the t favored the OSME group. Moreover, in three instances the differences were statistically significant (CALCU, CALCU2, and MODELS). As noted above, CALCU and CALCU2 were two variables of interest to the computer component, the t's approached significance.

TABLE 31

COMPUTER DATA

t TESTS: PARTICIPANTS BY NONPARTICIPANTS

Variables	Participants N	Participants Mean	Nonparticipants N	Nonparticipants Mean	DF	*t* Value	Probability
MATHLAB	18	2.7	21	2.9	37	- .76	.45
SELFDEV	18	2.4	21	2.5	37	- .40	.69
PROBSOL	18	2.0	21	2.5	37	- .19	.07
DIVERSE	18	2.0	21	25.	37	-1.56	.13
MATFIND	18	2.4	21	2.3	37	.42	.68
LEARNC	18	3.3	21	3.3	37	- .02	.98
PERSONL	17	2.8	21	2.6	36	.45	.66
GAMES	18	2.2	21	2.8	37	-2.05	.04*
CALCU	18	2.3	21	2.9	37	-1.82	.08
COMPUTER	18	2.8	21	3.5	37	-1.48	.15
COMPMAT	18	2.9	21	3.7	37	-1.81	.08
COMEQU	18	2.9	21	3.4	37	-1.01	.32
BASIC	12	2.2	12	3.1	22	-1.53	.14
NORML	17	2.7	20	2.2	35	1.12	.27
PROJECT	18	3.8	21	3.9	37	- .74	.46
MAGAME	18	3.6	21	3.7	37	- .06	.95
CENTERS	18	4.3	21	4.8	38	-1.74	.09
HMMADE	18	2.2	21	2.8	38	- .21	.83
CALCU2	17	3.1	21	3.9	36	-2.08	.04*
COMREL	18	3.7	21	4.3	37	-1.78	.08
MODELS	18	3.0	21	3.9	37	-2.30	.03*
COMP	18	3.6	20	4.3	36	-1.42	.16
ALONE	17	3.5	21	3.8	36	-1.12	.27

*p $< .05$

EFFECTS ON STUDENTS

Context

A final aspect of the research design called for an analysis of the effect of OSME programming on students. Initially, the study was to examine student impact in three Project component areas: elementary, math for the uninvolved, and computer. However, the diffuse nature of the latter two programs would have made it extremely difficult and costly to construct student samples. Therefore, the study focused on student effects at the elementary level.

The question of student impact has been a very elusive construct in the research agenda of this evaluation. The OSME program was not designed for direct contact with students. Rather, the project developed teachers' capacity to lead other teachers, and provided opportunities for classroom teachers to learn about innovative approaches which they could use in their classrooms.

As noted throughout this report, the OSME approach stressed developmental, individualized, activity-based teaching strategies which were to be implemented through the extensive use of manipulatives, learning centers, math games, and creative problem-solving exercises. At no point did the Project claim that their efforts would have a direct impact upon student achievement scores. References were made, however, to better classroom interactions between teachers and students, and a greater appreciation for mathematics on the part of students.

In keeping with a systems orientation which directly focused on changing teacher behaviors, the direct system outputs must be thought of as alternative teacher behaviors. The secondary consequences of the alternative behaviors would be higher levels of appreciation for mathematics learning episodes on the part of students who have been instructed by OSME-trained teachers. Thus, the assessment of student effects at the elementary level focussed on student attitudes toward mathematics, student attitudes toward teachers, student perceptions of the relationships between mathematics, and occupational success. The key questions addressed in this assessment were:

1. Are high-OSME students more likely to select mathematics as a preferred subject than low-OSME or non-OSME students?

2. Are high-OSME students more likely to indicate a liking for mathematics than low and non-OSME students?

3. Are high-OSME students more likely to prefer mathematics assignments than low and non-OSME students?

4. Are high-OSME students more likely to involve their parents in their mathematics education than low and non-OSME students?

5. Are high-OSME students more likely to see a higher relationship between mathematics and life success than low or non-OSME students?

These questions were addressed through the various Student Survey scale items which were described previously.

Results

Are OSME Students More Likely to Select Mathematics as a Preferred Curriculum than non-OSME Students?

The paired comparison scales were used to provide data related to this key question. Table 32 presents the mean ranks for the three comparison groups (note non-OSME results appear in the first column and high-OSME in the third column). As can be seen, the non-OSME group tended to give slightly higher ranks for mathematics than the high-OSME group. The differences, however, were not statistically significant; moreover, the overall rank order for the six subject areas, as shown in Table 33 were identical. Interestingly, the mathematics rank was third following gym and art, respectively. Apparently, both OSME and non-OSME students view mathematics as a preferred curriculum to reading, spelling, and writing. In the free choice selection of curriculum, 39 percent of the high-OSME, and non-OSME students indicated math, and 29 percent of the low-OSME students did so.

Are High-OSME Students More Likely to Indicate a Liking for Math Than Low-OSME and Non-OSME Students?

Information pertaining to this key question was gathered through the math scales; three scale variables were of interest: LMATH, HOMEWRK, and MFUN. The results appear in Table 34. An examination of the analysis of variance Table (ANOVA) reveals significant F ratios for the three variables. Post Hoc tests to determine the locus of significance however, indicated that the observed differences did not come from the comparison high-OSME/non-OSME; instead the comparisons between the low-OSME students with high-OSME and non-OSME students produced significant differences. Thus, again, it appears as if Oregon students in general like math, but there is no difference between high-OSME and non-OSME students.

TABLE 32

MEAN PAIR SCORES[a] BY STUDENT GROUPS ON PAIRED COMPARISONS

Variables	Non-OSME	Low-OSME	High-OSME
Mathematics	2.82	2.37	2.77
Spelling	1.25	1.44	1.31
Reading	1.71	1.84	2.07
Writing	1.75	1.63	1.60
Gym	3.53	3.69	3.71
Art	3.70	3.56	3.28

[a]The higher the score (rank) the more preferred the subject

TABLE 33

OVERALL RANKS BY STUDENT GROUPS ON PAIRED COMPARISONS

Variables	All Subjects	Non-OSME	Low-OSME	High-OSME
Mathematics	3	3	3	3
Spelling	6	6	6	6
Reading	4	5	4	4
Writing	5	4	5	5
Gym	1	2	1	1
Art	2	1	2	2

TABLE 34

ANOVA OF MATH SCALE VARIABLES

VARIABLE	Non-OSME Mean	Low-OSME Mean	High-OSME Mean	TOTAL Mean	DF	F RATIO	F PROB.
LMATH	5.8	5.1	6.0	5.5	519	4.4	.01**
HOMEWORK	4.5	3.6	4.1	4.0	518	3.8	.02*
LTEACH	8.2	7.7	7.5	7.9	520	4.5	.01**
MFUN	6.4	5.6	6.6	6.1	519	5.6	.01**
MATHJOB	7.4	7.4	7.3	7.4	517	.03	.97
PARMATH	8.4	8.3	8.8	8.4	516	3.7	.02*
DLTEST	3.9	3.8	4.1	3.9	519	.28	.75
THELPS	8.1	7.8	7.4	7.8	517	2.8	.06
MOMDAD	5.9	4.6	5.6	5.3	518	7.9	.01**
GRADEHS	8.2	8.1	8.6	8.2	515	2.1	.13

*p < .05

**p < .01

Are High-OSME Students More Likely to Prefer Math Assignments Than Low-OSME and Non-OSME Students?

Four variables of the math scales related to this key question: HOMEWRK, MATHFUL, LTEACH, AND THELPS. As indicated previously, HOMEWRK AND MATHFUL did not provide support for a "yes" answer to the question. That is, high-OSME students were not more likely to prefer mathematics assignments than non-OSME students.

In terms of LTEACH and THELPS, Table 34 indicates that both the non-OSME and low-OSME groups had higher mean scores than the high-OSME group. In fact, the difference between high- and non-OSME groups for LTEACH was statistically significant. Moreover 27 percent of the high-OSME students rated their teachers below the scale midpoint on THELPS while only 14 percent of the non-OSME students did the same.

Are High-OSME Students More Likely to Involve Their Parents in Their Mathematics Education Than Low-OSME or Non-OSME Students?

Two variables on the math scales were associated with this key question: MOMDAD and PARMATH. Table 34 indicates statistically significant results for both variables. In terms of MOMDAD, the locus of significance can be attributed to the lower mean score for the low-OSME group; post hoc tests showed no difference between high-OSME and non-OSME students. Thus, high-OSME students were not more likely to talk to their parents about math class then non-OSME.

Related to PARMATH, high-OSME students did attain statistically higher scores than either low- or non-OSME students. Thus, they apparently felt that their parents wanted them to do well in math more so than the other two groups.

Are High-OSME Students More Likely to see a Relationship Between Mathematics and Life Success Than Low- or Non-OSME Students?

The variables MATHJOB and GRADEHS related to this question. As shown in Table 34, no differences of any kind were found for MATHJOB beyond a slight distributional tendency. In fact, very few students failed to recognize the important relationship between math studies and occupational success. More than 75 percent of the sample scored this variable above the scaler midpoint. GRADHS provided some support for the conceptualization implicit in the question; post hoc tests revealed significant differences between high-OSME and low-OSME students, and between high-OSME and non-OSME students.

In summary, the data indicated no support for the contention that high-OSME students feel more favorably toward mathematics or their teachers. The findings are consistent with earlier TR results using a different type of attitude scale.

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DISCUSSION

The findings and discussion related to OSME as a system were, for the most part, quite positive. However, the bottom line for system effectiveness is its impact upon system participants. It has already been discussed that in terms of system members, OSME's influence was apparent. A cadre of leaders was formed who indicated extremely positive feelings about the project and about OSME's influence upon their activities. But, OSME was not only concerned with creating leadership in the state; its main concern was to impact upon teacher attitudes, skills, and classroom practices with an underlying implication that students would be affected as a result.

In considering impact upon teachers and students, an appropriate research question might have been, "to what extent did teacher attitudes, skills, and classroom practices change as a result of the project?" However, the lack of baseline data made this comparison infeasible. Instead, the research questions probed in this study focused upon differences between teachers who had participated in the project and teachers who had not.

The latter design was also fraught with difficulties particularly related to the problem of identifying a "control" group. The fact that OSME affected 61 percent of all elementary teachers and 72 percent of all secondary mathematics teachers almost guaranteed contamination in a statewide study. Therefore, the findings discussed below must be considered in light of a contamination effect.

Teachers

In examining OSME's impact upon teachers, the Evaluators were primarily interested in determining effects upon skill areas, classroom practices, and attitudes.[4] Within the skills area, it was expected that teachers who had participated in OSME workshops in comparison to teachers who had not would feel more highly skilled in: 1) teaching through a math lab approach;

2) developing self-made instructional materials; 3) evaluating students through problem solving methods; 4) identifying general or remedial mathematics materials and methods; 5) setting up learning centers; 6) individualizing instruction; 7) using games and models for teaching math; and 8) using electronic calculators, computer applications, computer equipment, computer language. It was further expected that OSME teachers in comparison to non-OSME teachers would more frequently use with students: 1) math games; 2) learning centers; 3) teacher made instructional materials; 4) manipulatives; and 5) calculators, computer related materials and computers. Also, it was anticipated that OSME teachers would more frequently involve students in long-term projects, and less frequently involve them in seatwork using commercially made materials.

Findings were presented for elementary, math for the uninvolved and computer components. As the data revealed there was very little difference between OSME elementary and math for the uninvolved teachers and non-OSME teachers on either the skills or classroom practice variables. Teachers involved in the computer component however, rated themselves more positively than non-OSME teachers--in some cases the differences were significant and in others, there was definitely a trend toward significance on skill and use variables related to computers and calculators.

In terms of the elementary results, it is interesting to note that the mean ratings for OSME teachers were consistent with those reported in a 76-77 TR study with regard to use variables. However, the TR study also reported lower (less positive on their scale) mean ratings for non-OSME teachers, while the current study indicated similar ratings for the two groups. One possible explanation for the discrepancy can be attributed to the contamination effect. Perhaps, in the two years since the TR study was conducted the non-OSME teachers had a chance to "catch up" to OSME teachers in classroom practices making differences between the groups neglible. Whatever the explanation, it is significant that both OSME and non-OSME teachers report feeling skilled and using classroom practices associated with the OSME approach.

With regard to math for the uninvolved, both groups indicated that they did not feel highly skilled in using classroom materials and methods promoted by OSME and also that they did not frequently use such materials or methods with their students. A possible explanation for this may be that the project emphasis was not as strong at the secondary level.

In terms of the computer component, the findings were encouraging. In this area OSME seems to have made an impact both in terms of skills and classroom usage.

Students

The student findings were similar to teacher results in that all three treatment groups demonstrated positive attitudes towards mathematics, but for the most part there were no significant differences between high-OSME and non-OSME students. Given the possible contamination effect operating for elementary teachers, the results for students are not suprising. It should be noted that TR also conducted a survey of student attitudes towards mathematics and found similar scores for both OSME and non-OSME students.

In conclusion, it is apparent that in Oregon both teachers and students, especially at the elementary level, are favorably disposed toward mathematics whether or not the teachers have been exposed to OSME workshops.

Due to the lack of baseline data and other confounding variables, it is not possible to state conclusively that OSME influenced these results. However, the historical prespective provided by a review of TR evaluation studies related to teacher and student changes indicated increases in innovatve classroom practices over the course of the project. Thus it is probable that OSME affected teacher classroom practices in Oregon.

SECTION III

CONCLUSIONS

Throughout this report, the accomplishments as well as the weaknesses of the Oregon System in Mathematics Education have been presented. Judgments have been made and implications have been discussed. However, the ultimate relevance of the study for the National Science Foundation as well as for other interested parties lies in the conclusions that can be drawn relative to the following major questions.

1. What overall statements can be made about the effectiveness and impact of the Oregon System in Mathematics Education?

2. To what extent did NSF funding of OSME result in a viable systems model for achieving program improvement on a statewide basis?

3. What are the strengths and what are the weaknesses of this model?

4. What elements of OSME have the greatest potential for transportability, and what are the overall implications for future systems planning and implementation efforts?

The conclusions presented in this section relative to these major questions reflect the collaborative insights and recommendations of the Review Panel of Experts and the Evaluation staff.

The Effectiveness and Impact of OSME

Regarding the effectiveness and impact of OSME, the available data supports four general conclusions:

1. The level of teacher involvement stimulated by Project activities was remarkably high. For example, OSME's varied component projects reached an estimated 61% of the State's elementary teachers and an estimated 71% of its secondary teachers. This factor is significant in that one aspect of assessing the effectiveness of a dissemination/training system relates to the spread and exchange of ideas -- participation is indispensable to spread and exchange. A cynic might note the paucity of data documenting the effectiveness of spread and exchange activities; but it is clear that the attention of the target group was gained by the OSME Project.

2. System Members expressed uniformly positive perceptions of and satisfaction with, OSME programs and activities. The evidence revealed: high congruency between system member's goals and their perception of OSME emphasis on goals; congruence between system member's overall communication preferences and the mode used most frequently by OSME; concurrence on perceived effective leadership by the OSME staff; and expressions of satisfaction about participation in Project activities. Although positive affective responses by participants are no guarantee of change in behavior or increased effectiveness,

dissatisfaction and negative perceptions would be strong evidence that little or no change had occurred. OSME avoided this outcome at least on a system level basis.

3. Although evidential data on the effects of individual projects were not gathered systematically throughout the Project, there was concrete evidence that change was effected within Oregon educational agencies through participation in OSME activities. Furthermore, there was evidence of institutionalization of some of these changes. At the SEA level, as a result of involvement with OSME, the role of the Mathematics Specialist changed from that of a direct consultant to a facilitator and resource linker. Mathematics professional organizations in Oregon flourished as a result of support and influence. At the LEA level, evidence indicated that the twelve elementary resource centers initiated through OSME funding were maintained after funding ceased, and the "circuit rider" programs were continued through local district support in Oregon's Harney, Lake, and Eugene counties. Higher education institutions were also influenced. OSME methods were adopted in the pre-service training programs at all of the major schools of education in the state and these institutions are maintaining instructional resource centers that were initiated through OSME funding.

4. There is no evidence available to support the contention of impact by OSME on either the classroom behavior of teachers or the attitude of students toward mathematics except in the area of computer use. This conclusion must be examined in light of certain factors, however. Viewing the project in light of process and summative emphases leads to an interesting counterpoint of findings. By and large, formative questions of effectiveness can be answered in the affirmative, while summative questions of impact on teachers and students must be answered negatively in terms of the evidence at hand. However, the dearth of summative impact cannot be interpreted as a totally negative judgment of the Project's efforts in Oregon. Whatever the reasons, the blame can be placed broadly. First, the structure, process, and support for internal evaluation never adequately materialized. Secondly, the need for external evaluation was recognized too late for the installation of designs appropriate to the nature of the Project. Thus, as the Project drew to a close, summative evaluation results were insufficiently powerful, sampling problems interfered with control group measurement, and analyses incorporating pre-post measurement were infeasible. The problems that result from these factors arise seriously in the interpretation of findings. As mentioned in the report, there is much that can never be determined about the Project's impact on teachers and students because of the weaknesses in evaluation caused by conditions over which the Capla study had no control. The possibility for assessing summative impact was severely impeded by the lack of rigorous documentation and evaluation procedures throughout the project.

Other considerations also come to mind in the interpretation of the summative findings. There was clear agreement in OSME's needs assessment and goal statements that change in teacher attitudes and behavior was an essential outcome of OSME as a Project, and Project efforts were consistent with those expectations. That strong differences between OSME and non-OSME teachers did not occur, therefore, may be viewed with legitimate disappointment.

However, in light of sampling contamination, it is not definite that the OSME and non-OSME teacher samples were substantially different from each other in terms of their exposure to the OSME Project. As the report pointed out, large numbers of Oregon teachers had been reached by OSME over the course of five operational years. The fact that some teachers had not participated directly in OSME Projects does not rule out the strong possibility, over that length of time, that they would not have been influenced by the publicity and wide-spread communication surrounding it. Other influences also may have operated to weaken differences between OSME and non-OSME teachers: attendance at professional society meetings where OSME was discussed; journal articles on the subject; in-service training programs; school system newsletters to all teachers; and, personal-social contacts among teachers.

It is interesting to speculate on the possibility that differences between OSME and non-OSME teachers might have been found if measurements had been taken much earlier, for example, at one or two years after the introduction of the Project, when the OSME and non-OSME teachers would have been more cleanly differentiated. One could further hypothesize that early differences might erode as time passed. If this is true, a retrospective analysis conducted five years after program introduction would reveal only the results of the "wash-out" of differences, and in no way could show what positive effects had occurred earlier. It is also important to note that the absence of pre-post measurements obviated the possibility to establish changes in the behavior of OSME teachers: the comparison of post-treatment findings for the OSME and non-OSME teachers does not of itself attest to the fact that gains had not occurred in the OSME group as a result of participation.

In terms of student impact, this outcome was not overtly specified by OSME and when it was, it received low priority among the direct consequences to be expected from the Project. Since direct student results had not been built into the Project design, the Project cannot be judged as a failure in this respect.

In summary, notwithstanding an inability to ascertain the magnitude of effects that the foregoing factors had on the impact results that were obtained, it is clear that the findings of "no difference" between OSME and non-OSME teachers, or for that matter their students, cannot be accepted as a "true" assessment of the Project.

OSME As a State Systems Model

Viewing OSME as a Systems Model is a complex consideration. At the simplest level, one might ask whether OSME achieved the "systems approach" to program improvement envisioned by NSF. This was defined as "---an effort to sharpen the focus of state and local government and private agencies, now engaged in educational activities more or less independently, to deal with the mathematics needs of a region or state." The answer to that question is "yes". The positive response to that query is made easier by the fact that at the next higher level of questioning, the Capla study imposed stronger criteria for determining "systemness" than was included in the NSF definition; and study results presented convincing evidence that OSME did, indeed, meet the criteria normally used to define formal, temporary systems.

The more nagging question is whether or not the system created by OSME is a state systems model for program improvement. In the sense that any functioning organizational entity can be construed as a model for all subsequent entities the answer is simple enough. But there is little or no evidence that the inventors of the "model" had any systematic plan in mind for addressing questions of the generalizability or utility of their program improvement efforts for other states or regions. They set out to sharpen the focus of state and local agencies on mathematics needs in Oregon using strategies and tactics that seemed to fit their state and their style. This resulted in some unique strategies and tactics which would be of varying utility in other states depending upon such factors as: (1) the historical development of program improvement efforts in mathematics in such states; (2) the configuration of educational organizations and agencies within the states; and (3) the size and complexity of the states.

Thus, OSME's strength as a system model does not rest in its potential for emulation and exportability. As noted above, too many factors complicate an assessment of OSME in this respect. However, when OSME is assessed as a demonstration of the fact that program improvement in mathematics education can be organized on a statewide basis to involve all pertinent organizations, agencies, and institutions, it must be concluded that OSME was an effective systems model.

Strengths and Weaknesses of the OSME Model

The descriptive information about OSME revealed several characteristics which might be termed features of the "model". Certain of these elements seemed essential to the Project's success, and thus might be called the system's strengths. These included:

1. A consensus-based philosophical orientation toward improvement in mathematics education exemplified by the developmental, problem-solving approach.

2. A needs-based definition of activity areas as reflected in the component sub-project structure.

3. A sanctioning organization which integrated OSME with the state leadership in mathematics education - OMEC. This might be considered to be a device for sustaining an operational level of consensus.

4. A leadership team and staff committed to: (a) advocacy of the philosophic orientation; (b) confidence in local professionals to carry out project level activities; and, (c) a general posture of stimulation and support rather than specification and control.

5. An inclusive program approach, with activities spanning the elementary through collegiate levels and involving all concerned state agencies.

6. Procedures consonant with the emphasis on stimulation and support: (a) a proactive staff traveling throughout the state stimulating interest in OSME; (b) a grant procedure designed to help rather than judge submitters of proposals; (c) a flexible financing structure; and, (d) an informal reward system.

It might be argued that OSME re-adopted its philosophical orientation toward mathematics education as its general change strategy for program improvement in Oregon, i.e., a developmental, problem-solving approach. OSME seems to have tried to accept individuals and agencies where they were and supported them to do what they wanted to do leading to such observations in the study as:

> "The open evolving quality allowed agencies/institutions to grow and change within themselves as a result of participation in the Project."

> "The data revealed that the Project allowed system members to grow in a way that was congruent with their professional needs and interests. Specifically, individuals from different educational backgrounds and professional roles expressed satisfaction with project activities."

The OSME approach seemed to combine Havelock's problem-solving model of educational change with the description of the configuration change process in education explicated by Guba and Clark (1975). The latter authors argued that the change process depends upon the willingness of the change agency to accept the goals of educational agencies and individuals as the building blocks upon which change efforts must be constructed.

The Capla study also noted features of OSME which could be construed as weaknesses. As the Project progressed, the evaluation component became less and less integrated into the mainstream of Project activities, and very little emphasis was placed upon systematic evaluation and monitoring processes. Thus, little written documentation existed related to Project activities, and it was virtually impossible to determine the real impact of OSME on teacher behavior in the State. The study also noted that while a philosophic commitment to a particular approach to mathematics education provided a common language and perspective for system participants, it also resulted in the exclusion of some educators who might have participated.

While the above factors seem to represent identifiable and supportable weaknesses, the nature of how systems operate complicates the process of classifying characteristics as either strengths or weaknesses. The elements of OSME were integrated within the Project system and manipulating one to remedy an apparent weakness might provoke unanticipated consequences for other elements. Conversely, adopting one or a sub-set of OSME elements which appeared to be strengths might lead to less than anticipated results because others were not chosen for adoption. Could OSME have remedied its most visible weaknesses in evaluation, documentation, and monitoring and still retained its flexibility, responsiveness, informality, and confidence in local professionals? The answer to this question is not at all obvious.

The components of a dissemination/training system such as OSME are probably better viewed as a series of trade-offs rather than a list of strengths and weaknesses. The low level of OSME functioning in evaluation and monitoring may have been the trade-off necessary to maintain other positive features in the system; just as very informal grant procedures increased local enthusiasm for OSME; and the unifying focus provided by the philosophic orientation advocated by the central staff eliminated the participation of some educators.

Transportability and Future Implications

As noted earlier, answers to questions related to OSME transportability depend heavily on the destination of the transfer. Thus, it is more meaningful to conjecture about the features of OSME which seem worthy of further exploration and experimentation in other states.

- Perhaps explicitly, probably implicitly, OSME seems to have assumed the posture that educational agencies and individuals have self-improvement agendas of their own; and that supporting their ideas and programs will cumulate over time into a synergistic system of reinforcing program improvement efforts. Few change agencies have adopted this posture. It deserves further exploration.

- OSME seems to have been able to balance a sense of direction against overdirectedness. Perhaps this was achieved by avoiding a traditional needs survey and concentrating instead on establishing goals consensus. This approach was apparent at all levels of project operations and merits further use as an alternative goal-setting process in large scale projects.

- The concept that grants can be viewed as mutually developed performance contracts, and that the role of the change agent is to stimulate, foster, and refine rather than to judge ideas, seems worthy of further study.

- One of the keys to OSME success appears to have been inclusiveness rather than exclusiveness. All educational agencies within the State were encouraged to participate in the program. No one organization was identified as a key agency or an agency which constrained others by such processes as approval or sanction. The activity components stretched across grade level interests although the philosophical orientation placed some broad boundaries on inclusiveness.

- OSME achieved communication among professionals across agency lines at a level that is rarely discovered in evaluation of program improvement efforts. This seems to have been achieved by avoiding the error of compelling individuals and agencies to submit joint projects or to work together. Again, the concept of allowing agencies and agents to work at their own improvement efforts may be the best way to foster interagency communication.

In conclusion, the overall impression of the Evaluation staff and Review Panel of the Capla Study is that OSME was a successful program improvement effort. What made it work seems to have been its openness, inclusiveness, flexibility, and trust in Project participants. Those very features provoke an anomaly for most funding agencies which are required to demonstrate accountability, prudence, and solid evidence of effectiveness. We may have to learn slowly from the incomplete documentation of many OSME-like programs that effective change systems rely on looser management structures than have been considered tolerable in the past.

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APPENDICES

APPENDIX A

FACTOR LOADINGS AND INTER-ITEM CORRELATIONS FOR ACTIVITY SATISFACTION SCALES

TABLE A

FACTOR LOADINGS FOR ACTIVITY SATISFACTION SCALES

VARIABLE LABEL[a]	FACTOR 1
VAR020	.88
VAR021	.84
VAR022	.80
VAR023	.78
VAR024	.82
VAR025	.69
VAR026	.72
VAR027	.63

[a]The items are tested as VAR020 to VAR027 for convenience sake. See page in report for operational definitions.

TABLE B

INTERITEM CORRLEATIONS FOR ACTIVITY SATISFACTION SCALES

	Variable Labels						
	VAR020	VAR021	VAR022	VAR023	VAR024	VAR025	VAR026
VAR020							
VAR021	.75						
VAR022	.71	.68					
VAR023	.64	.58	.65				
VAR024	.69	.65	.74	.79			
VAR025	.62	.67	.51	.47	.47		
VAR026	.65	.55	.49	.64	.63	.44	
VAR027	.54	.58	.44	.43	.38	.63	.47

APPENDIX B

SYSTEM QUESTIONNAIRE

Office of Management and Budget
Expires: December, 1978
Approval Number: 99-578006

OREGON SYSTEM IN MATHEMATICS EDUCATION

SYSTEM QUESTIONNAIRE

This questionnaire consists of two major sections. Section I is entitled "System Evaluation," and Section II, "System Communication." Since you have been identified as a key person in OSME activities, we would appreciate your carefully answering the sections and returning them as quickly as possible in the postage-paid envelope which is provided. Thank you.

SECTION I

SYSTEM EVALUATION

1. What is your position/job title (e.g., third grade teacher, assistant principal, etc.)? ____________ (Position)

2. Were your OSME activities mostly connected with:

- -Workshops or inservice courses for elementary teachers ☐
- -Mathematics for the uninvolved ☐
- -Computer education programs ☐
- -Other ____________ (Specify) ☐

3. In the past five years, about how many OSME-sponsored workshops and/or inservice sessions have you participated in? ____________ (Number)

4. Did you participate in any National Science Foundation sponsored institutes prior to OSME? ☐ Yes ☐ No

5. With regard to your educational background, what is your present status? (Check highest degree.)

Education	Major Field		Education	Major Field	
Bachelor's Degree	____________	☐	Master's Degree plus 45 quarter hours	____________	☐
Bachelor's Degree plus 45 quarter hours	____________	☐	Doctorate (Ph.D., Ed.D., etc.)	____________	☐
Master's Degree	____________	☐	Other ____________ (Specify)	____________	☐

6. Please indicate from whom and how you first heard about OSME (i.e., from a friend, at a meeting, from a newsletter, from a person connected with a university). ____________ (Specify)

7. In a few sentences, can you describe your role in OSME?

____

____

____

____

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8. Please provide the following information about all OSME-sponsored projects which you directed or coordinated?

PROJECT	BEGINNING DATE	ENDING DATE	AVERAGE DAYS PER MONTH DEVOTED TO PROJECT ACTIVITY
a.			
b.			
c.			
d.			
e.			
f.			

9. Please rate the following statements in view of your experience(s) in OSME-sponsored projects. Circle the number which most closely represents your feelings. The number "1" indicates that you strongly agree with the statements, while the number "5" indicates strong disagreement.

	Strongly agree	Agree	No opinion	Disagree	Strongly disagree
a. The activities in which I participated responded to my professional needs.	1	2	3	4	5
b. I have been able to utilize the ideas presented in the project(s) in my work.	1	2	3	4	5
c. The activities in which I participated met my expectations.	1	2	3	4	5
d. I would welcome the opportunity to participate in additional similar activities.	1	2	3	4	5
e. I would recommend the same experience to a colleague.	1	2	3	4	5
f. Participation in the project(s) has led to a change in my teaching/administrative style.	1	2	3	4	5
g. Participation in the project(s) has led to expanded communication with other professionals.	1	2	3	4	5
h. Noticeable changes have occurred in my students because of my involvement with the project(s).	1	2	3	4	5

10. From your own perspective, rank order the following ten goal statements in terms of: a) how important they are to OSME, and b) how important they are to your own activities in association with OSME. Place a "1" on the line next to the most important goal, a "2" next to the second most important goal, etc., until all ten goals have been ranked. Remember to do this for both columns.

	IMPORTANT TO OSME	IMPORTANT TO ME
a. Build and strengthen professional organizations in mathematics education	_____	_____
b. Improve teacher attitudes towards mathematics	_____	_____
c. Develop mathematics education leaders	_____	_____
d. Improve elementary mathematics education	_____	_____
e. Improve student attitudes towards mathematics	_____	_____
f. Develop illustrative mathematics programs in elementary and secondary schools	_____	_____
g. Improve communication among mathematics educators and various organizations	_____	_____
h. Strengthen and assist professional organizations	_____	_____
i. Improve student performance in mathematics skills	_____	_____
j. Improve the instructional use of computers in the schools	_____	_____
k. Improve secondary mathematics education	_____	_____
l. Other:	_____	_____

Indicate by letter of goal

11. Which one of the above goals came the closest to being attained as a consequence of OSME? _____

Which came second? _____

Which came third? _____

12. Do you feel that OSME failed to attain any of the above goals? ☐ Yes ☐ No

If yes, please indicate by letter (a,b,c,etc.) from above list, which goals you felt were not attained. ____ ____ ____ ____ ____

13. During the past five years, have you had any association with the following agencies relative to your role as a mathematics educator? (Check "yes" or "no" for each agency listed below.)

	Yes	No
a. OREGON MATHEMATICS EDUCATION COUNCIL (OMEC)	☐	☐
b. OREGON MUSEUM OF SCIENCE AND INDUSTRY (OMSI)	☐	☐
c. STATE DEPT. OF EDUCATION (SDE)	☐	☐
d. OREGON COUNCIL OF TEACHERS OF MATHEMATICS (OCTM)	☐	☐
e. OREGON ELEMENTARY SCHOOL PRINCIPALS ASSOCIATION (OESPA)	☐	☐
f. OREGON COUNCIL OF COMPUTER EDUCATION (OCCE)	☐	☐
g. OREGON ASSOCIATION OF SCHOOL SUPERVISORS (OASS)	☐	☐
h. EDUCATION COORDINATING COUNCIL (ECC)	☐	☐
i. OREGON EDUCATION ASSOCIATION (OEA)	☐	☐
j. TEACHERS OF TEACHERS OF MATHEMATICS (TOTOM)	☐	☐
k. TEACHING RESEARCH (TR)	☐	☐
l. ANY OTHER AGENCY? ______________ (Specify)	☐	☐

14. When you have a question related to mathematics education, what group(s) do you customarily contact for an answer?

____

15. Please rank order the following six communication methods (a-f) in terms of: 1) your frequency of use in OSME activities, and b) your personal preference. For each column, use "1" to represent the highest, etc., until all six methods have been ranked.

	FREQUENCY	PREFERENCE		FREQUENCY	PREFERENCE
a. FACE-TO-FACE	____	____	d. GENERAL MEMO	____	____
b. TELEPHONE	____	____	e. PERSONAL LETTER	____	____
c. GROUP MEETING	____	____	f. NEWSLETTER	____	____

16. a. How many times a year did OSME monitor or evaluate your project(s)?

________ (Times per year)

b. Please identify the two most common methods OSME staff members used to ask you about your program or project. Place a "1" in the box next to the method most commonly used, and a "2" next to the second most commonly used.

a. Mailed questionnaire ☐
b. Free form written material ☐
c. Personal site visitation ☐
d. Telephone calls ☐
e. Other ______________ (Specify) ☐

17. a. Have you ever been a workshop or inservice leader for OSME in the past five years? ☐ Yes ☐ No

b. If yes, how many times (check appropriate box)?

☐ less than 10 ☐ 26 - 50

☐ 11 - 25 ☐ over 50

c. Did you ever receive a fee or honorarium when you conducted workshops or inservice courses? ☐ Yes ☐ No

18. a. As a result of your OSME activities, did you ever attend an out-of-state convention? ☐ Yes ☐ No

b. If yes, what percent of your expenses were ever paid by OSME? ______ (Percent)

19. a. Did you ever make a formal presentation at an out-of state convention (e.g., led a workshop)? ☐ Yes ☐ No

b. Did you ever have an opportunity to speak before a group as a result of OSME-related activities? ☐ Yes ☐ No

20. Did your participation in OSME provide you with an opportunity to publish your thoughts or views? ☐ Yes ☐ No

21. Did you ever receive financial support from OSME or OMEC? ☐ Yes ☐ No

22. Do you provide leadership in mathematics education at your job or local district? ☐ Yes ☐ No

23. Do you annually upgrade and/or change program material you use in providing service to your students? ☐ Yes ☐ No

PLEASE CONTINUE ON TO SECTION II.

SECTION II

SYSTEM COMMUNICATION

What is meant by "communication?" You communicate whenever you talk with someone on a face-to-face basis, use the telephone, or write or read a letter or memo. Exchanging ideas or advice, or asking or receiving people's views, are examples of communication. We would like you to describe your communication contacts with other mathematics education personnel throughout the state. The results of this part of the study will allow the construction of an overall "map" of information flow in the state.

On the pages that follow, the names of some 200 people who have been associated with the Oregon System in Mathematics Education are arranged alphabetically. A preliminary identification number is next to each name: a final number will be assigned by the evaluation staff to keep your replies confidential. However, in order to avoid problems caused by personnel changes, we need to verify that the person to whom this questionnaire is sent is the one who completes the form. Therefore, please sign your name on the first page of the communication section. No one besides the evaluation staff will have access to your individual reply. Without your name, your data cannot be used to construct the communication network.

There are three columns next to the name of each person. Each column heading refers to a different topic of professional communication you might have had with a colleague. The types of communication topics are defined as follows:

Column I: A discussion related to math education ideas promoted by OSME/OMEC--materials, programs, and approaches emphasized by the project.

Column II: A discussion related to OSME/OMEC operations--goals, organization, and procedures.

Column III: A professional discussion having no relationship to OSME/OMEC.

We are interested in finding out from whom you sought and/or received information about these communication topics--this could have been on a face-to-face basis, by telephone, or by written memo.

Please read down the list of names and decide whether you have communicated with each person at least once in the past three or so years on one or more of the three topics. If you have communicated a lot in the past few years, place a "3" in the box. If you have communicated about average (compared to communication with other colleagues), place a "2" in the box. If you have communicated very little, place a "1" in the box. If you have not communicated at all, either about a topic, or with an individual, leave the boxes blank.

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EXAMPLE: An example of how to fill out the form is shown below. The three topic headings are in columns. The number "1" in the first column adjacent to person 128 means that you communicated with D. Bouchard a little in the past three years about OSME/OMEC approaches. The second row is left blank because you did not communicate with person 037 at all. However, with person 465 you communicated (1) a little about OSME/OMEC approaches, (2) an average amount about OSME/OMEC operations, and (3) had a lot of professional discussion not related to OSME/OMEC.

	Communication Topic I: Discuss OSME/OMEC Math Ed. Approaches	Communication Topic II: Discuss OSME/OMEC Operations	Communication Topic III: Non-OSME/OMEC Professional Discussions
	PAST 3 YEARS		
Contact Names	Amount	Amount	Amount
128 Bouchard, D.	1		
037 Miller, J.			
465 Richards, N.	1	2	3

PLEASE CONTINUE WITH SYSTEM COMMUNICATION.

15?

APPENDIX C

FACTOR LOADINGS AND INTER-ITEM CORRELATIONS

FOR TEACHER MATH SCALES

TABLE C

FACTOR LOADINGS FOR TEACHER MATH SCALE

Variables	Factor 1	Factor 2	Factor 3	Factor 4
CALCU	.66			
COMPUTER	.94			
COMPMAT	.94			
COMEQU	.92			
BASIC	.79			
COMREL	.65			
COMP	.63			
MATHLAB		.60		
SELFDEV		.62		
PROBSOL		.54		
DIVERSE		.74		
MATFIND		.61		
LERNC		.62		
PERSONL		.62		
GAMES		.61		
MAGAME			.63	
CENTERS			.68	
MODELS			.68	
CALCU2				.55
*NORML				
*PROJECT				
*HMMADE				
*ALONE				
Eigenvalue	5.37	4.76	1.02	.59
% of Variance	46%	40.6%	8.7%	5.0%

*These variables did not load on any factors

TABLE D

Inter-Item Correlations--Elementary Data

	MATHLAB	SELFDEV	PROBSOL	DIVERSE	MATFIND	LEARNC	PERSONL	GAMES	CALCU	COMPUTER	COMPAT	COMEQU	BASIC	NORML	PROJECT	MAGAME	CENTERS	HMMADE	CALCU2	COMPREL	MODELS	COMP	ALONE
MATHLAB																							
SELFDEV	.49																						
PROBSOL	.42	.48																					
DIVERSE	.52	.60	.54																				
MATFIND	.35	.39	.50	.47																			
LEARNC	.54	.57	.41	.53	.48																		
PERSONL	.41	.48	.46	.48	.51	.48																	
GAMES	.42	.61	.42	.59	.35	.52	.39																
CALCU	.13	.01	.25	.15	.17	.16	.18	.18															
COMPUTER	.16	.04	.26	.18	.19	.14	.17	.17	.76														
COMPMAT	.15	.01	.27	.14	.17	.15	.16	.14	.70	.91													
COMEQU	.16	.02	.24	.17	.18	.17	.21	.15	.63	.80	.86												
BASIC	.11	.16	.15	.16	-.03	.09	.09	.01	.31	.25	.18	.21											
NORML	-.11	-.20	-.15	-.06	-.20	-.09	-.14	-.17	.00	-.09	-.03	-.07	.16										
PROJECT	.35	.20	.22	.22	.23	.17	.26	.23	-.02	.27	.24	.24	.23	.09									
MAGAME	.16	.31	.25	.31	.24	.34	.28	.46	-.02	.02	.00	.02	.00	-.04	.12								
CENTERS	.36	.38	.31	.37	.23	.56	.22	.40	.06	-.04	-.03	.00	.15	-.01	.12	.51							
HMMADE	.21	.41	.23	.28	.18	.28	.35	.38	.51	.01	-.02	.04	.05	-.11	.08	.40	.42						
CALCU2	.04	-.04	.09	.05	.11	.10	.07	.03	.28	.42	.38	.23	.23	-.04	.03	-.08	-.02	.00					
COMPREL	.15	.03	.15	.09	.19	.09	.08	.10	-.10	.51	.53	.45	.05	-.09	.32	.15	.00	.07	.35				
MODELS	.29	.41	.28	.37	.21	.35	.28	.41	.27	-.04	-.07	.00	.04	-.13	.18	.48	.48	.43	-.05	.07			
CPMP	.06	.04	.16	.13	.04	.14	.05	.06	.08	.33	.35	.34	.08	.08	.12	.06	.09	.03	.31	.42	.00		
ALONE	.28	.27	.23	.17	.16	.29	.25	.22	.09	.04	.04	.14	.11	-.08	.28	.10	.32	.27	.02	.00	.36	.10	

TABLE E

Inter-Item Correlations--Math For the Uninvolved Data

	MATHLAB	SELFDEV	PROBSOL	DIVERSE	MATFIND	LEARNC	PERSONL	GAMES	CALCU	COMPUTER	COMPMAT	COMEQU	BASIC	NORML	PROJECT	MAGAME	CENTERS	HMMADE	CALCU2	COMREL	MODELS	COMP	ALONE
MATHLAB																							
SELFDEV	.32																						
PROBSOL	.27	.17																					
DIVERSE	.58	.52	.26																				
MATFIND	.32	.52	.18	.68																			
LEARNC	.65	.30	.16	.70	.49																		
PERSONL	.31	.26	.12	.48	.48	.60																	
GAMES	.52	.37	.23	.53	.32	.54	.41																
CALCU	.35	.03	.14	.14	-.05	.28	.25	.39															
COMPUTER	.03	-.30	-.16	-.05	-.22	.22	.14	.05	.43														
COMPMAT	.11	-.27	-.10	.07	-.18	.24	.11	.09	.42	.90													
COMEQU	.06	-.19	-.02	.01	-.22	.24	.12	.02	.43	.82	.82												
BASIC	.16	-.06	-.09	-.04	-.18	.21	.04	.06	.43	.67	.69	.74											
NORML	.01	-.14	.08	-.09	-.08	.03	-.05	.01	.09	.03	-.02	-.01	-.06										
PROJECT	.27	.34	.26	.38	.33	.35	.18	.32	.04	.10	.25	.32	.23	-.26									
MAGAME	.26	.31	.28	.33	.35	.36	.27	.52	-.00	.02	.05	.09	-.03	-.14	.43								
CENTERS	.18	.17	.15	.27	.19	.28	.26	.29	.13	.24	.11	.26	.09	-.04	.29	.38							
HMMADE	.21	.06	.19	.06	.21	.21	.29	.06	.06	.22	.13	.17	.14	-.14	.23	.23	.15						
CALCU2	.24	.01	.02	.00	-.10	.11	.12	.12	.60	.21	.21	.29	.26	-.08	.15	-.09	.01	.23					
COMREL	.02	.05	-.08	.21	.10	.20	.27	.03	.17	.57	.56	.65	.54	-.06	.37	.11	.41	.22	.12				
MODELS	.45	.23	.08	.31	.19	.29	.17	.52	.29	.02	.03	.01	.02	-.17	.38	.43	.34	.12	.28	.06			
COMP	.11	-.07	-.06	.09	-.08	.17	.11	-.01	.16	.56	.49	.65	.48	-.09	.26	.19	.37	.22	.17	.85	.20		
ALONE	.12	.25	.14	.32	.34	.17	.32	.21	.14	.15	.12	.17	.20	-.14	.46	.27	.23	.10	.01	.34	.43	.25	

TABLE F

Inter-Item Correlations--Computer Data

	MATHLAB	SELFDEV	PROBSOL	DIVERSE	MATFIND	LEARNC	PERSONL	GAMES	CALCU	COMPUTER	COMPMAT	COMEQU	BASIC	NORML	PROJECT	MAGAME	CENTERS	HMMADE	CALCU2	COMPREL	MODELS	COMP	ALONE
MATHLAB																							
SELFDEV	.69																						
PROBSOL	.21	.11																					
DIVERSE	.42	.41	.45																				
MATFIND	.15	.19	.10	.25																			
LEARNC	.44	.48	-.01	.21	.41																		
PERSONL	.32	.38	.32	.39	.28	.33																	
GAMES	.57	.65	.32	.57	.43	.46	.37																
CALCU	.46	.33	.22	.44	.19	.48	.10	.43															
COMPUTER	.08	.07	.03	.18	.02	.19	-.01	.15	.51														
COMPMAT	.18	.17	.10	.26	.03	.24	-.00	.21	.58	.97													
COMEQU	.08	.09	.01	.20	.04	.21	-.01	.11	.51	.98	.97												
BASIC	.04	.16	.30	.37	.11	.11	-.13	.30	.67	.88	.88	.89											
NORML	.18	.15	.01	-.07	.22	.07	.48	.04	.00	-.12	-.11	-.10	-.44										
PROJECT	.35	.25	.02	.14	.13	.37	-.13	.32	.42	.42	.46	.43	.51	-.05									
MAGAME	.13	.33	-.12	.07	.15	.17	.09	.34	.07	.25	.28	.27	.15	.13	.32								
CENTERS	.41	.28	.30	.19	.02	.23	.12	.36	.23	.12	.17	.12	.02	.21	.45	.29							
HMMADE	.33	.45	-.04	.17	.04	.18	.00	.16	.31	.02	.14	.10	.08	.17	.17	.05	.16						
CALCU2	.30	.05	-.17	.04	-.23	.28	-.26	.09	.49	.34	.35	.30	.27	-.23	.39	.02	.29	.10					
COMREL	.19	.25	-.05	.18	-.14	.23	-.01	.23	.39	.59	.61	.62	.45	-.08	.37	.41	.33	.20	.51				
MODELS	.17	.20	.09	.20	.05	.31	-.13	.41	.42	.16	.22	.16	.49	-.19	.33	.10	.21	.26	.41	.42			
COMP	.15	.25	-.18	.13	-.09	.26	-.11	.28	.34	.64	.62	.63	.52	-.17	.34	.40	.23	.07	.56	.87	.33		
ALONE	.36	.35	.04	.01	-.36	.27	.02	.13	.21	.33	.38	.32	.18	-.11	.18	.16	.31	.26	.43	.45	.24	.44	

APPENDIX D

TEACHER SURVEY

Office of Management and Budget
Expires: December, 1978
Approval Number: 99-S78006

OREGON SYSTEM IN MATHEMATICS EDUCATION
(OSME)

TEACHER SURVEY

Please complete Section I and II of the Survey. The information you provide will be kept strictly confidential. Identification information which requests your name and name of school is used for maintaining a record of questionnaire returns only. Thank you for your time and consideration.

NAME ________________ NAME OF SCHOOL ________________

SECTION 1

1. a. Please indicate the level at which you teach by circling the appropriate grade or grades.

K 1 2 3 4 5 6 7 8 9 10 11 12

b. How many years have you taught? ________ (Years)

2. How often do you teach mathematics?

One period a day _____ At least half of the school day _____ Full time _____

3. On the average, how many different students do you teach in the course of a school year? ________ (No. Different Students)

4. With regard to your educational background, what is your present status? (Check highest degree)

Bachelor's Degree ________

Bachelor's Degree plus 45 quarter hours ________

Master's Degree ________

Master's Degree plus 45 quarter hours ________

Doctorate (Ph.D., Ed.D., etc.) ________

Other ________ (Specify) ________

5. How many courses in mathematics and/or mathematics education have you taken in the past five years - include both credit and non-credit in-service courses as well as graduate courses.

________ No. Courses

6. Please identify any courses you remember as outstanding - please indicate the course name, the course sponsor (this could be a college/university, school district, or an agency such as the State Department of Education. OCTM, or OMEC), and the course instructor.

	COURSE NAME	COURSE SPONSOR	COURSE INSTRUCTOR
a.			
b.			
c.			

7. a. Have you been a member of the Oregon Council of Teachers of Mathematics (OCTM)? ____ Yes ____ No

b. Have you been a member of the Oregon Council for Computer Education (OCCE)? ____ Yes ____ No

c. Have you ever read or used the Math Enthusiast, Arithmetic Teacher, Math Teacher, or OCTM Newsletter? ____ Yes ____ No

d. Prior to receiving this questionnaire, had you ever heard of OSME or OMEC? ____ Yes ____ No

8. Please indicate whether you think the following statements about OSME/OMEC are true or false.

	True	False
a. OSME/OMEC received part of its funding from the State of Oregon.	____	____
b. The OSME/OMEC project was designed to develop leaders in Oregon mathematics education.	____	____
c. OSME/OMEC did not provide funds for local district projects.	____	____
d. OSME/OMEC diffused specific educational programs to Oregon schools.	____	____
e. In order to be funded by OSME/OMEC a detailed proposal had to be submitted.	____	____
f. OSME/OMEC mostly achieved its goals by working through colleges and universities.	____	____
g. OSME/OMEC played an important role in developing the current state mathematics guide, "Math in Oregon Schools."	____	____
h. Most of the workshops conducted by OSME/OMEC were designed by the Oregon Department of Education.	____	____
i. Teachers could get college credit by participating in OSME/OMEC sponsored workshops/inservice courses.	____	____
j. OSME/OMEC emphasized the use of behavioral objectives in math classes for children.	____	____

9. Listed below are various items which relate to mathematics instruction. We would like you to rate your level of skill for each item by circling a number from "1" to "5". The number "1" indicates that you feel highly skilled, while the number "5" indicates that you do not feel skilled for that item.

		Highly skilled	Quite skilled	Somewhat skilled	Slightly skilled	Not at all skilled
a.	teaching mathematics through a math lab approach	1	2	3	[illegible]	5
b.	developing self-made instructional materials for mathematics	1	2	3	4	5
c.	evaluating students through problem-solving methods	1	2	3	4	5
d.	making use of a great diversity of mathematics teaching materials	1	2	3	4	5
e.	identifying materials and methods appropriate for use in a general or remedial mathematics class	1	2	3	4	5
f.	setting up mathematics learning centers	1	2	3	4	5
g.	individualizing instruction in mathematics	1	2	3	4	5
h.	using models, games, and a variety of manipulatives for teaching mathematics	1	2	3	4	5
i.	using electronic calculators as devices for teaching mathematics skills	1	2	3	4	5
j.	making use of computer applications in mathematics instruction	1	2	3	4	5
k.	using computer-related instructional materials	1	2	3	4	5
l.	using computer equipment in the mathematics instructional program	1	2	3	4	5
m.	using a programming language such as BASIC, Fortran, or FOCAL					

10. This question is concerned with classroom activities. For each item, please put a check on the line.

MY STUDENTS	Daily	Several Times A Week	Once A Week	Less Than Once A Week	Never
a. do seatwork using commercially-prepared materials, such as handouts or workbooks	____	____	____	____	____
b. work on projects that may take several days to complete and may involve one or more students	____	____	____	____	____
c. use math games	____	____	____	____	____
d. work at learning centers	____	____	____	____	____
e. use teacher-made instructional materials	____	____	____	____	____
f. use electronic calculators as part of their classwork	____	____	____	____	____
g. use computer-related materials	____	____	____	____	____
h. work with physical models and manipulatives	____	____	____	____	____
i. use computers	____	____	____	____	____
j. work on independent projects	____	____	____	____	____

11. Have you ever participated in an OSME/OMEC sponsored activity? This may have been a workshop for Computer Literacy, Math Enthusiasts, Math Lab, Math for the Uninvolved, Math Resource Centers, a Math Round-Up, or New Trends in Mathematics. ____Yes ____No

If you answered YES, please complete items 12-23 and then go on to SECTION II.

If you answered NO, skip items 12-23 and go on to SECTION II.

12. Please indicate the OSME/OMEC program component with which you were most actively involved. (CHECK ONLY ONE.)

- .Workshops or inservice courses for elementary teachers (Math Lab, Math Enthusiasts workshops/courses) ______
- .Computer Education ______
- .Math for the Uninvolved for Jr. High/ High School Students ______
- .Other______________________ ______

13. How many OSME/OMEC workshops or inservice courses have you taken in the last five years? ______

14. In the last five years, how many hours or days have you spent in OSME/OMEC sponsored workshops or inservice courses? ______ (Hours) or ______ (Days)

15. Have you conducted workshops for other educators under OSME/OMEC auspices? ____Yes ____No

16. Did you ever get release time for attending an OSME/OMEC-sponsored workshop or inservice course? ____Yes ____No

17. Did you ever receive inservice credit for attending an OSME/OMEC-sponsored workshop? ____Yes ____No

18. Did you ever receive any travel expenses for attending an OSME/OMEC-sponsored workshop from OSME? ____Yes ____No

19. Did OSME/OMEC ever subsidize your tuition for a workshop or inservice course? ____Yes ____No

20. Did OSME/OMEC ever sponsor your attendance at a conference? ____Yes ____No

21. Did you ever receive free materials at an OSME/OMEC-sponsored workshop or inservice course? ____Yes ____No

22. Did you ever receive technical assistance through an OSME/OMEC-related project? ____Yes ____No

23. a. Do you ever use mathematics resource centers? ____Yes ____No

b. If yes, how many times in the past year? ______ (Times in past year)

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SECTION II

INSTRUCTIONS TO RESPONDENTS

The following questionnaire asks you to give us your judgment on some important topics in mathematics education. The questionnaire will probably seem unusual; however, it has been designed especially for Evaluation which needs precise answers. Each topic is paired with other topics or concepts important to mathematics education in Oregon. We want to find out how much alike, or how different, these topics are. Because it is easier for most people to think in terms of how things are different, we will ask you to tell us how far apart each topic is from some other topic.

The questionnaire is composed of pairs of concepts (topics). We want you to tell us how far apart the concepts in each pair are from each other. To make it easier for you to do this, we will use a sort of mental "yardstick." We will say that A HISTORY AND A MATH CLASS ARE 100 UNITS APART. This is just a yardstick. Any number, no matter how large or small, may be used to describe how different two items are.

In other words, all the differences between a history class and a math class together add up to 100 units. (Differences between topics or concepts are measured in units, so the more different two concepts are, the more units they are apart.) Remember, as you complete this questionnaire, that some pairs of concepts may be more different than a history and a math class, and some may be less different. If you think a pair is more different, or farther apart than a history and math class, you will want to use a number <u>larger</u> than 100. If you think a pair is less different, or closer together than a history and a math class, you will use a number <u>smaller</u> than 100. Providing you with a 100 unit difference between history class and math class assists you in judging how different the other pairs are.

FOR EXAMPLE: We gave special education teachers the following yardstick: A SPECIAL EDUCATION CLASSROOM AND A GENERAL EDUCATION CLASSROOM ARE 100 UNITS APART. Then we asked them, how far apart are:

CHILD-CENTERED AND YOUR JOB______ EFFICIENT AND FRUSTRATED______

Since they thought CHILD-CENTERED AND YOUR JOB (the respondent's job) were less different than A SPECIAL EDUCATION CLASSROOM AND A GENERAL EDUCATION CLASSROOM, their answer looked like this:

CHILD-CENTERED AND YOUR JOB 45

The "45" means they thought the concepts, CHILD-CENTERED and their job (YOUR JOB), were about half as different as the "yardstick" concepts.

Since they thought EFFICIENT AND FRUSTRATED are more different than A SPECIAL EDUCATION CLASSROOM AND A GENERAL EDUCATION CLASSROOM, their answer looked like this:

EFFICIENT AND FRUSTRATED 150

We realize that you might feel you cannot be perfectly accurate about every pair. (REMEMBER, THERE IS NO RIGHT ANSWER. YOUR BEST ESTIMATE OF THE DISTANCE BETWEEN EACH PAIR WILL BE FINE FOR OUR PURPOSES.) If you do not recognize or cannot give a number for a pair, leave the space blank.

Before you start, we should remind you that OSME is the Oregon System in Mathematics Education.

Remember, your rule is: A HISTORY CLASS AND A MATH CLASS ARE 100 UNITS APART. This is intended to be a middle range value.

IF A HISTORY CLASS AND MATH CLASS ARE 100 UNITS APART, HOW FAR APART ARE:

OSME/OMEC AND DISLIKE	________
NEW MATERIALS AND IMPORTANT	________
IMPORTANT AND COMPUTERS	________
IMPORTANT AND USEFUL	________
YOUR JOB AND USEFUL	________
MATHEMATICS AND NEW MATERIALS	________
CHANGE AND COMMUNICATION	________
MATHEMATICS AND COMPUTERS	________
COMMUNICATION AND USEFUL	________
IMPORTANT AND DISLIKE	________
USEFUL AND DISLIKE	________
MATHEMATICS AND YOUR JOB	________
YOUR JOB AND IMPORTANT	________
LEADERS AND DISLIKE	________
MATHEMATICS AND USEFUL	________
SATISFYING AND IMPORTANT	________
COMMUNICATION AND DISLIKE	________
MATHEMATICS AND IMPORTANT	________
YOUR JOB AND SATISFYING	________
OSME/OMEC AND IMPORTANT	________
CHANGE AND SATISFYING	________
LEADERS AND USEFUL	________
MATHEMATICS AND CHANGE	________
OSME/OMEC AND USEFUL	________

IF A HISTORY CLASS AND A MATH CLASS ARE 100 UNITS APART, HOW FAR APART ARE:

MATHEMATICS AND LEADERS	__________
CHANGE AND IMPORTANT	__________
LEADERS AND NEW MATERIALS	__________
NEW MATERIALS AND COMMUNICATION	__________
SATISFYING AND DISLIKE	__________
YOUR JOB AND DISLIKE	__________
NEW MATERIALS AND COMPUTERS	__________
NEW MATERIALS AND DISLIKE	__________
MATHEMATICS AND SATISFYING	__________
CHANGE AND OSME/OMEC	__________
YOUR JOB AND OSME/OMEC	__________
USEFUL AND COMPUTERS	__________
OSME/OMEC AND NEW MATERIALS	__________
LEADERS AND IMPORTANT	__________
CHANGE AND USEFUL	__________
MATHEMATICS AND COMMUNICATION	__________
IMPORTANT AND COMMUNICATION	__________
DISLIKE AND COMPUTERS	__________
COMMUNICATION AND COMPUTERS	__________
CHANGE AND YOUR JOB	__________
LEADERS AND YOUR JOB	__________
LEADERS AND SATISFYING	__________
SATISFYING AND OSME/OMEC	__________
LEADERS AND COMMUNICATION	__________

IF A HISTORY CLASS AND MATH CLASS ARE 100 UNITS APART, HOW FAR APART ARE:

YOUR JOB AND NEW MATERIALS	________
YOUR JOB AND COMMUNICATION	________
SATISFYING AND COMMUNICATION	________
NEW MATERIALS AND USEFUL	________
CHANGE AND DISLIKE	________
LEADERS AND OSME/OMEC	________
CHANGE AND LEADERS	________
MATHEMATICS AND OSME/OMEC	________
MATHEMATICS AND DISLIKE	________
CHANGE AND COMPUTERS	________
SATISFYING AND USEFUL	________
YOUR JOB AND COMPUTERS	________
SATISFYING AND NEW MATERIALS	________
SATISFYING AND COMPUTERS	________
OSME/OMEC AND COMMUNICATION	________
CHANGE AND NEW MATERIALS	________
LEADERS AND COMPUTERS	________
OSME/OMEC AND COMPUTERS	________

Thank you for your cooperation.

APPENDIX E

STUDENT SURVEY

Office of Management and Budget
Approval Number: 99-S78006
Expires: December, 1978

OREGON SYSTEM IN MATHEMATICS EDUCATION
(OSME)
STUDENT SURVEY

DEAR STUDENT,

WE ARE INTERESTED IN HOW YOU FEEL ABOUT SOME THINGS YOU HAVE DONE IN SCHOOL. WE WOULD LIKE YOU TO HELP US, BY ANSWERING SOME QUESTIONS. YOUR TEACHER WILL HELP YOU IF YOU GET STUCK ON A QUESTION OR HAVE TROUBLE UNDERSTANDING. PLEASE THINK ABOUT THE QUESTIONS, AND ANSWER THEM AS BEST YOU CAN. THANK YOU.

1. HOW OLD ARE YOU? ________

2. HOW WELL DO YOU USUALLY DO IN SCHOOL SUBJECTS?

   VERY WELL ______

   ABOUT IN THE MIDDLE ______

   POOR ______

3. WHO IS YOUR MATH TEACHER NOW? ________ (WRITE THE TEACHER'S NAME)

4. WHO WAS YOUR MATH TEACHER LAST YEAR? ________ (WRITE THE TEACHER'S NAME)

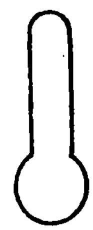
5. DID YOU GO TO THE SAME SCHOOL LAST YEAR?

   ______ YES ______ NO

BELOW ARE SOME SENTENCES. TELL US HOW EACH ONE OF THE SENTENCES DESCRIBES HOW YOU FEEL. YOU TELL US HOW YOU FEEL BY DRAWING A LINE THROUGH THE THERMOMETER NEXT TO EACH SENTENCE. IF YOU THINK A SENTENCE IS TRUE OF YOU, DRAW A LINE THROUGH THE THERMOMETER UP HIGH. IF YOU THINK A SENTENCE IS NOT TRUE OF YOU, DRAW A LINE NEAR THE BOTTOM OF THE THERMOMETER. IF YOU FEEL SORT OF IN-BETWEEN, DRAW A LINE THROUGH THE MIDDLE.

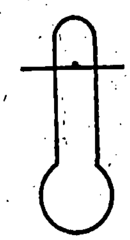
EXAMPLE: WE ASKED SOME BOYS AND GIRLS IN THE FOURTH GRADE HOW THEY FELT ABOUT BASKETBALL. WE DID IT LIKE THIS:

I LIKE BASKETBALL



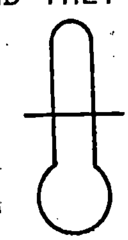
SOME BOYS AND GIRLS REALLY LIKED BASKETBALL, SO THEY MARKED THEIR THERMOMETERS LIKE THIS:

I LIKE BASKETBALL



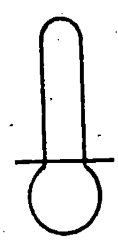
OTHER KIDS JUST SORT OF LIKED BASKETBALL, AND THEY MARKED THEIR THERMOMETERS LIKE THIS:

I LIKE BASKETBALL



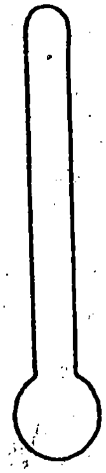
AND SOME KIDS DIDN'T LIKE BASKETBALL AT ALL. THEY MARKED THEIR THERMOMETERS LIKE THIS:

I LIKE BASKETBALL

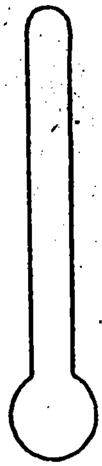


NOW REMEMBER, THESE KIDS WERE TELLING US HOW THEY FELT. WE WANT YOU TO READ EACH SENTENCE AND TELL US IF IT DESCRIBES YOU, OR THE WAY YOU FEEL.

1. I LIKE TO STUDY MY MATH



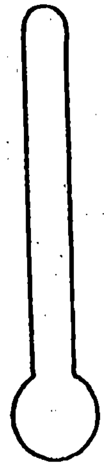
2. I LIKE MY MATH HOMEWORK



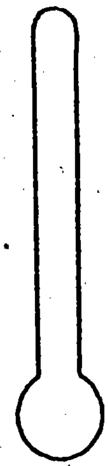
3. I LIKE MY MATH TEACHER

4. I THINK MATH IS FUN

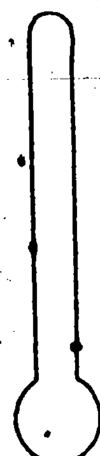
5. I NEED MATH TO GET A GOOD JOB WHEN I GROW UP



6. MY PARENTS WANT ME TO DO WELL IN MATH

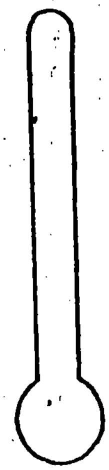


7. I DON'T LIKE TO COME TO SCHOOL WHEN THERE IS A MATH TEST

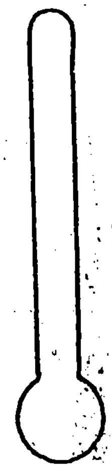


8. MY MATH TEACHER HELPS ME WHEN I AM STUCK

9. I TALK WITH MY MOM AND DAD ABOUT MY MATH CLASS



10. I NEED MATH TO GET GOOD GRADES IN HIGH SCHOOL



FOR THE NEXT PART, WE WANT YOU TO THINK ABOUT SUBJECTS YOU LEARN ABOUT IN SCHOOL. THE SUBJECTS ARE LIKE THE KINDS OF CLASSES YOU TAKE. WE HAVE THEM IN PAIRS (TWO'S). LOOK AT EACH PAIR AND THEN CHOOSE THE SUBJECT YOU LIKE TO DO THE MOST AND PUT AN (X) BY IT. DO EVERY SET.

1.	SPELLING	( )	OR	WRITING	( )
2.	SPELLING	( )	OR	READING	( )
3.	SPELLING	( )	OR	GYM	( )
4.	SPELLING	( )	OR	MATH	( )
5.	SPELLING	( )	OR	ART	( )
6.	READING	( )	OR	GYM	( )
7.	READING	( )	OR	MATH	( )
8.	READING	( )	OR	ART	( )
9.	WRITING	( )	OR	ART	( )
10.	WRITING	( )	OR	GYM	( )
11.	WRITING	( )	OR	READING	( )
12.	WRITING	( )	OR	MATH	( )
13.	MATH	( )	OR	ART	( )
14.	MATH	( )	OR	GYM	( )
15.	ART	( )	OR	GYM	( )

TELL US WHAT YOU WANT TO BE WHEN YOU GROW UP.

FIRST CHOICE: ______________________

SECOND CHOICE: ______________________

WHAT SUBJECT DO YOU LIKE THE MOST?

____

WHAT SUBJECT DO YOU LIKE THE LEAST?

____

HOW WELL DID YOU DO IN MATHEMATICS ON YOUR REPORT CARD?

VERY WELL ________

IN-BETWEEN ________

POOR ________