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ABSTRACT

This evaluation report investigates the effectiveness of the Unified Science and Mathematics for Elementary Schools (USMES) program during the academic year, 1973-74. USMES is a curricular program designed to develop the problem solving abilities of students attending grades one through eight. The goal of the program is the development of 32 interdisciplinary units engaging the student in long-range investigations of real and practical problems taken from his or her school or community environment. These areas were identified as high priority issues during the first year of a comprehensive program evaluation: actual usage, proof of concept, materials, teacher training, and indirect effects. Once these issues were specified, the evaluators selected the following indicators through which they would gather the required data: (1) a test especially designed for assessing problem solving abilities; (2) selected subtests of the Stanford Achievement Test; (3) observational scales for classroom activity analyses; (4) questionnaires surveying how the teachers were implementing the USMES program; (5) direct interviews with USMES teachers, principals, district level administrators, and leaders of district resource teams who would train USMES teachers; and (6) on site visits for unstructured observations and interviews to determine the actual patterns of program adoption or adaptation. Following an initial overview, chapters two through six address each issue, one by one. A concluding chapter then summarizes, offers specific conclusions, and makes recommendations for the future development and implementation of the USMES program. (RC)

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CHAPTER I

AN OVERVIEW OF THE USMES PROGRAM AND THE USMES EVALUATION PROJECT

This evaluation project has been assigned the task of investigating the effectiveness of the USMES program during the academic year, 1973-74. USMES, the Unified Science and Mathematics for Elementary Schools, is a curricular program designed to develop the problem solving abilities of students attending grades one through eight.

USMES Philosophy and Goals

The following statement of the purposes and intentions of the USMES program is drawn from two descriptive documents prepared by their Central Staff: The USMES Guide (May, 1974) and the USMES Systems Approach to Development, Widespread Implementation and Maintenance of a Real Problem Solving Program in Elementary Schools (March, 1974).

The goal of the USMES program is the development of thirty-two interdisciplinary units engaging the student in long-range investigations of real and practical problems taken from his or her school or community environment. By responding to these problems, called "challenges," the student develops his problem-solving abilities, and does so in a manner that gives him an experiential understanding (learning-by-doing) of the problem-solving process, as well as the acquisition of its basic skills and concepts.

USMES intends to teach the cognitive skills and strategies of problem-solving as a new area of learning, and not merely as a new method or a new content within an already defined area. Furthermore, this program sees itself as interdisciplinary in nature, in that its presence in the curriculum would support and facilitate the existing disciplines--

mathematics, reading, etc.

> [USMES] will not fulfill every cognitive and affective need;....other, mo[illegible] pro- grams may be needed to tea[illegible] [illegible]mal aspects of the discipline [illegible] are [illegible] in the cognitive range of chi[illegible] [illegible] grades 1-8. (The USMES Guide, p. 9.)

USMES developers further believe that, to learn the process of problem solving, the student himself must analyze the problem, choose the variables to be investigated, search out the facts, [illegible]idge the correctness of the hypotheses and conclusions. The teacher acts only as a coordinator and collaborator. This, they acknowledge, requires a new, more indirect style of teaching.

Progress toward a solution to a problem requires the combined efforts of a group of students, not just an individual student working alone. While some work may be done individually, the USMES construct provides for a division of labor and an exchange of ideas--a total group effort.

A final essential characteristic of this program is the relevancy of the task. The "challenges" undertaken by the students must be both <u>real</u>, i.e., embody some valid aspect of school or community life rather than an invented problem imposed prepackaged by the curriculum, and <u>practical</u>, i.e., the student's solution may lead to the actual improvement of that situation being investigated. The problem leads to an experience of useful accomplishment in the student's life.

<u>Evaluation Project Design</u>

When designing this project, the evaluators reviewed the informational needs of a variety of audiences: the National Science Foundation which sponsors both the program development and its independent evaluation; the developers of the USMES program and the members of their Planning Committee; the on-site users of USMES and trainers of users; prospective USMES users and trainers.

Our preliminary conversations with these interes oups led to the identification of several critical areas for investigation. These areas were identified as high priority issues during the first year of a comprehensive evaluation of the program. We have defined these issues as follows:

(a) Actual Usage. In those school situations where the USMES program is being implemented, what learning activities are actually occurring? What student behaviors are being developed as a result? What kind of student-to-student and student-to-teacher interaction patterns are fostered under the USMES environment. How do these interaction patterns differ from those of the "control" groups?

(b) Proof of Concept. Have the problem solving abilities of the students increased as a result of using USMES? Has this program affected in a positive or negative manner the students' basic skill development, especially in reading and mathematics? These are seen as two interdependent issues. While NSF is concerned that the program's primary goal, the enhancement of problem solving, be actualized, professional educators (principals and teachers) are equally concerned that they remain successfully accountable for the communication of basic skills.

(c) Materials. Are the supportive materials offered by USMES being used? Are they helpful? These materials include teachers' manuals, "How-To" cards, design labs, and technical papers.

(d) Teacher Trai[illegible] Are the national USMES workshops effectively train[illegible] [illegible]chers? Moreover, does the Resource Personnel Workshop model prove to be an effective disseminator of the program? Are the present local training efforts capable of realizing a second generation of teachers and thereby insuring the continuation of this program? What further continuing support will be required?

(e) Indirect Effects. Is the USMES program bearing significant secondary effects on the environment, e.g. on student attitudes...on teaching styles? Are there evidences of tertiary effects on those only indirectly related to the program: on colleagues of the involved teachers...on other students within the school...on the administrators of selected schools...on school scheduling...on school practices?

Once these issues were specified the evaluators selected the following indicators through which they would gather their required data:

(a) a test especially designed for assessing problem solving abilities.

(b) selected subtests of the Stanford Achievement Test.

(c) observational scales for classroom activity analyses.

(d) questionnaires surveying how the teachers were implementing the USMES program.

(e) direct interviews with USMES teachers, principals, district level administrators, and leaders of district resource teams who would train new USMES teachers.

(f) on site visits for unstructured observations and interviews to determine the actual patterns of program adop- [illegible] ntation.

Evaluation Report

The plan of this report is to draw on the various data products by these six indicators, to tabulate and interpret their results, and so to address the five central issues raised above. The report will proceed in this manner: following this initial overview, chapters two through six will address each issue, one by one. A concluding chapter will then summarize, offer specific conclusions, and make recommendations for the future developmen. and implementation of the USMES program.

This report will draw upon preliminary reports alread presented to the National Science Foundation and other audiences. However, their representation in this document will be adapted to the present concerns with new information added, and unnecessary duplication eliminated.

In the coming weeks, a brief, summary document will be made available for distribution. This document will seek to address a wider audience, who are more interested in the basic information, summative conclusions and recommendations, and less concerned with the detailed tables commentary on the information contained herein.

Caveat

For a correct appraisal of this report, one serious limitation must be noted by the reader from the outset. This evaluation project was to have begun in August, 1973. However, it remained without funding until March 22, 1974. As a result, the evaluation team was unable to assume early control of the evaluation activities, to train observers, designate samples, advise observers on data collection problems, and monitor the data collection process--all necessary to insure complete, usable returns.

To aid us in this limitation, the USMES Central Staff themselves undertook the responsibilities of sampling, observer training, instrument purchase and pre-testing. While their extended efforts were admirable, it is obvious that such a procedure does not enhance the objectivity of an outside evaluation and that it does make presumptions on the time, experience and expertise of the developers which can not be justified.

These problems resulted in a serious loss of usable data. In some geographic areas, observers did not meet their commitments to collect data at the time of pre-testing, or post-testing, or both. Some of the data were unanalyzable because of inappropriate testing procedures (e.g., children were proded in problem-solving tests; time limits were not followed; the wrong SAT subtests were administered).

The data losses were most damaging to an adequate assessment of student performance in basic skills and in problem solving because the measures for these traits were time consuming or otherwise difficult to administer, and they were disruptive to the school day.

On the other hand, the schedule for site visitations and interviews was little effected by this eight month lapse for the grant award. It is the judgement of the evaluation team that other data, especially the interview data and the unstructured observations during the site visits, provided the most comprehensive, helpful, and illuminating information about the USMES program. We have relied heavily on these kinds of data in the assessments that follow.

CHAPTER II

METHODS AND PROCEDURES

The evaluation design for this project could be carried out in its original conception. Those compromises on the initial design which were necessitated by the late funding are described in this chapter. However the principle burden of this section is to describe to the reader the actual sample selections achieved, the data collection instruments applied to these samples, the methods used for data collection, and those techniques of analysis which were employed.

Selection of Sample Classes

USMES Teachers received various category designations according to the nature of their training and the extent of their USMES experience. The following types pertain to the 1973-74 evaluation program.

(a) Development Teachers: Those who attended more than one national level workshop conducted by the Central Staff and who were expected to try out ideas for new USMES challenges in their classrooms. They were experienced USMES teachers.

(b) Implementation Teachers: Those who were new to USMES, who were attending their first national level workshop during the summer of 1973, either at Lansing, Michigan, or at Boston, Massachusetts. There they received training and resource materials for newly developed units. Their implementation of these new units were supposed to enable the developers to assess the adequacy of the workshop training and utility of the resource materials.

(c) Locally-Trained RPW Teachers: "Second-generation" USMES teachers, trained at the local level by District Resource Teams who used the Resource Personnel Workshop model. The team members had been trained at a national workshop conducted in Lansing, Michigan by the USMES Central Staff with the help of consultant-specialists. In turn, the teams were expected to train and support a "second-generation" of USMES teachers in their own districts. The intent was to implement a more cost effective method of training teachers.

(d) Chicago Workshop Trained Teachers: Those Area A Chicago teachers who attended the Chicago Workshop conducted by the Central Staff in August, 1973. The purpose of this Chicago District Implementation Experiment was to investigate the strategies, support mechanisms and resources designed to provide teacher training, program coordination and implementation in a city school district which was solely dependent on its own talents to achieve those ends.

The proposed design for the 1973-74 evaluation called for a variety of data collections from samples of USMES teachers and their students in each of the four categories listed above. The number of USMES sample classes chosen from each category are shown in Table 1.

Random sampling was not feasible; selections had to be limited to classes in those areas where trained observers were available for data collection. Furthermore, the evaluation staff could not visit the many

TABLE 1

Sample Classes Selected for Data Collection and Sample Classes from Which Data was Obtained

	Number of USMES Trained-Teachers				Number of Control Teachers		
	Selected for Sample	Used USMES	Confirmed: Did not Use USMES	No Information Obtained	Selected for Sample	Some Information	No Information
National Development Sample	25	15	5	5	0	-	-
National Implementation Sample	18	9	8	1	18	9	9
Chicago District Implementation Sample	24	4	20	0	12	3	9
Sample of Locally Trained RPW Teachers	28	12[a]	0	16	0	-	-

[a]These teachers claimed either to have just begun a unit or to have planned introducing a unit challenge to their classes within a month of the interview date.

widely scattered sites which could have resulted from a random sample. Given these constraints, purposive sampling was done to insure that the class selections represented a cross section of USMES unit challenges, grade levels and socio-economic levels in a manageable number of geographic areas. The number of sample classes in each of the geographic areas was proportionate to the intensity of USMES involvement expected by the program developers.

Control classes were selected for only two of the four categories of USMES teachers. Since the unit development activitives and the development of local training strategies were formative in nature, no controls were selected for USMES development teachers or for RPW teachers. Control teachers were identified for each of the 18 national implementation sample teachers, as shown in Table 1. Controls were also selected for the Chicago implementation sample, but in this case, proportional n's were sought--12 controls for 24 Chicago USMES classes--to maximize salient information and minimize costs for data collection.

With few exceptions, the control classes were chosen from non-USMES classes in the same schools as the sample USMES classes. If possible, controls were matched with USMES teachers on grade level and teaching experience. Members of the USMES Central Staff made the control selections and secured permission for the necessary evaluation activities.

By the time the evaluation team was able to assume control of the evaluation project in March, 1974, serious data losses were beyond reclaim. The only appropriate or feasible time for collecting such information as student performance data had gone by. Table 1 indicates the number of classes from which any data--student performance, teacher interviews, or program monitoring--was obtained.

Characteristics of Sample USMES Schools

The descriptions of USMES sample schools presented below are based on data from the School Information Form shown in Appendix A. Because evaluators assured participating schools of anonymity, the exact locations of these schools are not indicated.

A. Geographical Distribution

"USMES schools" are scattered throughout the country. That is, evidence of USMES usage, the presence of USMES materials, and/or the presence of USMES-trained teachers can be found in many sections of the country, in urban, suburban, and rural school systems, and in communities encompassing a variety of socio-economic levels.

Program dissemination, however, has been most apparent in college and university towns where USMES Planning Committee Members or other USMES contacts reside and in towns located near the offices of the Program Developers. The former group of towns included Durham, New Hampshire; Athens, Georgia; East Lansing, Michigan; Iowa City, Iowa; Boulder, Colorado; Bakersfield, California; and Monterey, California. The latter group of USMES locations--those areas near the development offices--included Arlington, Lexington, Watertown and Roxbury, Massachusetts. Even from the initial stages of program implementation, however, the developers also made continued efforts to disseminate the program in many less affluent urban settings: Atlanta, Georgia; Washington, D.C.; Lansing, Michigan; Chicago, Illinois; Minneapolis, Minnesota; and Los Angeles, California; as well as Roxbury, Massachusetts. Only two states had more than a limited pocket of towns using USMES: Michigan and California. The above list is not intended to be exhaustive of the locations where USMES was used or was expected to be used during 1973-74; it is presented to illustrate the wide pattern of geographical dissemination.

Sample classes from which data was to be gathered for this Evaluation came from 37 schools. Chicago schools were to have been heavily represented in this sample of (13 of 37) because of the intensive district implementation experiment planned for Chicago.

USMES observers in the sample site areas were directed to complete a School Information Form for each of their sample schools. Completed forms were received from 29 of the 37 schools designated for the sample. Observers from the remaining eight sample schools did not meet their commitments for any data collection and no information was obtained. While 13 of the 29 returns were from Chicago, only three of these Chicago schools had teachers who had used USMES at all during the year. The discussion below, therefore, is based on 19 schools: 3 from Chicago and 16 from scattered areas throughout the country.

B. <u>Population Densities of Communities</u>

The community settings of the 19 sample USMES schools can be characterized as follows: 2 rural, 12 suburban, and 5 urban. This distribution seemed to reflect the national picture of USMES usage. Most of the school systems interested in trying USMES were suburban. Urban systems had too many other needs and immediate problems which preempted attention to USMES. Despite an intensive effort to disseminate USMES in Chicago Area A, only four teachers in three Chicago schools used the program at all during 1973-74.

C. Socio-economic Levels

The communities in which the sample USMES schools were located represented a wide cross section of socio-economic levels. These were distributed as follows:

Socio-economic Level	Number of Sample Schools Reporting
High	0
Upper Middle	2
Middle	7
Lower Middle	5
Low	5
	19

As indicated in Table 1, these completed forms were obtained from 15 USMES development teachers and 13 implementation teachers--four from Chicago and nine from other parts of the country. We were able to secure 12 completed forms from the Chicago Implementation sample and 9 from controls for the national implementation sample. No controls were designated for the USMES development classes.

This present report deals only with the data pertaining to teacher characteristics and class size. Further information on the nature and intensity of the treatments received by sample classes will be reviewed in Chapter III.

1. Development Teachers. Class Information Forms were obtained for 15 USMES development teachers. The grade levels which they taught were

distributed as follows:

Grade Levels	Teachers at that Grade
3	4
3-4	1
4	3
4-5	1
5	2
4-6	1
6	1
6-7	1
7	1

The teachers of the class combining grades 4 through 6 and of the class designated above as 6-7 were teachers in departmentalized schools. All other classes were self-contained.

Class size for these development teachers ranged from 17 through 30 and averaged 27 students per class.

The number of years of teaching experience represented by this sample of fifteen ranged from 3 to 20 years, with a median of 5.5.

Most of these teachers had very little, if any, specialized training in math or science beyond pre-service methods courses and USMES workshops. Their math/science training can be summarized as follows:

(a) 3 teachers had undergraduate math or science majors.

(b) 1 teacher had taken one graduate course in math.

(c) 2 teachers had taken one or more undergraduate courses in math and/or science.

(d) 2 teachers had attended one or more in-service workshops for other science curricula (SCIS, EES, SAPA).

(e) 1 teacher had attended an NSF summer institute.

(f) 6 teachers had no additional math/science training beyond their undergraduate methods courses or USMES workshops.

2. Implementation Teachers. Of the first-trial implementation teachers who completed the Class Information Forms, four were from Chicago and nine were from other parts of the country. The grade level distribution for the 13 classes is as follows:

Grade Levels	Teachers at that Grade
2	1
2-3	1
3	2
4	3
5	2
5-6	1
6	1
7	0
8	2

Both eighth grade classes were in departmentalized middle schools; the other classes were self-contained.

Class size for the implementation teachers ranged from 16 to 31 with an average of 27 students per class.

Further descriptive information on the implementation teacher sample--teaching experience, specialized math/science training, nature of non-USMES curricula used in their classes--is contained in the following comparison of these teachers with their control group counterparts.

3. Control Teachers. Class Information Forms were obtained from 12 control teachers. Nine of the controls were "matches" for the nine classes in the national USMES implementation sample. Three of the controls matched three of the four Chicago implementation classes. The missing control class in this group was to have been a third grade class. With this exception, the distribution of grade levels for control classes matched that shown earlier in this report for the implementation sample. Class sizes in the control sample were also comparable in class sizes for the implementation sample.

The USMES implementation teachers were similar to the group of control teachers with respect to both teaching experience and specialized training in math or science. The USMES teachers had been teaching between 2 and 16 years, with 6.8 years as the median of teaching experience. The range for the control teachers was between 3 and 17 years with a median of 7 years' experience. Two of the 14 implementation teachers and two of the 13 control teachers had undergraduate degree majors in math or science. None of the other teachers in either group had any special training in math or science beyond required math and science methods courses which were part of their teacher preparation programs.

Selection of Interview Respondents

Classes were to have served as the sampling unit, not only for testing student performance, but also for data collection via teacher interviews and teacher questionnaires. Those teachers, whose classes were to have been tested, were also the teachers whom we intended to interview, and to whom we would mail questionnaires. However, since the need for information on critical issues about future USMES development and implementation was urgent, we proposed to expand our efforts on data collection via site visits, interviews, and teacher questionnaires--techniques not jepordized by the funding.

Expanding the sample of interview respondents did not involve an increase in the number of locations we would have visited using the original selection criteria. Sample teachers from the development, RPW-trained, and Chicago Workshop-trained teacher designations were already scheduled for interviews. However, when we ascertained that there were few locally-trained teachers doing USMES, and that very few Chicago teachers were using the program, we decided to interview implementation teachers and pre-service trained USMES teachers at those sites designated for visitations.

The 80 USMES teachers, respondents to out interviews, can be classified according to the nature of their USMES training in the following manner:

(a) 26 development teachers.

(b) 16 implementation teachers.

(c) 16 "second-generation" locally-trained, RPW teachers.

(d) 20 Chicago Workshop trained teachers.

(e) 2 pre-service trained teachers whose undergraduate teacher preparation in math-science educational methods included training in USMES.

These 80 teachers encompassed a cross section of new and experienced USMES teachers at all grade levels.

Additional administrative personnel were also interviewed at these sites. Their roles or positions, in respect to USMES, are identified as follows:

(f) 13 RPW team leaders responsible for organizing and conducting USMES training workshops at the local level. Of the 13, 4 were elementary school principals, 2 were elementary school teachers, 4 were district-level administrators or curriculum supervisors, and 3 were Elementary Intern Program supervisors from Michigan. Thus, all but four of the 17 District Resource Teams in attendance at the national Lansing Resource Personnel Workshop, were represented in the interviews. No site visitations were made of the Atlanta or La Grange, Georgia teams since their leaders informed us by telephone that no local workshops had been conducted by May, 1974. Because of the time constraints on the evaluation team we were unable to schedule interviews with the Fullerton, California team or with one of the Los Angeles area groups.

(g) 17 elementary school principals (in addition to the 4 mentioned above serving as RPW team leaders). Of the 17, seven had attended a national USMES workshop. These principals were interviewed because they had, or were expected to have had, USMES teachers in their buildings.

(h) 3 district level curriculum supervisors, consultants, and resource teachers, all of whom were serving as members, but not leaders, of local RPW teams.

(i) 5 district superintendents or associate superintendents.

The following locations were represented by our interview respondents: Los Angeles, Bakersfield, Oildale, Monterey, Carmel, and Campbell, California; Boulder, Colorado; Minneapolis, Minnesota; Eaton Rapids, Lansing, Flint, Battlecreek, and Waren, Michigan; Chicago, Illinois; Washington, D.C.; Arlington, Lexington, Roxbury, and Watertown, Massachusetts; and Durham, and Gossville, New Hampshire.

Selection of Questionnaire Respondents

The Program Monitoring Form (Cf. Appendix C) was sent to USMES teachers in May, 1973. While all sample teachers received a copy of this form, it was determined at our on site visits that only 28 teachers from the original sample had sufficiently used USMES in their classes that year to be able to respond to the questionnaire in a meaningful manner.

This questionnaire was also sent to an additional 77 USMES teachers from a list of names and addresses supplied by the developers. At their request, we agreed to expand the teacher sample using this form to secure much needed information. This decision provided a much larger data base with this relatively inexpensive method of data collection.

Assessment of Student Performance in Problem Solving and Basic Skills

The USMES project seeks to enhance the problem solving abilities of elementary school students without impairing their basic skill development.

USMES claims that, by responding to real life, meaningful challenges taken from the local school/community environment, students will be involved in all steps of problem solving: observation, data collection, representation and analysis of data, formulation and trial of successive hypotheses, and decision on the final action to be taken. The project further claims that while investigating real problems, students quickly learn many mathematics, science, social science, and language arts skills.

Validation of this project concept necessitated the collection of student performance data in the areas of both problem solving and basic skills. A pre-test, post-test control group design was pursued for both areas. Problem solving skills were measured by the Playground Problem, a test specially designed for this USMES evaluation. (The Administrator's Manual and the Scoring Manual for the Playground Problem are found in Appendices E and F.) Two subtests of the Stanford Achievement Test Battery were used to measure basic skills development in the critical areas of reading and mathematics. Further specification and discussion of the instrumentation, data collection, scoring, analysis, and results of this data on student performance will be found in Chapter IV. It is important that the reader review these results in the context of our discussion on the serious limitation of this data collection, which is provided in Chapter IV.

Interviews During Site Visitations

During site visits, the individuals listed earlier in this chapter were interviewed about those aspects of USMES appropriate to the respondent's postion and experience with the program. The interviews took place over a four month period, extending from February through May, 1974.

Interview guides had been prepared for the largest respondent groups: USMES teachers, team leaders, and principals. (Cf. Appendices G, H, and I, respectively.)

We told respondents at the outset of the interviews that our purpose in speaking with them was, in essence, to explore the feasibility of implementing the USMES program in various schools, each with its unique set of assets and limitations. We emphasized that our intention was to evaluate the program and its training component, not the respondent. We tried to foster a polite cordial, non-threatening interaction in order to elicit honest responses, both positive and negative.

In general, our method of interviewing started with a broad question, followed by further probing or requests for clarification on the issues which respondents raised. If there were any points not covered by a respondent, for which we wanted answers, we then asked direct questions.

While we entered the interview situations with preconceptions of what was important to evaluate, we felt that it would be inappropriate to use a more structured technique, especially during this first year of a comprehensive USMES evaluation. Structured interviews force a choice between rigidly formulated answers to rigidly formulated questions. While this technique promotes easy quantification of responses, its use presumes that <u>a priori classifications for responses</u> will reflect the important concerns of the respondents. Instead, the strategy of intensive interviewing with interview guides enabled us to ask questions about what interested us, but also to elicit from each respondent those concerns he considered to be of first importance in the USMES program. Using this technique, we learned, for example, that problems with the Design Lab were of vital concern to teachers. The strength of this feeling probably would not have been apparent had we used a purely objective instrument. Moreover, our experience with cordial unstructured interviews has been that, given a chance, teachers would talk first and at greatest length about those aspects of the subject most meaningful to them.

The use of unstructured interviews was especially appropriate for gathering pertinent information on USMES teacher training. The respondents were products of a variety of training models or had no USMES training at all. Of those with USMES training, some were highly experienced in its classroom use, while others had not taught USMES at all. Local USMES training efforts were especially diverse, and we could not assume that we knew a great deal about the reasons behind the productivity or inactivity of each team. We needed to find out what kinds of things were happening at each site rather than to determine the frequency of predetermined kinds of things that we thought would be happening.

Most of the interviews were conducted by members of the evaluation team working in pairs. One member directed the questioning while the other served primarily as recorder. Except as noted below, the respondents were interviewed individually. All interviewers were trained by the Project Director prior to site visitations and were debriefed at group meetings of the evaluation team upon their return.

Only 36 of the 80 teachers were seen individually by these two-person interview teams. Group interviews were used with the remaining teachers since they had little free time during the school day and then were available only in groups. We were reluctant to impose on their time much before or after the hours of the normal school day. However, only in one case did we feel that group interviewing was less productive than discussions with individual teachers. [In that case, one teacher dominated the interview and stiffled the comments of her colleagues.] Generally, the small group situations evoked a more detailed response from the teachers. These group interviews had the advantage of allowing the teachers more time to reflect, to recall experiences, to rethink and to amend initial accounts that upon reflection seemed in need of amplification, qualification, or revision. Overall, the tone remained cordial. Even in the group interviews, teachers felt free to disagree with, or qualify, a colleagues responses.

Unstructured interviews present two problems: (1) minimize the subjectivity of the interviewer, and (2) present the information obtained in some meaningful form. To standardize the interviewing procedures as much as possible, all interviewers were trained by the Project Director prior to site visits and were debriefed upon their return. When we judged the consistency of response patterns reported by five interviewers, we felt sufficiently successful in having overcome the first problem.

Analyzing the results presented a more difficult problem. For various reasons, it was impossible to quantify the responses. By design, our interview guides did not permit this type of analysis. Certain questions were not appropriate for all respondent groups or individuals within the groups. Some people had not used the program at all or at least sufficiently to respond to certain questions. Our tallies would have been replete with "Not appropriate" for these respondents. Since some teachers had to be interviewed in groups, we received several composite viewpoints, which may or may not have reflected accurately each individual opinion within the group.

Instead, we based our qualitative analysis of the interview data on the procedures described by Lofland (1971, Chapter 6). Notes were developed from the initial interview records and were filed in various ways: by topical issues, by respondent positions, and by site locations. Commonalities were culled from the data; inconsistencies were noted and studied; trends were abstracted.

The interview results reported in subsequent chapters are based on these methods of examination, re-examination, and abstraction. We have not recorded individual interview data. Neither do we see any advantage in recording unique situations, nor do we want to jepordize the prospects for productive interviews with some of the same respondents or their colleagues in the future.

Program Monitoring

A mailed questionnaire was used to obtain information from teachers about how they used USMES in their classrooms. (These end-of-the-year, summary viewpoints complemented other data that were also used to assess actual program use.)

The Program Monitoring Form, shown in Appendix C, consists of two parts: (1) a series of 11 open-ended questions, and (2) a rating scale. The evaluation team developed this form after we interviewed 80 USMES teachers during our site visitations. We based these questions on what we perceived to be widespread concerns among the teachers about introducing a unit, sustaining students' interest, and anticipating those preparations and resources needed for a unit. Since time constraints on the teachers' schedules had forced us to limit the number of questions we could ask during the interviews, we hoped that this use of the Program Monitoring Form would enable us to: (1) gather more extended and representative information on how USMES units were being used in the classroom; and (2) corroborate or verify teacher interview responses about the effects of their USMES units on their students' behaviors.

In May, 1973, the Program Monitoring Form was sent to 105 USMES development and implementation teachers who had used at least one USMES unit during the 1973-74 academic year. An accompanying memo from the evaluation team explained the purpose of the form and notified the teachers that they would be paid for its completion. Second notices and duplicate forms were sent to non-respondents one month later. The final return rate was 83/105 or 79%. The respondents included teachers from California, Colorado, Georgia, Iowa, Massachusetts, Michigan, New Hampshire, Oregon, and Washington, D.C. Collectively, these responses were based on 24 different "challenges" or units.

The questions on Part One of the Program Monitoring Form were open-ended and did not lend themselves to ready quantification. Therefore, our analyses of these results were based on the processes of content analysis review, abstraction and synthesis. In addition, we used anecdotal information from these forms to illustrate the trends, or more often, the variety of positions which we culled from the data.

Part Two of the Program Monitoring Form consisted of a scale requesting teachers to rate the emphases which their units placed on various content areas and learning activities. Since fully 24 different units were represented by the respondents, the ratings were collated by activity across all units. The data are presented simply as rank ordered percentages of respondents who felt their units emphasized each given content or activity.

Other Data Collection by Trained Observers

During a three day period in August, 1973, observers were trained to administer the Stanford Achievement Tests and the Playground Problem, and also to use an observation scale which would enable the evaluation project to have a more objective accounting of the classroom activity. This observation technique and the results of its application are reported in Chapter III. The Classroom Activity Analysis Form itself is illustrated in Appendix D.

Near the end of the school year, the observers were asked to complete a School Information Form for each sample school, and a Class Information Form for each teacher in the evaluation sample, both USMES and control. The forms are shown in Appendices A and B. They were designed to obtain descriptive and classification information to characterize the sample schools and classes and to be used as independent variables in other analyses.

Chapter Summary

This chapter detailed the evaluation design of this project, particularly its bases of sample selection, the instruments employed for its data collection, its methodologies of data collection, and the techniques of analysis applied to the resulting data.

Purposive sampling of the four designations of USMES teachers was used to achieve a sample of USMES classes representing a cross section of USMES-teacher-experience, unit challenges, grade levels, socio-economic levels and geographic areas. Control teachers at the same grade levels, and from the same schools were selected only for USMES implementation and Chicago classes. Sample attrition due to late funding and other problems was serious. Actual data is based on 19 schools with a variety of population settings and socio-economic levels.

Class Information Forms, soliciting descriptive and classification data, were obtained from 15 USMES development teachers and 13 implementation teachers, plus 12 more from control teachers. The teaching experience, past training in math/science, and class size were noted for each category.

Data collection efforts were expanded by site visitations, interviews, and teacher questionnaires. A total of 80 teachers and 38 administrators were involved in on-site unstructured interviews by the evaluation staff between March and May, 1974. A Program Monitoring Form was sent to the original sample of USMES teachers, but only 28 had sufficiently used USMES to be capable of responding informatively. The questionnaire was then sent to 77 others.

These 80 teachers represented a cross section of new and experienced USMES teachers at all grade levels. Only 36 were interviewed individually by a two-person team, and the remainder were interviewed in small groups.

The interview data were analyzed by qualitative methods. Teacher interviews were followed up by a mailed Program Monitoring Form to gather more extensive and representative information on USMES use in the classroom and to verify the teacher interview responses about the effects of USMES on student behaviors.

To test the problem solving ability claimed by the USMES program, trained observers administered the specially developed Playground Problem.

The program's effect on the students' acquisition of basic skills, involved two sub-tests of the Stanford Achievement Test, Arithmetic Computation and Reading Comprehension. An observational Classroom Activity Analysis Form was also administered. The interpretation of this acquired data will be presented in subsequent chapters.

CHAPTER III

A DESCRIPTION OF ACTUAL USMES USAGE

The Need for a Description of Actual Use

Meaningful evaluation of an innovative curriculum project like Unified Science and Mathematics for Elementary Schools (USMES) should include a description of the way the new program is actually being used in field settings, as well as a description of the more traditional treatment groups, or "control" groups, against whose performance the success of the USMES-taught classes is measured.

Charters and Jones (1973) noted that many evaluators expend considerable resources developing appropriate outcome measures and planning and executing elaborate research designs without attending to crucial description of the actual differences between the programs in the "experimental" and "control" situations. Writing in the Educational Researcher, Charters and Jones (1973) underscored the importance of such documentation for meaningful program evaluation:

> "What is not standard practice in evaluation studies is to describe, let alone to measure, how the programs in "experimental" and "control" situations actually differ from one another - or even to certify that they do. There are certainly circumstances in which differences between what researchers regard as "experimental" and "control" programs are more fictional than factual, but in the absence of a measurement technology or tradition, such circumstances may well go undetected. Then the researchers' findings of no consistent differences in student otucomes between "experimental" and "control" programs can fundamentally mislead educators regarding the substantive worth of innovations." (Charters & Jones, 1973, p. 5.)

This descriptive component is especially important for an evaluation of USMES. Unlike more structured curricula which might prescribe relatively uniform student and/or teacher activities through texts, workbooks, teacher guides, programmed instruction, etc., USMES is purported to be "an important new style of education" (USMES Central Staff, March, 1973, p. 1) designed to involve students in real problem solving. While a series of challenge units and tangible resource materials have been developed by USMES, this program, according to its developers, is more accurately portrayed as a philosophy of education than as a collection of materials. Each USMES challenge unit should evolve from the children's identification of, and action on, a problem which is real and important to them. By design, the USMES approach could result in as many different treatment groups as there are classes using USMES.

The purpose of this chapter is to describe how USMES classes actually used this program, to differentiate the treatment USMES classes received with the math/science programs used in control classes, and to distinguish between the classroom activity patterns of USMES and those of the control classes. The primary bases for these descriptions are data from the following forms: (a) School Information Forms; (b) Class Information Forms; (c) USMES Program Monitoring Forms; and (d) Classroom Activity Analysis Forms used for both USMES and control classes. These forms are exhibited in Appendices A, B, C, and D, respectively. Also included is pertinent information gathered from teacher interviews. The interview guide is shown in Appendix G.

Length and Intensity of USMES Usage Experiences by Sample USMES Classes

A. Development Classes

First will be summarized the answers given by the 15 sample development teachers to the series of questions (1-6) on the Class Information Forms.

These deal with the teachers' and students' experience with USMES. Ten of these development teachers had been with the program for two years and five more were completing their third year. Over this two- and three-year period, these teachers had used between one and five units, in addition to the development units assigned for 1973-74. The list of units they had used virtually exhausts the units available for implementation by 1973. Their 1973-74 development units were distributed as follows:

Name of Development Unit	Number of Sample Teachers Working on that Unit
Advertising	1
Animal Behavior	2
Bicycle Transportation	1
Classroom Design	1
Community Services	2
Ecosystems	2
Learning Processes	2
Manufacturing	3
Music Production	1

Many persons involved in or interested in the USMES development and this evaluation project have pointed to the long term effects of the program as a very important issue for investigation. In preliminary response, we included questions on the Class Information Form about the students' experience with USMES. We wanted to corroborate other data on how intensive and extensive was the application of the treatment we were evaluating.

As to the length of exposure to USMES, only four teachers had classes with children who had prior USMES experience. The percentages of these USMES-experienced children in those four classes ranged from 20% to 60%.

As to the intensity of USMES usage during 1973-74, the pattern which emerged varied. An inspection of Table 2 will reveal that the development teachers spent anywhere from 1 to 4 hours per week on USMES over a 6½ to 36 week period.

Three of the 15 development teachers expressed no interest in using USMES the following year. We did not pursue the reasons for this negative response. It may have been disenchantment with the program; it may have been for other reasons.

B. Implementation Classes

By definition, implementation teachers were less experienced with USMES than the development teachers described above--all of the implementation teachers were using USMES for the first time that year. The units which they were using were distributed as follows:

Name of Implementation Unit	Number of Sample Teachers Working on that Unit
Consumer Research	1
Describing People	3
Designing for Human Proportions	4
Dice Design	1
Traffic Flow	1
Weather Prediction	3

While these implementation teachers were themselves inexperienced with USMES prior to 1973-74, two of the 13 sample implementation teachers had students with prior USMES experience. In one class, half of the students had used USMES before; in the other class, the figure was 80%.

The picture of the intensity of 73-74 USMES usage, emerging for the 13 sample implementation teachers, was exceedingly varied. Seven teachers had used only one unit during that year; four used two units, and two teachers

TABLE 2

Time Spent on USMES Activities Including Design Lab Work, by Fifteen Sample Development Teachers During 1973-74

Teacher	Hours/Week Spent on USMES	Weeks/Year Spent on USMES	Total Number of Hours
A	3	19	19
B	?	23	?
C	1	12	12
D	4	23	92
E	?	23	?
F	3	36	108
G	3.5	28	98
H	4	24	96
I	3	30	90
J	3	30	90
K	3	26	78
L	2.5	30	75
M	3	6.5	19.5
N	2	28	56
O	.75	30	22.5
Average (based on N=13)			Mean = 68.77 Median = 78

had used three. However, the number of units alone can not be used as a yardstick to measure intensity. The variability in time spent on USMES by the implementation teachers can be seen in Table 3. This data underscores the difficulty which one faces in trying to characterize the nature of the treatment, i.e., the USMES curriculum as it is actually applied in classrooms. Looking at the factor of time alone, one notes that USMES might have been used intensively over a short period of time, (e.g., teacher C), in small doses over a great number of weeks (e.g., teacher J), or with any combination of values of intensity and duration.

Another descriptive note on these 13 sample implementation teachers is that all but one expected to continue using USMES the following year.

We had intended to describe the ways that USMES teachers in self-contained classrooms reportedly apportioned their instruction time among the various subjects when USMES was and was not being used. However, we errored by omitting the column headings, "When USMES is used," and "When USMES is not used," over the two columns of lines on page 2 of the Class Information Form. This error precluded a meaningful interpretation of the time periods reportedly spent by USMES teachers on the nine areas listed in question 2, and page 2. We could not say whether the teachers had included or excluded USMES in their assignments of the time spent on math, science, social studies, etc. Unfortunately, this error also prevented us from making comparisons between USMES implementation teachers and their controls on this distribution of instruction time.

TABLE 3

Time Spent on USMES Activites, Including Design Lab Work, by Thirteen Sample Implementation Teachers During 1973-74

Teacher	Hours/Week Spent on USMES	Weeks/Year Spent on USMES	Total Number of Hours
A	1.5	?	?
B	1.5	20	30
C	6	2.5	15
D	3	25	75
E	2.5	38	95
F	1	12	12
G	1	8	8
H	6	16	96
I	3	12	36
J	2	26	52
K	5	7	35
L	5	13	65
M	2	20	40
Average (based on N=12)			Mean = 46.58 Median = 38.

Non-USMES Curricula in USMES and Control Classes

A. Development Classes

When asked on the Class Information Form to list the names of the non-USMES science, social studies, math and language arts programs and texts used by their classes, the USMES development teachers responded with a lengthy set of replies defying anything but gross categorization. The USMES development teachers used, in addition to USMES, only texts, no texts, or most frequently, a combination of texts, self-developed materials, commercially prepared workbooks, and parts of other science/math curriculum programs including ESS, SCIS, SAPA, ISCS, and IPI.

B. Implementation Classes and Their Controls

It should be emphasized that the control classes for the 1973-74 USMES evaluation were selected from the same schools and at the same grade levels at their USMES counterparts in the sample. We did this to minimize the differences between USMES and control classes in these extraneous factors which could account for differences in program outcomes. Thus, it should not be surprising that there was great consistency between USMES and control classes within a school in the kinds of non-USMES curricula which the teachers reportedly used. Across schools, one noted an enormous variety of texts, programs, and materials used for non-USMES science, social studies, math and language arts, while, within a school, USMES and control teachers tended to use the same programs, texts, and materials outside of USMES.

The Influence of USMES on Control Classes

While the selection of control classes from the same schools as the experimental classes had the advantage of minimizing extraneous variance, this practice also had the undesired effect of reducing the treatment differences between USMES and control classes. The "contamination" of non-USMES classes with the USMES program was a phenomenon observed by the members of the evaluation team during our site visitations earlier in the year. For example, one teacher, who had not been trained in the use of USMES, borrowed ideas and materials from an USMES-trained colleague and effectively persued an USMES challenge in her classroom. To label this kind of teacher, as a "control teacher" would have been very misleading.

Furthermore, some students who had used USMES prior to the 1973-74 evaluation year were now assigned to classes taught by teachers not trained to use USMES, i.e., to potential control teachers. To use as control data, performance data based on these students with prior USMES experience would have been equally misleading.

Observers were directed to ask control teachers the questions on page three of the Class Information Form in an effort to assess the possible contamination of control classes by exposure to USMES. One of the 13 control classes might better have been classified as an USMES class because that teacher claimed to have used the USMES philosophy in her classes and to have read some unit resource books for teachers, although she did not use an USMES-developed unit. Moreover, her students had used USMES in prior years and were continuing to use the design lab facilities. Two other "control" teachers of the group of 13 claimed to know and to subscribe to the USMES philosophy. While they say they use the USMES philosophy in their classes, they are not familiar with any USMES-produced material nor had their students been exposed to USMES. The remaining 10 control teachers claimed to have no knowledge of the USMES program, nor its philosophy, materials, or approaches. Data only from the latter 10 control classes could be used as control data in the analysis of student performance.

Design Lab Facilities in the Schools

Of the 19 sample schools where USMES was being used, 6 were in their first year of USMES usage, 8 in their second, and 5 in their third. Fifteen of the 19 sample schools had design labs; 4 did not although one of these 4 was a middle school with an extensive industrial arts workshop available for use by USMES classes.

On our site visits, USMES teachers expressed concern about being able to use a well equipped, adequately staffed design lab during their USMES units. For this reason, we included questions about the design lab facilities, materials, and staffing on the School Information Form. The number of hours per week that each school's design lab was staffed by someone other than the classroom teacher using USMES were distributed as follows:

Hours During Which The Design Lab is Staffed	Number of Schools Reporting
0	7
8-11	3
15	2
20	1
30	1
	14

The staffers included released time teachers, paid teacher aides, adult volunteers, building principals, and a retired Army Sergeant. None of the 15 sample schools used older students to supervise younger students. (One of the 15 schools had one design lab as a permanent part of an USMES teacher's classroom; for them, this question was inappropriate.)

The quantity of tools contained in the 15 schools' design labs were appraised as follows:

Tools Available in Design Lab	Number of Schools Reporting
Very few tools	1
Basic tools	5
Extensive tools	7
Not answered	2
	15

Nine of the 15 sample schools reported they had designated a separate room for the design lab facility. The remaining schools were pressed for space and had to resort to other arrangements for their labs. The following situations were reported:

Location of Design Lab	Number of Schools Reporting
Separate room	9
Permanent part of classroom	1
Portable design lab cart	3
Part of auditorium	1
Off school grounds in another building	1
	15

Teachers' Viewpoints on the Place of USMES in the School's Curriculum

This assessment is based on the interview responses of 80 USMES teachers. The questions dealing with the place of USMES in the school's curriculum are found on page one of the Interview Form for USMES Teachers (Cf. Appendix G). The sample of teacher respondents is described above in Chapter II.

We opened the interviews by asking the teacher if he considered USMES a supplement to, or a replacement for, the subjects of math, science, and social studies. A small minority responded saying that, if one followed the philosophy completely, USMES would be a replacement for these subjects. It would require careful planning, but, as one teacher put it: "Anything can be taught under the 'umbrella' of a unit." However, the vast majority, of USMES teachers interviewed saw USMES as a supplement to regular class work, especially in math and social studies. They felt that math skills in particular needed to be taught directly and then could be reinforced by the problem solving activities of USMES.

More commonly, USMES was considered a replacement for science, possibly because it was the only science which many teachers taught. Many teachers used USMES to satisfy the amount of time for science teaching required by their districts. If the requirement was an hour-a-day for five weeks, and on plants, primals or the solar system--and such was the case in some districts we visited--then the teachers wanted an USMES unit tailored to those specifications.

No teacher viewed USMES as a replacement for his regular social studies instruction. Although the teachers' perceptions of the program were governed by the unit they were using--the Burglar Alarm unit was a "science" unit; any unit containing graph work was a "math" unit--few teachers seemed to label any unit a "social studies" unit.

Some of the teachers who used USMES as a supplement to these three content areas said they were doing so because of the demands of their districts to "cover" certain content areas during the school year. These teachers felt that concentrating too much effort on USMES might hinder their ability to meet these demands. Other USMES teachers who used this program on a limited basis, cited demands from parents: that teachers cover prescribed content; that students do well on standardized tests; that their students compare favorably on traditional criteria to other children at the same grade level. Obviously, these teachers were unwilling to risk giving up what has worked for them in the past in their attempts to satisfy the demands--

real or perceived--of their districts or of the parents of their students.

In answer to another question as to whether USMES really is an integrated approach to the teaching of math, science and social studies, the overwhelming response from teachers was "yes." Only one person issued a negative response. Several teachers noted that it depended on the unit. It is interesting to note that, although the teachers considered USMES an intergrated approach, they had no difficulty separating out the various content areas.

Results from the Program Monitoring Forms: How Were USMES Teachers Using the Program in Their Classes?

The Program Monitoring Forms shown in Appendix C were completed and returned by 79% (83/105) of those USMES development and implementation teachers reported to have used at least one USMES unit during the 1973-74 academic year. Collectively, their responses were based on 24 different units. The results are summarized below, question by question.

Question 1, 2, and 3 dealt with issues of vital concern to teachers, issues expressed to us repeatedly during our interviews with them the previous Spring. They are: how do you introduce a challenge; and once it is introduced, how do you set realistic and meaningful goals?

Question 1: How was the unit you are presently working on introduced to the students?

After studying the responses to this question from 83 questionnaires, it seemed obvious to us that only rarely did any of the challenges arise initially out of concerns expressed by the children. Rather, as in most classroom teaching, the USMES teachers either contrived situations and hoped that, as a result, the problem would arise, or they posed the problem to the children directly. The ways in which the situations were "set-up" varied so greatly that it was impossible for us to draw generalizations without presenting a distorted picture.

Question 2: What were some of the typical student reactions to the unit?

Generally, student reactions to the unit were reported to be very favorable. Excitement, enthusiasm, and enjoyment were reactions noted by many teachers. In responding to Question 2, only a few teachers cited boredom, confusion, or disinterest. Some of the more detailed responses noted a variation of student reactions over the course of the unit and/or between one child and another.

Question 3a: What were your goals for this unit?

Question 3b: How did the students define the challenge for their situation?

Extreme variability across responses was quite evident in the teachers' answers to this goal setting question. Indeed, considerable diversity in responses to Questions 3a and 3b was expected among teachers who were using different units. However, some teachers identified general goals; others cited specific behavioral objectives. Many answers did not really address the questions. Perhaps some of the teacher respondents were not sure of their goals or their students' goals for the unit; instead they responded to Question 3a and 3b by listing the teaching/learning activites or by elaborating on their responses to Question 2.

To afford the reader a picture of the broad scope of the methods which the teachers used to present the unit and of the wide range of student reactions to the challenge, we have chosen to present a cross-section of the teachers responses to Questions 1, 2, and 3. We further decided not to take a random sample of responses, but to deliberately select answers which illustrate the variation in content, length, and depth of teacher responses within one unit (Describing People), across several units, and across grade levels. In addition, we decided to present selected answers for Questions 1, 2, and 3 from the same teacher, to give some notion of how the goals may or may not relate to the method of introducing the challenge. The sample responses are shown in Table 4.

In reviewing the teachers' responses to the 11 open-ended questions on the Program Monitoring Form, we noted with interest that no differences in the teacher responses could be attributed to either grade level or unit factors. (The only exception to this observation appeared in the responses to Question 9: From the teachers' view, the content emphases on math, science and social science and the resulting attitude changes in the children toward these subjects were unit-dependent.) Further study of the answers to Questions 4 through 11 on the Program Monitoring Form suggested that it was two other factors which accounted for some of the differences in teacher responses: frequency of USMES usage, and teacher directiveness.

Question 4a: Did the children lose sight of the goals during the unit?

Question 4b: If yes, th why in your opinion did this occur?

Question 4 was the only item on the Program Monitoring Form which elicited consistent responses from the teachers. The overwhelming majority felt that the students did lose sight of the goals during the unit. Responses did not differ by unit or by grade level. Both lower and upper

TABLE 4

Selected Responses From USMES Teachers to Questions From the Program Monitoring Form

Unit	Grade	Question 1: How was the unit you are presently working on introduced to the students?	Question 2: What were some of the typical student reactions to the unit?	Question 3a: What were your goals for this unit?	Question 3b: How did the students define the challenge for their situation?
Describing people	1-2	I introduced describing people by motivating the children to develop games using descriptive terms.	The children enjoyed the unit tremendously. They were fascinated by the ways and terms in which each of them, as well as others could be described. The children wanted to make graphs as a result of some of their findings.		They defined their particular challenge as an interesting, workable, and a problem solving technique which they hoped to master by themselves.
Describing people	3	We were talking about T.V. shows and especially police stories. They mentioned a local store being held up and how the police caught the robbers because the owner identified and described them.	Some of the identifying factors they brought up were hilarious. They had small arguments over which parts of a description were best and would help the most in identification. Being third graders they thought it fun to play police. They were really excellent in their choice of descriptive words.	To teach the children to be more observant. To notice more in the environment. To increase their vocabulary. To make them more aware of other persons, places and things about them.	At first, they considered it a game. But as we progressed into the unit they could see that they all agreed that it was something they could do themselves and that sometime it might turn to their advantage to be able to recognize someone or some object. We more or less stayed with describing people more than anything else.

TABLE 4 (Cont.)

Unit	Grade	Question 1: How was the unit you are presently working on introduced to the students?	Question 2: What were some of the typical student reactions to the unit?	Question 3a: What were your goals for this unit?	Question 3b: How did the students define the challenge?
Describing people	4-5	Asked one student to go to another room and bring back a blue eyed, brown haired person. Immediate response was. "You didn't tell us enough." Started small groups to write descriptions of the person I had sent for.	Ranged from boredom at times to high excitement at others.	To reach unit challenge to introduce USMES approach to the children. To have children experience "learning" as opposed to traditional education. Have children experience problem solving situations.	To describe someone using a list of good descriptions and the fewest (descriptions).
Describing people	5	We had been working on adjectives by listing characteristics of people. Played sit down game with characteristics chosen to describe a person	Excitement.	To present a real life problem and finding ways to solve problems.	"That's easy."
Describing people	6	We were working on a unit on the human body. One of the counselors came in on the pretense of finding out some information. When she left I had the children to describe her, She returned later and had changed clothes. We discussed the fact that we all tend to describe clothing not people.	The children were enthusiastic and made comments to the effect that they couldn't wait for Thursday and Friday to come, (USMES days).	My main goal was for the children to become more observant of people and their individual characteristics.	The students worked to obtain the 5 characteristics bhey deemed to be the very best characteristics with which to describe a person When they established thes 5 characteristics they the went on to clarify exactly what they meant by each one.

TABLE 4 (Cont.)

Unit	Grade	Question 1: How was the unit you are presently working on introduced to the students?	Question 2: What were some of the typical student reactions to the unit?	Question 3a: What were your goals for this unit?	Question 3b: How did the students define the challenge?
Learning	5	It was introduced after a test, by asking how could they have done better on the test--this led to the discussion of different ways of learning.	Some were very confused--some very enthusiastic about testing each other.	To have each child satisfied that he had completed his testing and had some results that had a value to him.	Most of them got learning and teaching concepts confused. Their learning involved different methods of presenting materials like teaching.
Ways of Learning	8	The students have been exposed to many ways of learning (assumed) this year. The teacher and the students thought that it would be nice to explore the possibility of learning content by means of creative problem-solving.	The unit was begun during the last two weeks of the school year. The students are very excited about learning content and having fun in the meantime.	To deliberate techniques for the production of new ideas and idea-combinations. To produce new ideas consciously and deliberately without waiting for an unpredictable inspiration.	How can we learn content and still be creative.
Learning	8	The teacher asked the students if they had ever studied percent. Since so few students had, the teacher asked the class how they thought they could best learn about percent. The discussion then went to a more general one about how they learned anything best. The class decided to run an experiment about learning.	Very competitive, highly motivated to learn about percent, very interested in how they learn best, more task oriented than with previous units. (These are low ability classes.)	To have these low ability students analyze their learning process and to apply what they found out about how they learned in future situations. To teach the basic concepts of percent.	After the more general discussion on learning, the experiment was conducted on learning the concepts of percent. They identified 4 or 5 ways to learn such as tapes and films, games, learning centers, applications.

Unit	Grade	Question 1: How was the unit you are presently working on introduced to the students?	Question 2: What were some of the typical student reactions to the unit?	Question 3a: What were your goals for this unit?	Question 3b: How did the students define the challenge?
Growing plants	2	The challenge - Growing a plant for their Mother's Day gift. Discussed different things that would be nice for their mothers, something that their mother could keep over a long period of time.	All the students really enjoyed working with the plants, taking care of them and watching them over the period of time. In the end each child was so proud of the plants.	For each child to really learn the parts and their functions of a plant. Each one had to take care of his or her plant. But the main goal was for each child to survive.	To be a success to grow their plants for Mother's Day.
Growing plants	3	Discussion of plants in the classroom, having a garden at school.	Much excitement and interest.	Appreciation of plants and caring for a school garden.	How to grow plants at school school. Bake sale to earn money to buy plants (proceeds: $93.00). Plant sale (proceeds: $55.00).
Nature area (Nature trails)	5	Nature walk through woods behind school with students recording observations (they used 5 senses and had had previous training in observing).	They liked the study very much and were excited about it. They would stay after school or do extra work at home. They especially liked being outside. One student invited the class for a walking hike to her home to study tree identification, terracing, plant identification.	To develop a site to serve as a laboratory for outdoor investigation. To increase the students' awareness of nature. To function as the setting for a curriculum enrichment program.	To preserve and to study the natural life of an area behind the school and to make a place where people can enjoy themselves and learn about nature.
Nature trail	7	How could we make a place at school to help others and ourselves learn about nature?	Generally very enthusiastic - wanted to go outside and start looking for a place immediately.	To make a nature trail. To label trees. To make learning centers along the trail - ran out of time.	We have quite a bit of land surrounding the school which is forest. They thought of a nature trail and wanted to explore the woods for the best place. They were eager to have a trail and take other classes through the area and teach about what they'd learned.

grade teachers felt that their students became distracted solving minor or tangent problems which took them away from their overall goals.

> "They tend to keep discovering new problems before any are solved and have trouble establishing priorities."

> "Yes, some of the sub-challenges became more exciting than the original problem."

> "They got carried away with inventing drinks and forgot to find a best drink. Besides, it was more fun than wrestling with the other aspects of the problem."

When asked why the children lost sight of the goals, many lower grade teachers commented that this happened because the children were young, and they constantly needed to be reminded of where they were going.

> "Of course they did--by virtue of age (6-7 year olds), and the nature of the beast."

> "Young age of children. They were more interested in experimenting with sound."

Question 5: How often and in what situations was refocusing required during the unit?

In responding to Question 5, most teachers agreed that they had to redirect their students' attention toward the goals of the unit, but how often they were required to do this depended on the frequency each teacher used the USMES unit. If the students worked on the unit daily, refocusing was necessary only infrequently; if USMES was used only once a week, refocusing was required at each meeting.

> "When several days elapsed between USMES sessions, a general review was needed to refocus students' thoughts toward goals and challenges."

> "It would be great if this were a unit used each day rather than twice a week."

"Yes, after vacations, camping for a week, and other special events which were so time consuming that we didn't have time for USMES."

"Yes, after long vacation lapses."

Question 6a: Were there fluctuations in student interest during the work on the unit?

Question 6b: If yes, please explain at what points these occurred.

The value which USMES teachers attached to intensive use of USMES was certainly one of the strongest issues to come out of the Program Monitoring Form. In responding to Question 6, many teachers commented on the neccesity of not spreading an USMES unit over a long period of time. They recommended that once a unit is started, it should be done often, not merely once a week.

"More interest was apparent when sessions were scheduled closer together."

"I feel that student enthusiasm would have been more favorable had the unit been presented in a more concise manner. Time lapses between sessions caused a break in continuity and lessened student interest."

Apparently much enthusiasm was generated at the start of a unit, and the approaching solution of the problem appeared also to be reinforcing. But during lapses of time, whether vacations, or time intervals from "USMES day" to "USMES day," the reinforcement declined. This time factor and the nature of the activity being pursued were the two most frequent reasons given for fluctuations in interest as the unit progressed.

Interest in USMES was greatest when children were involved in physical projects: working with tools; going to other classrooms to collect data; going outside the school for nature walks. However, it appeared that once these activities were completed, children lost interest.

> "Interest lagged when we were not actually doing mixing or testing or selling."
>
> "People who raised plants soon got bored. Once containers were built, simply observing became much less exciting."
>
> "(Interest lagged) during more pedestrian labors which required time, patience, and accuracy, such as measuring."
>
> "During graphing."
>
> "Children are happier in units that involve physical activity. The nitty-gritty or writing down and tabulating turns them off."
>
> "USMES was fun when we built cages, but after that it got boring."

Question 7: If the children hit any impasses during the unit, at what points did this occur and how was the impasse overcome?

Some responses to Question 7 were relevant and some were merely repetitious of the responses to Questions 4 and 6. Children hit an impasse during a unit when they lost sight of the major goal or when they completed the physical activity components of a unit. Other teachers added that an impasse arose when it appeared that no progress was being made, or when groups could not work together, or when the children lacked the specific skills needed to continue working toward a solution. These comments applied to both lower and upper grades. Those teachers who reported a halt in unit progress due to "slow-going," or to lack of student skills usually responded to the impasse by being directive. All of these teachers agreed that some additional progress recaptured the children's interest in the problem. Some of these teachers commented that, in retrospect, they should have been <u>more</u> directive at these points to help the children deal with their frustrations.

Reports of frustration and comments on the need for more structure were by no means universal, however. Some classes, apparently because of the make-up of the groups or because of previous experience working in groups, did not encounter these really frustrating experiences. It could also be that some teachers were more sensitive to the students' approaching sense of frustration and were more directive, consciously or unconsciously, at these points. One teacher who was aware of his intervention noted:

> "Sometimes the teacher needs to be directive. He shouldn't be inhibited by the 'USMES approach'."

> Question 8: Please explain the nature and extent of any student comments or criticisms on your present USMES unit and/or the USMES approach in general.

Teachers' reports of students' comments or criticisms of USMES were solicited in Question 8. There can be no doubt that in the teachers' view, USMES generated a high level of excitement and enthusiasm in their students.

> "All comments were positive, since the units were student initiated and student run."

> "Students ask for USMES time and think of it as a 'fun' activity."

> "Children really love the unit. They especially enjoy doing it themselves."

The instances of a child not liking an USMES unit were rare. Out of 83 questionnaires, there were only 4 teachers who said that a small minority of the class was uninvolved. They further noted that these same children remained uninvolved in most other classroom activities as well. As we noted previously in this report, some parts of the unit were reportedly more popular than others. But in the overall, one must conclude that the USMES units were popular activities for at least part of the time.

Question 9: Have you noticed any attitude change (+, -) in the children towards math, science, social studies, or any other subject since the children began work on the USMES unit?

Whether or not this student enthusiasm and excitement with USMES was accompanied by changes in their attitudes toward specific subjects or toward school in general was an issue which elicited a variety of teacher comments. (We had also asked teachers to respond to this issue during our on site interviews. Their comments then were equally diverse.) Nonetheless, some meaningful response categories can be summarized.

The majority of teachers noted positive changes in student attitudes toward specific subjects, but not all subjects. Some teachers expressed the view that selective changes occurred when the various units emphasized a different subject. Some units, for example, stress math and others science. None were seen to emphasize social studies.

"The unit afforded a lot of math, and even the slower children showed a positive attitude."

"Math would be a plus. Not sure on other subjects."

"Yes, particularly in the maintenance of computation skills. Students accepted this as part of the challenge and not 'math work'."

"Some of the children hated math when they came in the fall. To date, I have the best math class I've ever had."

"Definitely yes. More interest expressed particularly in the science area."

"Social studies teacher notes they are more eager to make decisions about things."

A few teachers reported that more general attitude changes toward school had occurred in the children since they began working on an USMES unit.

> "I have noticed a positive attitude toward school in general."

About 25% of the teachers saw no change in the children's attitudes, either toward specific subjects or toward school in general.

> "I have noticed no change in attitude at all."

> "No. They are enthused about the unit, but I can't see any carry-over into the other subjects."

> "Their attitude towards these things is good when they are working on the USMES project. I've <u>not</u> seen that this runs over to their regular math class."

> "Not really."

The remainder of the responses to Question 9 came from teachers in schools which departmentalized. Usually each of these teachers would speak to his particular subject, but felt he couldn't speak to others. Again, many of these teachers noted positive changes toward their subjects. Others did not speak of attitude change.

> "I only teach science."

> "We have separate classes for these subjects."

> Question 10: Were there any activities in the unit which posed special problems for you, the teacher, as a classroom manager? Please explain.

Questions 10 and 11 dealt with different facets of the same topic--special needs or problems of the teacher using USMES. The responses to Question 10 were quite consistent. Fully three-quarters of the teachers encountered at least some difficulty managing the children in small groups or during individual USMES activities, especially in the Design Lab.

> "It was hard to be with all the groups at the same time."
>
> "It was difficult to guide small group activity. The children were not independent enough to work with only limited guidance."
>
> "I definitely found the need to have more than one adult in the lab because of safety reasons."

This last comment was echoed repeatedly by USMES teachers, both in their responses to the Program Monitoring Form and during our interviews.

About 25% of the teachers said they had no special problems of classroom management with USMES. There could be many reasons for this: some groups of children work better together; some teachers can tolerate more noise and confusion; some principals are more understanding of the program's need to operate a "freer" classroom. It is also possible, however, that once children and teachers have been through several units, and expectations are known, things run more smoothly. In view of the concern expressed by such a large number of teachers, the special problems of classroom management for USMES appears to be an area in need of further study and increased attention at USMES Training Workshops.

Question 11: Were there any special needs that this unit required such as materials, teacher preparation, teacher aides, etc.?

Question 11 tended to elicit more specific needs. Most teachers responded by providing a list of materials needed for their unit: rain guage, newspapers, radio, thermometers, cotton fabric, yarn, needles, staples, etc. The collective list would consume pages if all items were included.

Some of the teachers who were using units which emphasized science mentioned their need for greater technical background. (They did not ask for more papers on the subject; they simply said they needed more background.) Several teachers mentioned the need for a list of resource people in the community who could be called upon for help.

About 20% of the teachers replied that they needed to spend more time for preparation when USMES was being used. This increased preparation time was needed not only to learn background material for the unit, but also to collect tools and materials with which to work. Yet, there was no evidence that the increased time for preparation would deter these teachers from using the USMES program.

> "It did take a lot of preparation time! But I have learned as much as the children!!"

The answers to the 11 open-ended questions on the Program Monitoring Form were diverse, and analysis of responses to several questions permitted little more than gross categorization. However, several points were made with great frequency, and these, in particular, seem worthy of added note.

We think there can be no doubt that despite difficulties, the teachers who responded to this questionnaire enjoyed using USMES. This was probably due in large part to a factor of self-selection, but none-the-less, they have found the program workable, profitable for children, and professionally stimulating to themselves. Children also looked forward to "USMES day." As we pointed our previously, the children particularly enjoyed the physical activities which accompany the program.

There are several basic problems which emerge from the responses: how to schedule USMES for optimum value; now to manage a whole class of children either in or outside the classroom; how to collect the materials and information needed for a unit so that teacher's preparation time is cut down. Resolution of these 3 issues would make the program, not only manageable for the teachers, but potentially more profitable for the children.

The last page of the Program Monitoring Form consisted of a list of activities. Each teacher was asked to check the amount of emphasis given that activity by the particular unit on which he was working. (Cf. Appendix C.) These checks were collated, first by unit, and then by activity. We decided to include the analysis by activity, rather than by unit, since it gives the reader some idea of the proportion of emphasis placed on a particular activity across a variety of USMES units. For example, is "co-operation among peers" an integral part of all USMES units or is it specific to one? A glance at the data reveals that it is an integral part of all USMES; 97% of the teachers checked the last 2 columns ("heavy emphasis"). Conversly "memorizing" appears not to be a strong component of USMES; across all "challenges" or units, only 14% of the teachers felt USMES placed heavy emphasis on that activity.

The following is a list of all activities, ranked in order of the combined percentages of teacher responses in the last 2 columns ("heavy emphasis").

Co-operation among peers	97%
Responsibility for own actions	81%
Oral Communication	80%
Problem Solving	69%
Measuring	66%
Making Charts	63%
Tallying	61%
Writing	60%
Addition	58%
Graphing	55%
Science	53%
Subtraction	51%
Multiplication	43%
Reading	35%
Competition among peers	34%
Fractions	32%
Division	25%
Using Money	24%
Geography	17%
Memorizing	14%
History	5%

This list does not present many surprises and most of the responses can be readily explained. One response which will need further study is the item indicating that only 53% of the teachers feel USMES places a heavy emphasis on "Science." Perhaps definition of the term is needed. Or perhaps this confirms a comment we heard several times in our interviews: "USMES teaches the scientific method, but not the content of science." This issue needs clarification, and it should be addressed in next year's evaluation.

Results from the Classroom Activity Analysis Forms: What Student Behaviors Were Observed most Frequently in USMES Classes and in Control Math or Science Classes?

A. Expected Differences in Learning Activities for USMES Versus Control Classes

The Central Staff notes that the USMES program is "an important new style of education" (March, 1974, p. 1). This assertion is based in part on the premise that teachers and students using USMES engage in very different teaching/learning patterns from those activity patterns found in non-USMES classrooms.

The developers contend that, in learning the process of real problem solving, "students themselves, not the teacher, must analyze the problem, choose the variables that should be investigated, search out the facts, and judge the correctness of the hypotheses and conclusions" (March, 1974, p. 2). In the USMES mode of learning, the teacher takes on a new role--that of coordinator/collaborator--rather than the director's role typically portrayed by classroom teachers. Thus, USMES students are expected to engage in active, hands-on, "learning-by-doing." The "real problem" which the students tackle is supposed to provide a focus for various student activities: collecting real data; constructing measuring instruments, scale models, and test equipment; trying out suggested imporvements; preparing reports or summaries of their work; presenting their findings to the proper audiences. Furthermore, the developers contend that progress toward a solution to an USMES problem requires the efforts of groups of students, not just that of an individual student working along. By comparison, children in control classes would be expected to exhibit more passive, structured, teacher-directed, and teacher-dominated behaviors.

B. Procedures for the Observation of Student Behaviors

The Classroom Activity Analysis form shown in Appendix D was developed by Susan Rogers, a member of the USMES Evaluation Team, to enable assessment of differences in the patterns of activities for USMES versus control classes. The categories on the form represent classes of student behaviors which could be observed in an elementary school classroom. The form underwent successive revisions and pilot-testing over a period of two years in USMES and non-USMES classrooms.

Observers were trained for their proper use of the form. Upon entering the classroom, the observer conducted seven rounds of observations. Each round could take anywhere from a few seconds, if all the children were doing the same activity, to a maximum of five minutes. To insure a uniform time sampling procedure, the time period between the start of each round was set at five minutes. During each round, the observer was to look at each child as if taking a snapshot, then tally for each student that behavior category on the form which best described what the child was doing. Lists of observable student behaviors in each category accompany the Classroom Activity Analysis Form in Appendix D.

TABLE 5

Results of the 1973-74 Classroom Activity Analysis: Percentages of Observers' Tallies in 28 Student Behavior Categories During Fall, Winter, and Spring Observation Periods for USMES Control Classes

Observation Period	FALL		WINTER			SPRING	
Treatment Group	USMES Imp.	Control	USMES Dev.	USMES Imp.	Control	USMES Imp.	Control
Number of Classes	(10)	(10)	(14)	(7)	(6)	(5)	(3)
Category of Student Behavior	Percentages of Tallies in Each Category						
1. Measures	1.2	0.0	1.8	2.0	0.0	2.5	0.0
2. Counts	0.0	0.4	1.2	0.9	0.0	0.9	0.0
3. Constructs	7.9	0.4	11.6	0.0	0.0	2.8	0.0
4. Assembles	4.5	0.0	3.0	0.0	0.0	1.8	0.0
5. Tests/Experiments	18.4	0.8	1.3	2.1	5.7	4.0	0.0
6. Calculates	8.2	11.7	0.9	1.9	10.6	0.6	12.7
7. Records Data	6.2	1.8	1.1	6.5	0.2	2.3	0.0
8. Writes/Illustrates	0.2	0.2	5.6	2.5	4.1	3.9	0.0
9. Writes (pre-structured)	0.4	5.7	2.1	0.0	6.1	0.0	6.3
10. Reads How-To-Cards	0.2	0.0	0.8	0.0	0.0	0.1	0.0
11. Reads-Task	0.1	1.9	2.8	4.7	0.8	4.3	0.0
12. Free Reading, Writing, Drawing	0.5	0.9	3.4	2.2	1.2	1.2	0.6
13. Messes Around with Materials	1.1	1.2	1.3	0.1	0.9	1.4	0.0
14. Talks to Another-Task	2.2	1.0	2.8	3.2	3.5	4.6	3.9
15. Talks to Another-Social	3.8	4.7	1.5	3.2	7.2	4.1	8.0
16. Small Group-Task	2.3	0.3	12.4	0.0	1.4	1.4	0.0
17. Small Group-Social	1.1	1.9	0.1	0.0	0.0	0.0	0.0
18. Gives Pre-structured Info to Teacher	0.6	1.5	0.5	1.0	2.3	1.8	9.4
19. Gives Original Info to Teacher	3.3	0.8	1.3	2.2	1.7	6.1	0.0
20. Seeks Info from Teacher	2.9	3.5	2.0	1.7	2.7	2.6	3.2
21. Talks to Teacher, Social	0.2	0.4	0.3	2.3	0.0	0.1	0.0
22. Takes Part in Class Discussion, Presentation	4.9	11.2	6.7	17.1	4.4	8.7	10.7
23. Listen/Look at Child	7.3	1.9	4.8	13.2	4.2	2.7	2.3
24. Listen/Look at Small Group	1.4	7.2	1.2	2.1	1.2	0.3	0.0
25. Listen/Look at Class	2.3	2.6	7.2	3.2	0.4	0.5	1.9
26. Listen/Look at Teacher	14.1	31.0	13.2	21.0	30.1	28.4	26.3
27. Collecting Material/Maintenance	2.6	4.6	4.2	0.7	2.0	2.8	3.5
28. Resting/Waiting/Fooling Around	2.2	2.6	4.9	6.2	9.1	10.3	11.1
Total Percentages	100.1	100.2	100.0	100.0	99.8	100.2	99.9

(b) Next, for each record set containing the tallies of an observer for one visit to one classroom, the frequencies were averaged across the seven rounds.

(c) If more than one observation was done in a classroom during the Fall, Winter, or Spring, one set in each of these periods was randomly selected to use in the analysis.

(d) For each group (USMES Implementation, Control, and USMES Development) during each observation period, the behavior frequencies averaged across rounds were then averaged for groups within periods.

(e) These average frequencies were expressed as percentages of total frequencies for each group in each seasonal period.

C. Results of Classroom Activity Analysis

Table 5 presents these relative frequencies of student behaviors for the USMES Implementation and control classes during the Fall, Winter and Spring observation periods, and for the USMES Development classes which were observed only during the Winter. The results for USMES classes tend to indicate that:

(a) In the Fall, presumably at the beginning of an USMES unit, much class time was spent on constructing, assembling, and especially on testing/experimenting, but also on calculating and recording data. These "hands-on" activities, which were related to preparation for, and engagement in, the data collection process, consumed almost half (45%) of the time during which [illegible] sample USMES Implementation classes were observed. The percentage of time spent on these activities by USMES Implementation classes tended to diminish considerably from Fall to Winter and from Winter to Spring.

(b) As the amount of time spent on the activities mentioned above in "a" diminished over the school year, the following behaviors were observed more frequently in the USMES classes: writes/illustrates; reads-task; free reading, writing, drawing; small group-task (for development classes only); takes part in class discussion/presentation; listen/look at class; listen/look at teacher, film, or lecture; and resting/waiting/fooling around.

(c) Children in USMES Development classes spent significant amounts of time during the Winter observation period in the processes of constructing and working in small groups. Accordingly, they spent proportionately less time listening to and looking at the teacher. (See lines 3, 16, and 26 of Table 5.)

(d) The amount of time students spent using How-To-Cards was negligible. This result from line 10 of Table 5 corroborates the result of our teacher interviews on this point.

Some interesting patterns of activities are noteworthy for the control classes. The results in Table 5 seem to indicate that:

(a) The children in USMES classes spent more time measuring, constructing, assembling, testing/experimenting, and recording data. This difference between USMES and control classes in time spent on physical activity was especially pronounced in the Fall observation period.

(b) USMES students engaged in calculation to an appreciable degree during USMES classtime only in the Fall. The control students had a sustained emphasis on calculation, probably basic skills work in arithmetic.

(c) USMES Implementation classes spent virtually no time in any observation period on pre-structured writing during USMES class time, and the USMES Development classes devoted only 2.1% of their time during the Winter observations to pre-structured writing. However, control class children over the school year consistently spent about 6% of their observed class time on pre-structured writing in workbooks or on worksheets. These results appear in line 9 of Table 5.

(d) Line 15 of Table 5 suggests that during Winter and Spring observations about twice as much time as USMES children in one-to-one verbal interaction with their peers on social issues.

(e) As it was pointed out earlier in this report, the results on line 18 suggest that control teachers were using considerable amounts of Class time in the Spring for review for control students were then giving appreciably more pre-structured information to the teacher. The Spring column of line 19 suggests that USMES implementation teacher were also spending more time in review and/or summary, but here the students are giving original information to their teachers.

(f) Line 22 of Table 5 indicates that during the Fall observation period, control children spent considerably more time taking part in class discussions or presentations than children in USMES Implementation classes. This pattern was reversed during the Winter when USMES Implementation class students spent 17% of the observed time participating in class discussion or making presentations to the class. Differences between USMES Implementation and control classes in this behavior category were minimal in the Spring.

(g) Children in USMES Implementation classes spent appreciably more time listening to or looking at another child than control children did during the Fall and especially during the Winter observation periods. The group difference recorded in Spring for this activity was very slight. These results appear in line 23 of Table 5.

(h) Not surprisingly, both USMES and control students spent a sizable percentage of time listening to and/or looking at their teachers. (See line 26 of Table 5.) More significant, however, is the result that control students spent fully 31% of their observed time in the Fall listening to/looking at the teacher, while USMES Implementation students spent a much smaller percentage of their time (14%) in this way. The difference dropped from a ratio of 2:1 in the Fall (31% control versus 14% USMES), to a ratio of 3:2 in the Winter (30% versus 21%), to a 1:1 ratio in the Spring, with no appreciable difference between USMES and control classes (28% versus 26%). These results suggest that, in the beginning, USMES teachers did in fact adopt less dominating roles. However, in the final stages of the units, the USMES teachers dominated class time to a much greater extent than they did earlier in the school year. (The USMES entry on line 19 for the Spring observation period showed a corresponding increase over the previous period.)

(i) A final observation suggested by the data on line 28 of Table 5 is that both USMES and control students spent increasingly more time unproductively "resting/waiting/fooling," as the school year progressed.

Chapter Summary

USMES teachers varied considerably in how they used the USMES program. The diversity in application of USMES seemed especially noteworthy with respect to two kinds of factors: (1) intensity of usage, and (2) teacher directiveness. Some USMES classes experienced brief applications of the program throughout the school year which others had their USMES time concentrated in intensive periods over a few months only. Many combinations of levels of intensity and duration of usage were reported by the USMES sample teachers, and indeed the total number of hours they reportedly spent on USMES during the year ranged from 8 to 108.

Teachers' responses to the Program Monitoring Form and some of their comments during on-site interviews suggested that the factor of teacher directiveness could account for much of the additional observed and reported variations in their application of the USMES program. Variability in teacher directiveness was evident (1) in the variety of ways teachers reportedly introduced the USMES challenge to their students, (2) in the statements of goals which the teachers established for their units, (3) in teachers' comments as to why and when they had to redirect their students' attention toward the primary unit challenge, and (4) in the teachers' assessments of the impact USMES usage has had on their teaching overall.

Treatments and dosages could not be manipulated or controlled by the evaluators. The applications of USMES were diverse, and one can only assume that the control classes also represented much variety in their teaching/learning experiences. However, our results from the Classroom Activity Analysis reported above indicated that there were clearly distinguishable differences in the general patterns of activities which chacterize USMES and those which characterize the control classes over the school year; During the Fall especially, USMES children spent a much larger portion of their time engaging in physical, "hands on" activities, in testing and experimenting, and in collecting data. As the amount of time USMES classes spent on these activities diminished over the school year, increased amounts of time were devoted to the following behaviors: writing/illustrating; reading-task; free reading, writing, drawing; taking part in class discussion/presentation; looking/listening to other children and to the teacher. Control classes showed greater consistency in the patterns of student behaviors over the school year. Control students had a sustained emphasis on more structured, teacher-dominated activities: calculating; pre-structured writing in workbooks or on worksheets; and listening to/looking at the teacher.

Charters and Jones' (1973) caveat "On the Risk of Appraising Non-Events in Program Evaluation" was cited in the introduction to this report. The foregoing discussion on the characteristics of USMES and control classes constitutes the USMES Evaluation Team's attempt to proceed to level 4, the most rigorous level of comprehensive program description urged by Charters and Jones:

> "The manifest purpose of the teacher's role performance is to produce learning in students, but this cannot happen directly. The best the teacher can do is to induce statements to engage in activities deemed instrumental to the covert psychological processes he hopes to affect. It is the student's own activities and experiences that are most immediately related to learning outcomes,....and it is of no small importance for program evaluators to attempt to describe or measure the school's educational program as experienced and enacted by students." (Charters & Jones, 1972, pp. 6-7.)

CHAPTER IV

THE EFFECTS OF USMES ON STUDENT PERFORMANCE IN PROBLEM SOLVING AND BASIC SKILLS

Two kinds of data were drawn upon in the development of this chapter on the effects which the USMES program had upon its students. First, teacher perceptions of the program's effects on students were documented from interviews conducted during site visitations by the evaluation team. Second, student performance data in the areas of basic skills and problem solving were analyzed and discussed. Serious limitations to the student performance data were noted, along with recommendations for resolution of these problems in future evaluation work.

Teacher Perceptions of Student Performance

In order to assess the program from as many perspectives as possible, we felt that teachers would be questioned not only on their attitudes toward the USMES materials, the training workshops, etc., but also on their perceptions of what was happening to student behavior as a result of the program.

We inquired about those skills which USMES fostered or ignored, and yet we tried to avoid leading questions about specific kinds of skills; we encouraged the teachers to talk freely about those behavioral aspects of the child which were being developed or ignored under the influence of the program. We were impressed by the consistancy of their responses, regardless of the interviewer.

The list of skills fostered by the classroom use of USMES, according to the teachers' perceptions, is quite long and can best be related to the reader by grouping them into the following categories:

(a) Most basic math/measurement skills: geometry, fractions, additions, subtractions, graphing.

This appears to contradict another statement of the teachers--that USMES does not replace math, and that basic skills must be taught first and then applied to USMES projects. Nevertheless, the above statement was made repeatedly. No teacher we interviewed felt the program did not help foster these skills. Many felt they encouraged these behaviors even when not using the program, but admitted nonetheless that the program was still helpful in supporting these skills.

(b) Work-study skills: evaluation, analyzing, synthesizing, use of the scientific method, ability to think, decision making, inquiry.

(c) Socialization skills: working together in groups, fostering of cooperation rather than competition in trying to solve problems.

While the interviewers anticipated such responses as listed under category #1, these tended not to be the skills the teachers felt to be the most important. Rather their first response usually tended to be: "it fosters problem solving in the broadest sense," "encourages group processes," "decision making," "a sense of cooperation." While these are direct quotes from some interviews, these same ideas were given over and over.

(d) The development of a sense of confidence in the child. He experiments without a fear of failure. He senses accomplishment from the success he achieves. USMES develops perserverence in the child.

(e) Wider definition of learning. Several teachers indicated that children are learning that the whole world can be a classroom...that learning is not confined to the four walls of the classroom.

None of the teachers felt that any specific skills were being totally ignored since, they reasoned, any skill can be built into the units. However, they did sense some weaknesses in the program, weaknesses which might well be discussed here:

One limitation, in their perceptions, is the kind of student who can respond to USMES. Students must have a sufficient degree of self-direction or ability to assume some responsibility to cope with this program. Mature, self-directed pupils do well with USMES; the converse is also true. Some students not only do not benefit, but would be better off using another program. Such students tend to look at any unstructured program as free time. For example, they cannot handle themselves in a Design Lab. They are unable to think of a problem worthy of solution, to say nothing of being able to get enough direction to solve it. Another aspect of this same set of perceptions of the teachers is the feeling that this program is inappropriate for inner-city students. The program is not relevant to their needs or interests. Location is probably not the key factor, however. This same criticism was voiced by a teacher in an impoverished setting.

Seeking a response as to whether or not USMES fosters a sense of responsibility in students, we asked the question whether students seem more responsible for their learning as a result of using USMES. A large number of teachers felt that with USMES students <u>must</u> be responsible for their own learning. Students formulate their own problem and decide for themselves how it is to be solved. The teacher functions as a helper, not as a director.

Another large segment of the teachers agreed that children seemed responsible for their learning, but were unwilling to say that it was the USMES program which contributed to his effect. In fact, some felt this would have happened in their classroom, even without USMES. Still another group felt the program did not enhance responsibility, as their students were not ready to accept responsibility for their learning. If these particular students had had the opportunity to be in USMES several years in succession, behavioral changes might have occurred. Within the space of a year, however, noticeable changes did not occur.

Answers to the question as to whether or not teachers encountered any different kinds of discipline problems because of USMES followed directly from the previous question on responsibility. The majority of teachers said they observed no difference between the kinds of discipline problems th... had during USMES and during other classroom instruction. Some even cited a lower rate of discipline problems during USMES because the students were more actively involved, or "too busy to cause any disturbances." Where children would not assume responsibility for their learning, however, frequent discipline problems did arise during USMES. To these children, unplanned time was "free time," and these students cannot handle "free time" constructively.

This brings us to the important questions: What effect has USMES had on children's behavior?...on teachers behavior? While we have alluded to some of these earlier, they are included here as well since it is important to know what teachers feel are worth while changes in children and themselves.

(1) Children enjoy learning more. They're excited about school and working on their projects. They are not bored, but rather are enthusiastic about everything they do!

(2) Communication between children, between children and teachers, between children and parents has been aided. By explanation, the teachers commented that children are excited about what they are doing and talk about it. Some teachers and administrators volunteered that parents also have commented on the children's enthusiasm over the program.

(3) The children's self-confidence is increased; they know they can accomplich something. And because of this increased self-confidence, they try new things.

(4) The students learn to use people other then the teacher as resources. They recognize that they can also learn from each other.

With all these positive comments, the reader should be reminded that these teacher judgements apply to some children only. For others, the program seems to have few if any beneficial aspects.

Measurement of Students' Problem Solving Abilities

The primary objective of the USMES project is the enhancement of students' problem solving abilities. The USMES approach requires that students themselves analyze a problem meaningful to them, identify variables or factors relevant to the solution of the problem, collect pertinent data, use the information to judge the correctness of the hypotheses, and for appropriate conclusions and recommendations.

A. Instrumentation

The Playground Problem was conceptualized according to the above description of the problem solving process. This test requires that students develop a plan for a playground which would serve the students in their school. A catalogue of equipment, cost data, and measuring instruments are given to the students along with the information that they could spend up to $2,000. The test designed for administration to five children randomly selected from a class, who work as a group toward the solution of the challenge. The Manual for the administration of the Playground Problem is shown in Appendix E.

B. Scoring and Scorer Reliability

The scoring protocol developed for the Playground Problem yielded group scores on several dimensions. The behavioral assessment included rating scales of four aspects: motivation to accept the problem; commitment to task; allocation of responsibilities for efficiency of manpower; and the nature of group leadership. The cognitive assessment included four summary rating scores on variable identification, measurement calculation and recording. The students drawings of their proposed playgrounds were analyzed to yield four product scores: scale, labels, landmarks, and area designation. In summary then, 12 scores were derived from the scoring protocol: four behavioral, four cognitive, and four product scores. The actual derivation of scores is described in the Scoring Manual shown in Appendix F.

Two staff members scored the playground problems. Each worked independently to score the same ten, randomly selected, sets of text products.

(Each set included an audio tape of students' answers to questions, students' note papers, and the students' playground drawing.) Having completed this scoring, the two staff members compared ratings and discussed any discrepancies. They established points of agreement on how they would score various situations or various responses. Then the scorers proceeded to complete the remainder of the scoring without duplicating efforts and with consultation only on difficult judgements.

C. Results

Sample classes were selected to include a cross section of grade levels, USMES units, socioeconomic levels, and geographical areas within each of the following treatment designations: USMES Development classes (25); USMES Implementation classes (18); and control classes (18) at the same grade level in the same school as the Implementation classes. The Development classes had no controls.

Complete pre- and post-test returns were obtained for only 38 classes. The distribution of these classes by treatment and by grade level is shown in Table 6.

1. Behavioral Aspects. Distributions of pre- and post-test rating for Development, Implementation and Control Classes on each of the four behavioral aspects are shown in Table 7 through 10. Chi squares were computed to determine if there were significant differences in ratings for the pre-test or the post-test, among the treatment groups. None was significant.

Table 7 which contains the pre- and post-test ratings on the aspect of motivation to accept the problem shows a slight increase in the number of implementation class students who initially attempted to solve the problem. The motivation ratings for development and control groups remain virtually

TABLE 6

Distribution by Treatment and Grade Level for Sample Classes with Pre- and Post-Test Results on the Playground Problem

Treatment	Grade Levels			Total
	Primary 1,2,3	Intermediate 4,5,6	Advanced 7,8	
Development	4	13	1	18
Implementation	1	7	2	10
Control	1	7	2	10
Total	6	27	5	38

TABLE 7

Distributions of Pre-Test and Post-Test Ratings on Motivation to Accept the Problem for Development, Implementation and Control Classes

Treatment Group	Test	Ratings					
		0	1	2	3	4	5
Development (N=18)	Pre				11%	6%	83%
	Post				11%	6%	83%
Implementation (N=10)	Pre			10%		40%	50%
	Post					10%	90%
Control (N=10)	Pre				10%		90%
	Post			10%			90%

TABLE 8

Distributions of Pre-Test and Post-Test Ratings on Commitment to Task for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings					
		0	1	2	3	4	5
Development (N=18)	Pre			17%	50%	11%	22%
	Post		6%	6%	33%	28%	28%
Implementation (N=10)	Pre			20%	60%	10%	10%
	Post				50%	20%	30%
Control (N=10)	Pre				60%	40%	
	Post			20%	50%	10%	20%

TABLE 9

Distributions of Pre-Test and Post-Test Ratings on Efficient Allocation of Responsibilities for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings					
		0	1	2	3	4	5
Development (N=18)	Pre		11%	17%	50%	11%	11%
	Post		11%	17%	17%	28%	28%
Implementation (N=10)	Pre			40%	30%	20%	10%
	Post	10%	20%	30%			40%
Control (N=10	Pre			40%	50%	10%	
	Post		20%	40%	20%	10%	10%

TABLE 10

Distributions of Pre-Test and Post-Test Ratings on Group Leadership for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings				
		0	1	2	3	4
Development (N=18)	Pre	6%		30%	22%	39%
	Post	6%	6%	33%	22%	33%
Implementation (N=10)	Pre		10%	10%	20%	60%
	Post			30%	30%	40%
Control (N=10)	Pre	10%	10%	30%	30%	20%
	Post	10%		30%	20%	40%

The second behavioral aspect rated was commitment to task, or the intensity and sustenance of group interest in arriving at a solution. Table 8 shows that the implementation groups increase slightly on this factor from pre to post administration. The distribution of ratings for development classes showed more variability on the post-test with a very slight increase toward the high end of the scale.

Table 9 shows the distributions of group ratings on the behavioral aspect of allocation of responsibilities for efficiency of manpower. The Implementation classes showed a decrease in efficiency from pre-test to post-test. Overall, the classes in all three treatment groups became more variable on the post-test.

The fourth behavioral aspect scored was the nature of group leadership. Table 10 shows that the overall patterns across classes within each treatment designation changed very little from pre- to post-test. In most groups some form of leadership behavior emerged which was other than autocratic.

2. Cognitive Aspects. The scoring protocol for cognitive aspects of the students problem solving behaviors involved coding the variables or factors which each group identified as salient to the solution of the Playground Problem. Up to ten variables were scored. Eight possible factors were anticipated for the scoring protocol. Two additional variables could be accommodated. The number of factors which each group identified for consideration were summed. These scores are termed the "identification" scores. No group identified more than 10 factors.

Summations for each group were made for the levels of measurement the group achieved for each variable they identified. Similarly, summations were obtained across calculation ratings for each variable and across ratings on the adequacy of data recordings. Data analysis was based on these four summary measures: identification, measurement, calculation and recording.

Two types of analyses were conducted. First repeated measures analyses of variance were conducted to determine if Development, Implementation and/ or control classes realized statistically significant gains in any of the four cognitive summary measures. Second, covariance analyses were used to test the hypothesis that there were no statistically significant differences in post-test difference among the groups.

Sources of variance tables for the four repeated measures analyses using each of the four summary measures as dependent variables are shown in Tables 11, 12, 13 and 14. No significant changes from pre- to post-test were noted for the measurement, calculation, and recording scores. This result applied to all three treatment groups.

Significant differences in identification scores from pre- to post-test administration were observed ($p < .001$). An examination of Table 11 further reveals that this change from pre- to post-test scores must be qualified by treatment group. In fact, all three treatment groups showed a decline in the average number of factors they identified for consideration in their solution to the Playground Problem. Inspection of the means in Table 15 reveals that while the decline for the Development classes was very slight, the decline in the number of variables which the Implementation and control classes identified was more pronounced. These latter two groups identified on the average, approximately five factors for consideration on the pre-test but only about 3.5, on the average, for the post-test. The means summarized in Table 15 are also portrayed graphically in Figures 1-4.

TABLE 11

Repeated Measures Analysis of Variance for Pre- and Post-Test Results of the Identification Scores for Development, Implementation, and Control Classes

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	37	121.632	3.287		
Treatment (T)	2	0.131	0.066	0.0189	.982
Subjects x T	35	121.500	3.471		
Within Subjects	38	66.000	1.737		
Test Administration (A)	1	15.210	15.210	12.8280	.001
T x A	2	9.290	4.645	3.9170	0.028
Subjects x A x T	35	41.500	1.186		
Total	75	187.632	2.502		

TABLE 12

Repeated Measures Analysis of Variance for Pre- and Post-Test Results of the Measurement Scores for Development, Implementation, and Control Classes

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	37	10006.738	27.209		
Treatment (T)	2	13.180	6.590	0.232	.796
Subjects x T	35	993.559	28.387		
Within Subjects	38	218.000	5.737		
Tests (A)	1	6.367	6.367	1.149	.291
T x A	2	17.828	8.914	1.610	.213
Subjects x A x T	35	193.805	5.537		
Total	75	1224.738	16.330		

TABLE 13

Repeated Measures Analysis of Variance for Pre- and Post-Test Results of the Calculation Scores for Development, Implementation, and Control Classes

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	37	694.855	18.780		
Treatment (T)	2	4.605	2.303	0.116	0.890
Subjects x T	35	690.250	19.721		
Within Subjects	38	247.500	6.513		
Tests (A)	1	1.066	1.066	0.155	0.698
T x A	2	5.628	2.814	0.409	0.673
Subjects x A x T	35	240.806	6.880		
Total	75	942.355	12.565		

TABLE 14

Repeated Measures Analysis of Variance for Pre- and Post-Test Results of the Recording Scores for Development, Implementation, and Control Classes

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	37	424.737	11.479		
Treatment (T)	2	14.948	7.474	0.638	.539
Subjects x T	35	409.789	11.708		
Within Subjects	38	107.000	2.816		
Tests (A)	1	2.579	2.579	0.890	.646
T x A	2	3.032	1.516	0.523	.603
Subjects x A x T	35	101.389	2.897		
Total	75	531.737	7.090		

TABLE 15

Summary of Means and Standard Deviations for each Treatment Group on Each of the Playground Problem Cognitive Variables

Variable		Developmental $\bar{X}$	Developmental sd	Implementation $\bar{X}$	Implementation sd	Control $\bar{X}$	Control sd
Identification (Maximum possible score=10)	Pre	4.33	1.64	5.00	1.41	5.20	1.40
	Post	4.17	1.38	3.60	1.35	3.50	1.90
	Adjusted	4.42		3.52		3.33	
Measurement (Maximum possible score=50)	Pre	9.44	4.79	9.70	3.09	9.60	4.43
	Post	9.78	3.86	8.90	3.25	7.60	4.55
	Adjusted	9.86		8.83		7.59	
Calculates (Maximum possible score=27)	Pre	6.06	3.52	5.20	2.35	5.90	5.36
	Post	6.28	3.06	6.20	3.49	5.40	3.98
	Adjusted	6.13		6.42		5.32	
Records (Maximum possible score=16)	Pre	4.00	3.20	2.80	1.75	3.00	3.16
	Post	3.39	2.35	3.10	2.13	2.40	3.06
	Adjusted	3.00		3.35		2.54	

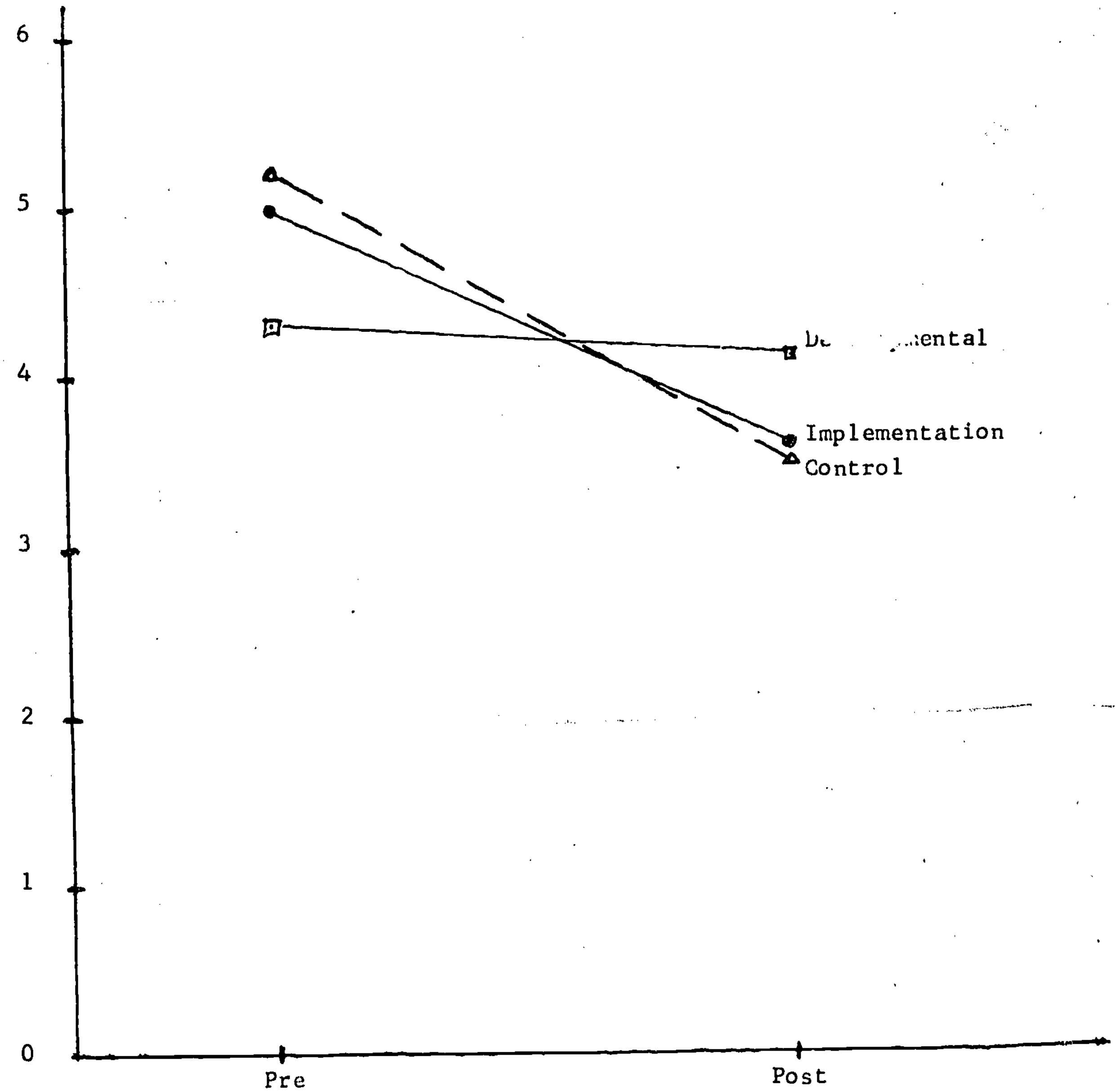

Figure 1.--Graph of Pre-test and Post-test Means of Identification Scores for Development, Implementation, and Control Groups.

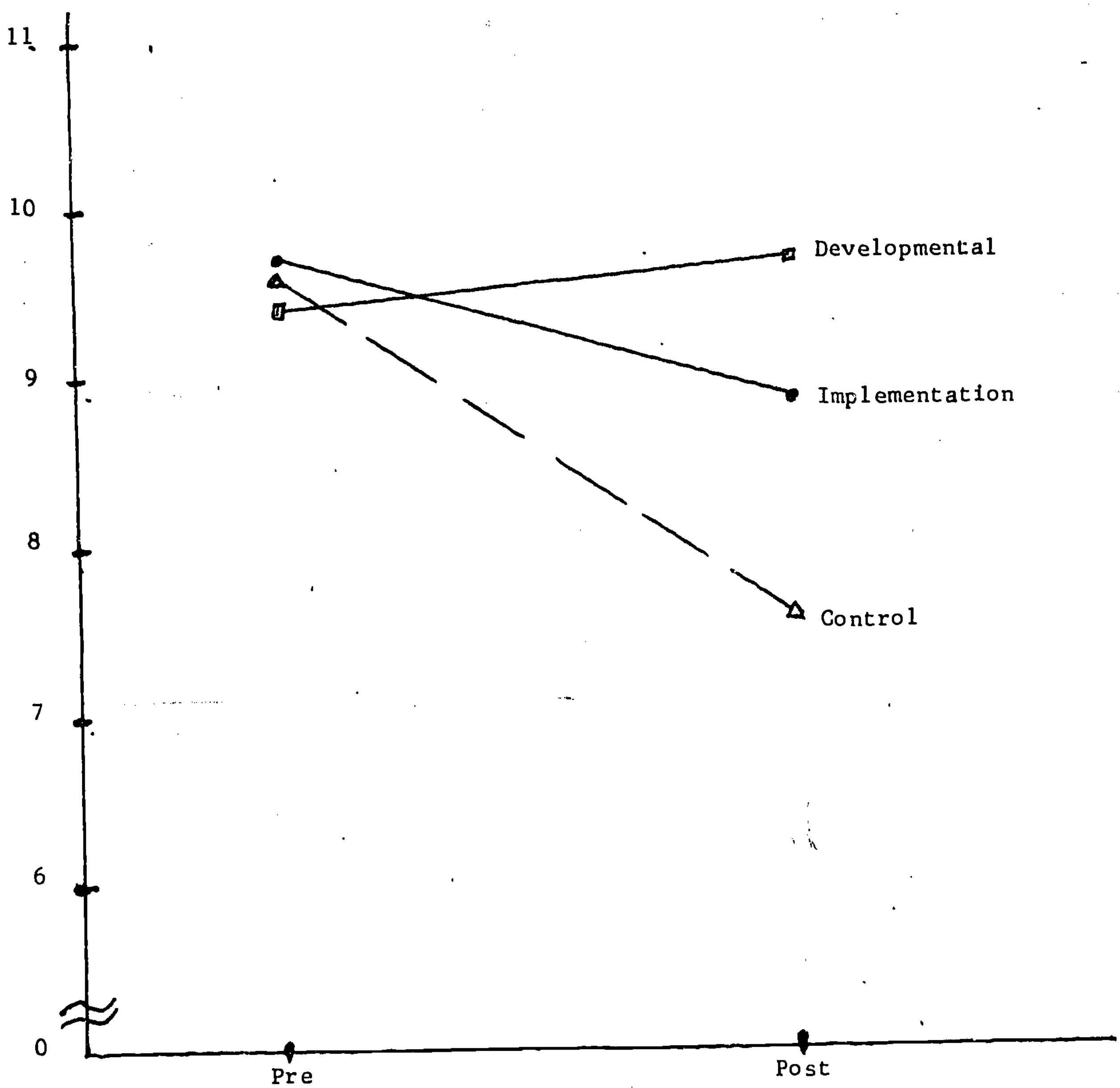

Figure 2.--Graph of Pre-test and Post-test Means of Measurement Scores for Development, Implementation, and Control Groups

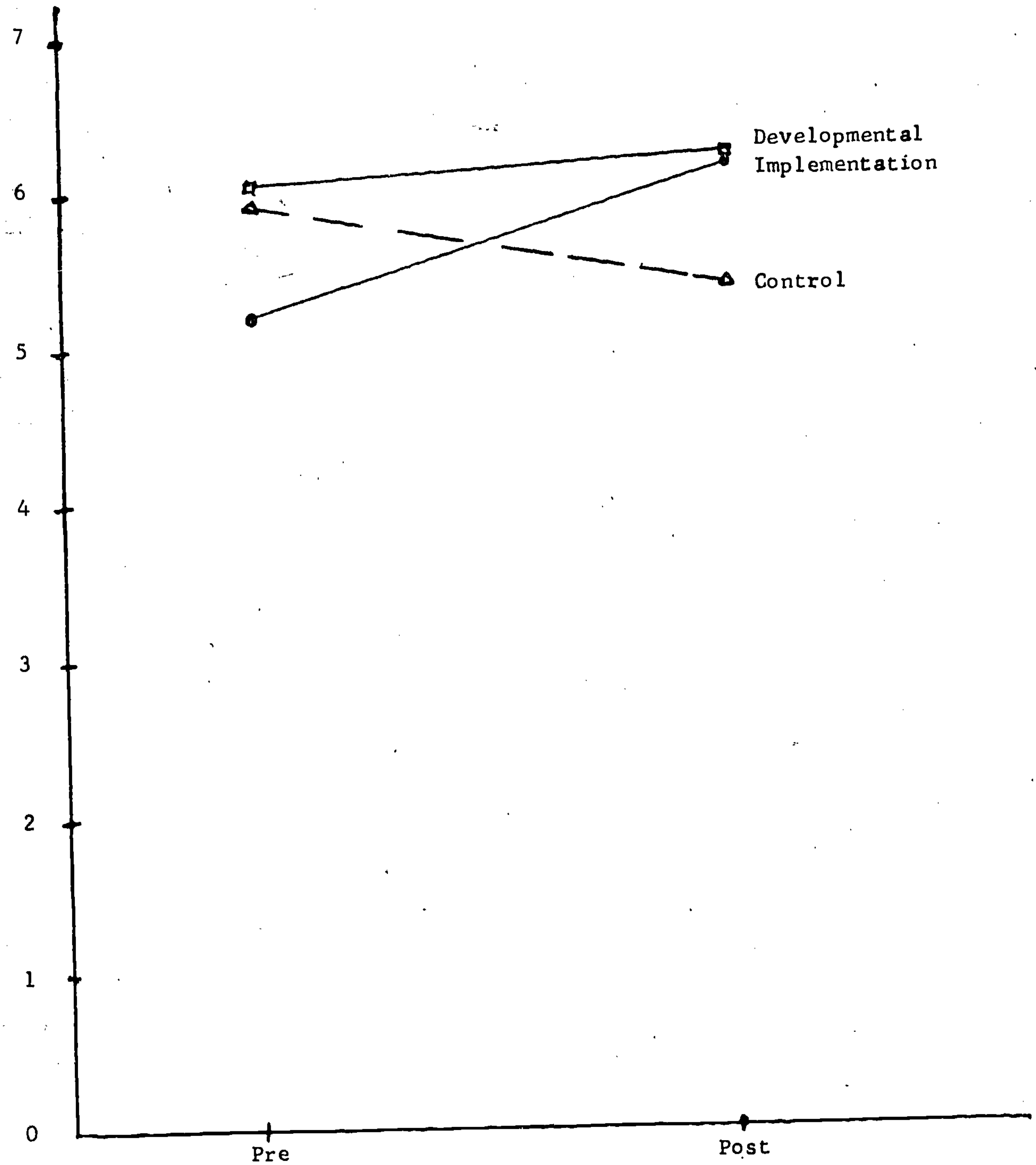

Figure 3.--Graph of Pre-test and Post-test Means of Calculation Scores for Development, Implementation, and Control Groups.

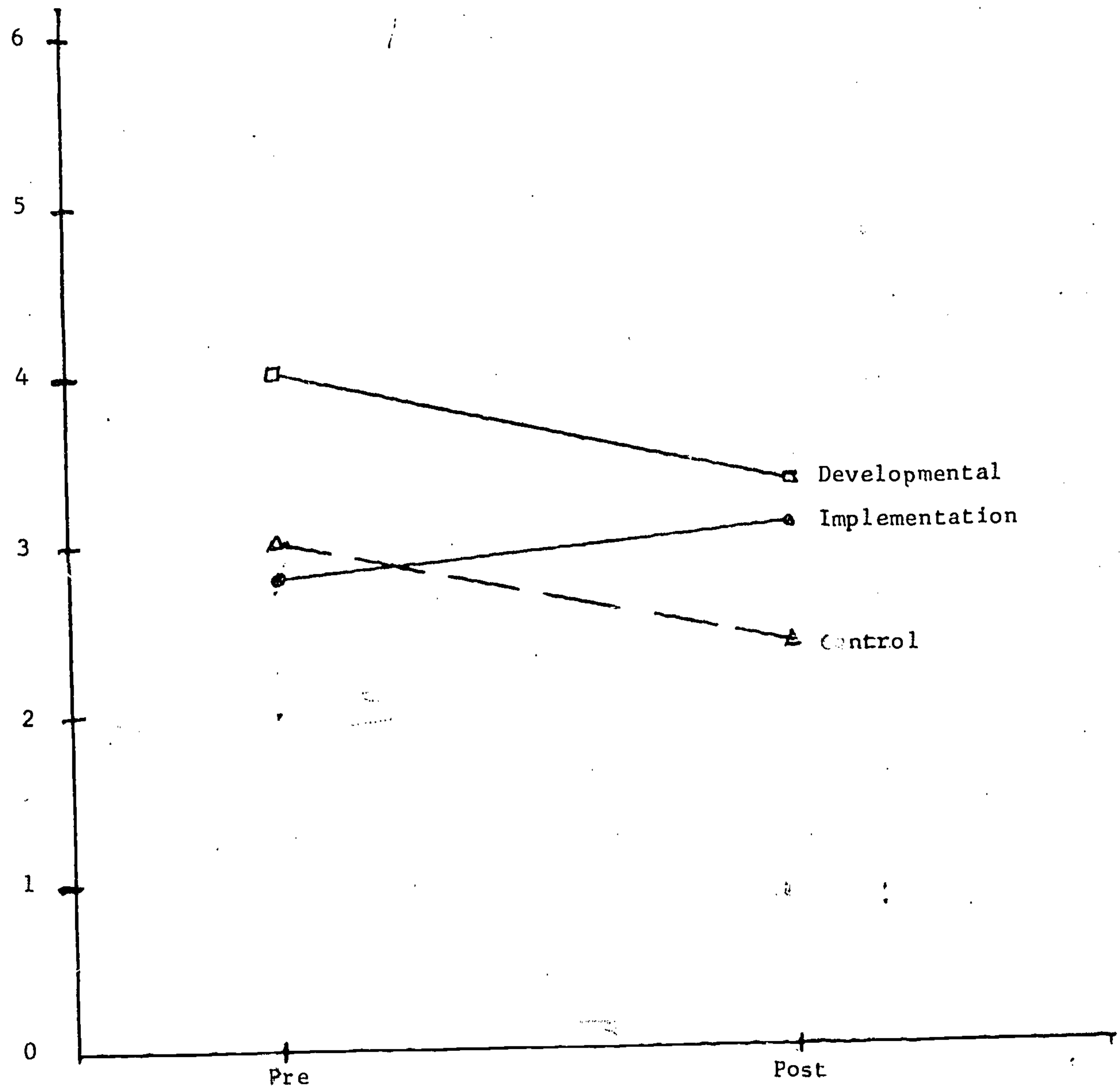

Figure 4.--Graph of Pre-test and Post-test Means of Recording Scores for Development, Implementation, and Control Groups.

The evaluation team had hypothesized that this drop in identification scores from pre- to post-test would be observed for USMES Implementation classes in which most of the students had no prior USMES experience. However, we hypothesized too a corresponding increase in their measurement and calculation scores, the rationale being that USMES students might pursue fewer issues in greater detail in a timed test situation. The results do not support this hypothesis.

Results of the one-way analyses of covariance used to test for adjusted post-test differences among the three treatment groups are shown in Table 16 for identification, measurement, calculation and recording scores. No significant differences were observed among treatment groups for any of the four dependent variables. No conclusions could be drawn about the relative superiority of the treatment groups with respect to the cognitive factors involved in problem solving as measured by the Playground Problem and its scoring protocol.

3. Product Aspects. Distribution of pre- and post-test ratings for Development, Implementation, and control classes on each of the four product aspects are shown in Tables 17-20. Chi squares were computed to determine if there were significant differences among treatment groups on any of the pre-test or post-test product ratings. None of the chi square results was significant.

Measurement of Students' Basic Skill Development

As was the case in the 1972-73 evaluation of the USMES program, performance in basic skills areas of children exposed to USMES was an integral component of the 1973-74 evaluation. In the 1972-73 evaluation the results

TABLE 16

Analysis of Covariance for Development, Implementation, and Control Classes Using the Four Post-Test Cognitive Summary Ratings as Dependent Variables and the Corresponding Pre-Test Scores as Covariates

Source of Variance	df	SS	MS	F	p
		Measurement Scores			
Treatment	2	8.90	4.45	2.45	0.10
Error	34	61.78	1.82		
Total	36	70.68	1.97		
		Identification Scores			
Treatment	2	33.57	16.79	1.97	0.16
Error	34	289.51	8.52		
Total	36	323.08	8.97		
		Calculation Scores			
Treatment	2	6.70	3.35	0.36	0.70
Error	34	314.40	9.25		
Total	36	321.10	8.92		
		Recording Scores			
Treatment	2	3.28	1.64	0.40	0.67
Error	34	138.04	4.06		
Total	36	141.32	3.93		

TABLE 17

Distributions of Pre-Test and Post-Test Ratings on Product Scale for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings		
		0	1	2
Development (N=18)	Pre	50%	44%	6%
	Post	22%	11%	17%
Implementation (N=10)	Pre	10%	80%	10%
	Post	20%	70%	10%
Control (N=10)	Pre	40%	60%	
	Post	30%	70%	

TABLE 18

Distributions of Pre-Test and Post-Test Ratings on Product Labels for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings	
		0	1
Development (N=18)	Pre	67%	33%
	Post	30%	70%
Implementation (N=10)	Pre	30%	70%
	Post	30%	70%
Control (N=10)	Pre	20%	80%
	Post	50%	50%

TABLE 19

Distributions of Pre-Test and Post-Test Ratings on Product Landmarks for Development, Implementation and Control Classes

Treatment Group	Test	Ratings		
		0	1	2
Development (N=18)	Pre	61%	17%	22%
	Post	67%	22%	11%
Implementation (N=10)	Pre	80%	20%	
	Post	70%	20%	10%
Control (N=10)	Pre	80%	10%	10%
	Post	70%	30%	

TABLE 20

Distributions of Pre-Test and Post-Test Ratings on Product Area Designation for Development, Implementation, and Control Classes

Treatment Group	Test	Ratings	
		0	1
Development (N=18)	Pre	50	50
	Post	56	44
Implementation (N=10)	Pre	20	80
	Post	50	50
Control (N=10)	Pre	40	60
	Post	40	60

indicated that there was no consistent evidence which could lead one to conclude that using USMES hindered growth in the elementary school basic skills areas (i.e., reading and math). The purpose of again examining growth in the basic skills areas was to determine if the 1972-73 results would br replicated.

A. Procedures

To answer the questions concerning growth in the basic skills areas, a two group (i.e., USMES and non-USMES classes), pre-test/post-test design was employed. The USMES classes received the treatment (i.e., worked on an USMES challenge), while the non-USMES (Control) classes did not. Thus, the independent variable was exposure or non-exposure to USMES. The dependent variable was the score each child attained on Form A of the 1973 version of the Stanford Achievement Test. The measurement of dependent variables (i.e., administration of the SAT subtests) in the sample classes was done both in the Fall and in the Spring. Unfortunately no standardized testing schedule was employed and thus both pre-tests and post-tests were given over a 2-3 month period. This problem reduces the generalizability of results as one can not really talk of "gains over the school year," but only of "gains over the pre-test/post-test period." The administration of these tests was limited to USMES implementation classes in both the National and Chicago samples. Due to a multitude of problems encountered with the Chicago Sample, only the results of the National Sample will be presented. The National Sample consisted of 18 experimental (i.e., USMES) and 18 control (i.e., non-USMES counterpart) classes. Due to several data collection problems, mentioned earlier, data from only six USMES classes and their controls could be used in the analysis.

Of the entire Stanford Achievement Test Battery, only the Reading Comprehension and Mathematics Computation subtest were administered. These were the basic skill areas which were of primary concern to prospective USMES users, and schools were reluctant to submit to extensive standardized testing.

These tests were administered by either the classroom teachers or the USMES classroom observers. These observers were employed by the USMES program for this purpose as well as for other data collection. The choice of who administered the tests was left to the discretion of the teachers and observers.

In the second grades, the Primary II form of the SAT's was used, and in the third grade the Primary III form was used. For both of these forms, the students marked their responses in the test booklets. In the fourth grade the Intermediate I form was used while the Intermediate II form was selected for fifth and sixth grade classes, and the Advanced form for the seventh and eighth grade classes. For the Intermediate I, Intermediate II, and Advanced forms, the students responded directly on machine scorable answer sheets. The data from the Primary II forms was transferred from the test booklets to Digitek answer sheets for optical scanning. All data from the remaining three forms was key punched directly from the answer sheets themselves. Test scoring was done with a computer program prepared especially by the program evaluators. The end results of the scoring procedure were, for each student, a raw score and it's corresponding scaled score on each of the two subtests of interest. The calculation of the scaled scores is described in the following paragraph which is taken from the Norms Booklet, Form A, of the Stanford Achievement Test.

> Scaled scores on the Stanford Achievement Test were obtained through a computerized application of the Thurstones absolute scaling procedure. This resulted in the development of a system of inter-battery standard scores which permitted the translation of raw scores at each level to standard scores with comparability across levels for a test area. The scale values were derived by setting the median raw scores of grade 3 and grade 8 in the Fall standardization equal to 132 and 182 respectively.

The scaled scores, rather than the raw scores were used in all analyses. The analyses were done using packaged statistical programs available at the Boston University Computer Center.

As had been expected, there was, in each classroom, some loss of data from pre-test to post-test due to both absenteeism and the mobility of the student sample. In addition, due to the small number of analyzable classrooms, students rather than the classrooms were used as the unit of analysis, although the classroom were originally designated the sampling unit.

One other point which needs to be mentioned concerns the classes from the National Sample which were analyzable. Four of the six classes are from the same geographical area, a fact which makes generalizations to the USMES program in other areas of the country impossible.

B. Results

The data were submitted to two general analyses: (1) repeated measures analysis of variance, and (2) analysis of covariance. The repeated measures analysis of variance was used to answer the question, "Do the USMES and/or Control (i.e., non-USMES) classes realize statistically significant gains in mathematics (i.e., Reading Comprehension) from pre-test to post-test." The analysis of covariance was used to test the hypothesis that there were no statistically significant differences in post-test scores between the

USMES and Control classes once adequate statistical allowances were made relative to pre-test differences between the groups. The pre-test score was used as the covariate. The results will be presented below in two sections corresponding to the two Stanford Achievement Tests subtests administered: i.e., Reading Comprehension and Mathematics Computation.

1. Reading Comprehension. The Reading Comprehension subtest measures reading comprehension at levels varying from simple recognition to making inferences from several related sentences in varying content areas.

The test questions sample the following skills:

- Comprehension of global meaning.
- Comprehension of the meaning of detailed information.
- Comprehension of implied meaning.
- Use of context for word and paragraph meanings.
- Drawing inferences from what has been said.

The difficulty of the items and the length of the selected paragraphs increases from the Primary II through the Advanced forms. The time allowed for the different levels are as follows: Primary II, 45 minutes; Intermediate I, 35 minutes; Intermediate II, 35 minutes; and Advanced 35 minutes.

a. Within group differences. Pre-test/Post-test gains were analyzed for both USMES and Control samples and for each individual classroom. Means and standard deviations for each classroom are presented in Table 21.

The classes were grouped into three general categories of grade levels based on whether they were administered Primary, Intermediate, or Advanced forms of the SAT's. The pair of classes lettered "A" is a Primary Level class, pairs B, C, and D are Intermediate Level classes, and pairs E and F are Advanced Level classes. An examination of the pre-test and post-test

TABLE 21

Means and Standard Deviations for Pre-Test and Post-Test Reading Comprehension

Pairs	Class	N	Pre-Test	Post-Test	Adjusted
Primary A	USMES[c]	18	122.72 (14.06)[a]	136.44 (19.17)	132.2[b]
	Control[c]	23	114.35 (28.75)	128.22 (31.39)	132.4
Intermediate B	USMES[c]	24	141.29 (16.17)	158.67 (10.66)	160.0
	Control[c]	18	145.11 (24.42)	154.06 (28.00)	152.7
C	USMES[c]	19	167.74 (16.43)	176.68 (22.77)	179.1
	Control[c]	24	172.08 (21.21)	179.00 (27.96)	176.6
D	USMES[c]	25	116.04 (43.15)	148.72 (20.45)	152.0
	Control	26	149.23 (17.75)	152.31 (17.11)	149.0
Advanced E	USMES[c]	19	191.89 (33.66)	206.00 (18.85)	200.6
	Control[c]	32	168.97 (21.67)	179.25 (17.80)	184.7
F	USMES[c]	22	201.68 (18.08)	215.45 (6.96)	215.1
	Control[c]	27	199.85 (20.04)	209.41 (12.90)	209.8

a. Figures in parentheses are standard deviations
b. Represents post-test means adjusted for pre-test differences
c. Significant at or beyond the .05 level

means for each class indicate that all classes realized gains in reading, comprehension, and for all classes except the control class of pair D, these gains were statistically significant at or beyond the .05 probability level. Repeated measures analysis of variance results for each class can be found in Tables 22 through 27. Overall the pre-test/post-test gains in mean scores varied from approximately 9 points (USMES class C/Intermediate Level) to 32 points (USMES class D/Intermediate Level) for the USMES classes while the corresponding mean increases for the control classes was approximately 3 points (Control class D/Intermediate) to 14 points (Control class A/Primary).

Tables 28 and 29 present the repeated measured analysis of variance of the total USMES group (Table 28) and the total Control group (Table 29). Both groups realized statistically significant gains in reading comprehension over the pre-test/post-test assessment period.

In summary, the USMES classes realized significant gains in Reading Comprehension over the period during which they were studied. The exposure to the USMES challenge does not appear, in anyway, to have hindered growth in this basic skills area. This appears to be true for virtually all grade levels analyzed. Control classes also appear to realize gains.

b. Between group differences. A two-factor analysis of covariance was used to investigate differences in Reading Comprehension between the USMES and Control classes. The first factor was Treatment (USMES vs. non-USMES) and the second factor was Grade level (Primary, Intermediate, and Advanced). Table 30 presents the combined means for each factor. Table 31 contains the summary table of the analysis of covariance. An examination of the F-Ratio and their associated probabilities reveals statistically significant main effects for both Treatment and Grade Level. The interaction

TABLE 22

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for Pair A

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	40	47771.00	1194.275		
Treatment (T)	1	1391.00	1391.000	1.170	.286
Subjects x T	39	46380.00	1189.231		
Within Subjects	41	6999.00	170.707		
Assessment (A)	1	3906.00	3906.000	49.267	.000
T x A	1	1.00	1.000	0.013	.906
Subjects x P x T	39	3092.00	79.280		
Total	81	54770.00	676.173		

TABLE 23

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for Pair B

Source of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	41	27524.00	671.317		
Treatment (T)	1	3.00	3.000	0.004	.948
Subjects x T	40	27521.00	688.025		
Within Subjects	42	8909.00	212.119		
Assessment (A)	1	3976.00	3976.000	34.824	.000
P x T	1	366.00	366.000	3.206	.077
Subjects x P x T	40	4567.00	114.175		
Total	83	36433.00	438.952		

TABLE 24

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for [illegible] C

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	42	38205.00	909.643		
Treatment (T)	1	235.00	235.000	0.254	.622
Subjects x T	41	37970.00	926.097		
Within Subjects	43	5881.00	136.767		
Assessment (A)	1	1311.00	13[illegible].000		
T x A	1	24.00	24.000	11.824	.002
Subjects x P x T	41	4546.00	110.878	0.217	.649
Total	85	44086.00	518.659		

TABLE 25

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for Pair D

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	50	54119.00	1082.380		
Treatment (T)	1	8619.00	8619.000	9.282	.003
Subjects x T	49	45500.00	928.571		
Within Subjects	51	37890.00	742.941		
Assessment (A)	1	7887.00	7887.000	15.828	.000
T x A	1	5586.00	5586.000	11.210	.002
Subjects x P x T	49	24417.00	498.306		
Total	101	92009.00	910.980		

TABLE 26

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for Pair E

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	50	56858.00	1137.160		
Treatment (T)	1	14711.00	14711.000	17.103	.000
Subjects x T	49	42147.00	860.143		
Within Subjects	51	12604.00	247.137		
Assessment (A)	1	3496.00	3496.000	18.987	.000
T x A	1	86.00	86.000	0.467	.505
Subjects x P x T	49	9022.00	184.122		
Total	101	69462.00	687.742		

TABLE 27

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Reading Comprehension for Pair F

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	48	19215.00	400.313		
Treatment (T)	1	376.00	376.000	0.938	.661
Subjects x T	47	18839.00	400.830		
Within Subjects	49	7139.00	145.694		
Assessment (A)	1	3211.00	3211.000	39.497	.000
T x A	1	107.00	107.000	1.316	.256
Subjects x P x T	47	3821.00	81.298		
Total	97	26354.00	271.691		

TABLE 28

One-Way Repeated Measures Analysis of Variance
for Reading Comprehension,
USMES

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Within Subjects	126	325289.00	2581.73		
Assessment (A)	1	19437.00	19437.00	62.981	.000
Error	126	38886.00	308.62		
Total	253	383621.00			

TABLE 29

One-Way Repeated Measures Analysis of Variance
for Reading Comprehension
Control

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Within Subjects	149	333862.00	2240.68		
Assessment (A)	1	5745.00	5745.00	55.67	.000
Error	149	15377.00	103.20		
Total	299	354984.00			

TABLE 30

Combined Pre-Test, Post-Test, and Adjusted Means for Treatment (USMES and Control) and Grade Level (Primary, Intermediate, and Advanced) Reading Comprehension

Group	N	Pre-Test	Post-Test	Adjusted
USMES	127	155.7	173.2	168.6
Control	150	160.4	169.1	161.7
Primary	41	118.0	131.8	152.1
Intermediate	136	147.8	161.1	163.7
Advanced	100	188.9	200.4	179.7

TABLE 31

Two-Factor Analysis of Covariance for Reading, Comprehension, Treatment (USMES vs. Control) by Grade Level (Primary, Intermediate, Advanced)

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Treatment (T)	1	3171.812	3171.812	12.218	0.0006
Grade (G)	2	14096.938	7048.469	27.151	0.0001
T x G	2	296.562	148.281	0.571	0.566
Error	270	70092.540	259.602		
Total	275	87657.852	318.756		

of these factors was not significant. These results indicate (1) that significantly higher scores in Reading Comprehension once pre-test differences were taken into account, and (2) that there were statistically significant differences among the three grade levels, with the rank from highest adjusted mean to lowest being Advanced, Intermediate and Primary. These adjusted means on the SAT Reading Comprehension subtest are presented graphically in Figure 5.

A summary of the results of covariance analyses for the individual classes is presented in Table 32. The data in this table indicate that only at the Advanced Level (pairs E and F) were there statistically significant differences in Reading Comprehension between USMES and Control classes. References to the Adjusted means column of Table 21 sheds further light on these findings. In all classes, except class A (Primary Level), the adjusted means for USMES classes were higher than those for the Control classes. The difference in adjusted means for pair B appears at first glance to be large enough to reach statistical significance, however, reference to Table 32 reveals that for pair B, there was a relatively large amount of variance within the groups, thus increasing the size of the error term. Consequently, the ratio of the variance between the groups to the variance within the groups was not large enough to reach statistical significance at the conventional level (.05), they were rather large and are worthy of note.

These findings would seem to indicate that in the six classes analyzed, the exposure to the USMES program does not hinder growth in Reading Comprehension, and in some cases aids growth, relative to Control classes which were not exposed to this program.

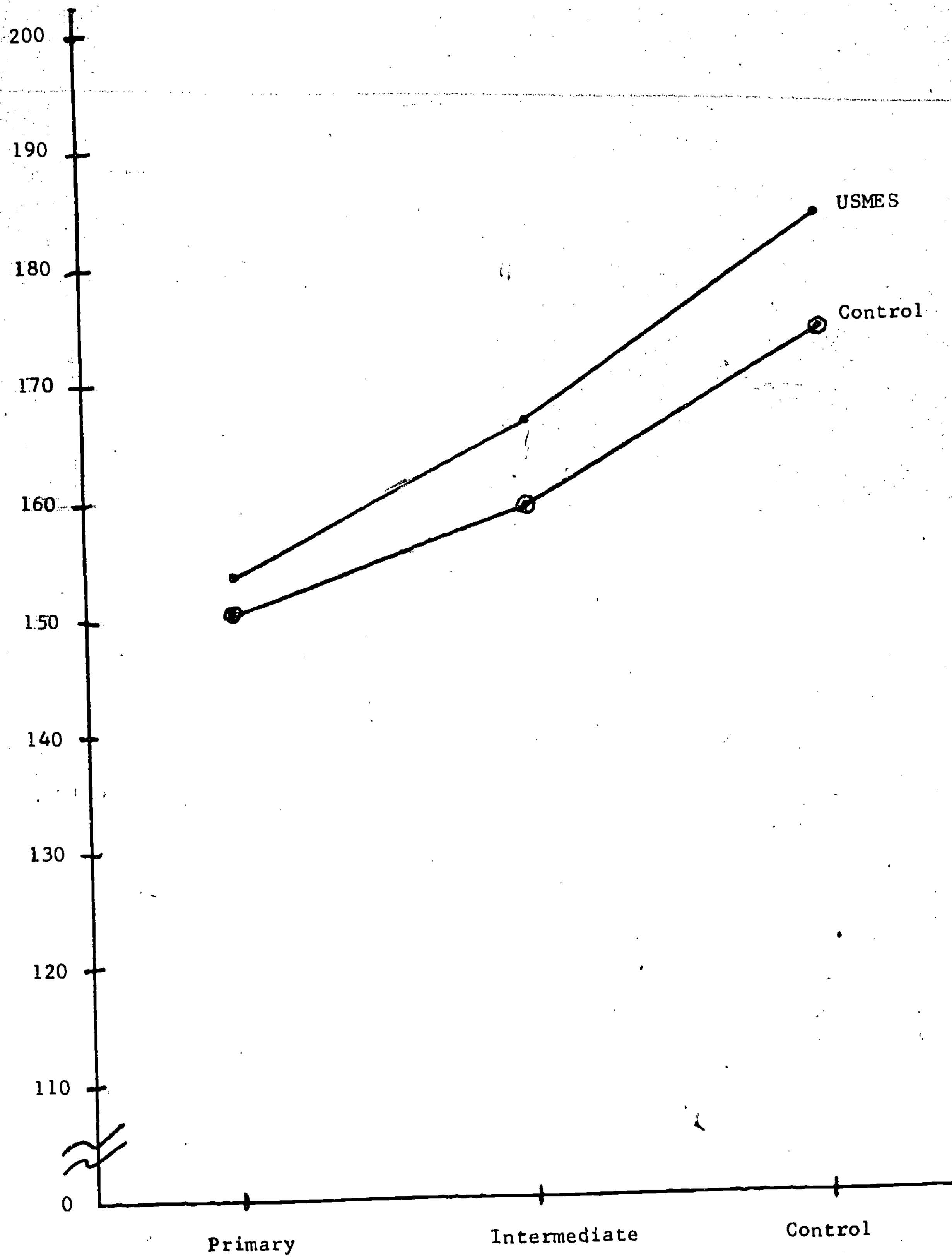

Figure 5.--Adjusted Cell Means by treatment and on the SAT Reading Comprehension subtest.

TABLE 32

One-Way Analyses of Covariance by Class for the Reading Comprehension Subtest

Pair	Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Primary Level A	Treatment	1	0.34	0.34	0.002	.964
	Error	38	6181.80	162.68		
	Total	39	6182.15	158.52		
Intermediate Level B	Treatment	1	547.08	547.08	2.742	.106
	Error	39	7780.50	199.50		
	Total	40	8327.58	218.19		
C	Treatment	1	63.55	63.55	0.285	.597
	Error	40	8931.52	223.29		
	Total	41	8995.07	219.39		
D	Treatment	1	94.92	94.92	0.299	0.587
	Error	48	15241.10	317.52		
	Total	49	15336.02	312.98		
Advanced Level E	Treatment	1	2549.91	2549.91	14.638	.0004
	Error	48	8361.60	174.20		
	Total	49	10911.51	222.68		
F	Treatment	1	333.63	333.63	7.365	.009
	Error	46	2083.66	45.30		
	Total	47	2417.30	51.43		

2. Mathematics Computation. All forms of the Mathematics Computation Subtest of the SAT measures skills in the four basic operations - addition, subtraction, multiplication, and division. The size of the numbers used in the problems become larger as one progresses from the Primary II test through the Advanced test. In addition to basic computation, there are questions requiring knowledge of greater-than and less-than relationships, common and decimal fractions, percent, average, exponents, simplification of sentences, and graphing. The amount of time allowed for each form are as follows: Primary II, 38 minutes; Intermediate I, 35 minutes; Intermediate II, 35 minutes; and Advanced, 35 minutes.

The USMES class of Pair D (Intermediate) unfortunately did the Mathematics concepts subtest for a pre-test and thus is not included in this section of analysis.

a. Within group differences. Pre-test and post-test gains were analyzed for both USMES and Control groups and for all the individual classrooms. Means (pre-test, post-test, and adjusted) are presented in Table 33. An examination of the pre-test and post-test means indicates that, except for the Control class of pair E (an advanced grade level), positive gains were realized. Four of the five USMES classes showed statistically significant gains from pre-test to post-test, while one USMES class showed no statistically significant improvement. Of the Control classes two gained significantly, and three showed no significant gain. Repeated measures analysis of variance tables for each class can be found in Tables 34 through 38. The range of gains for the USMES classes were from a low of .07 (USMES class A/Primary) to a high of 18 (USMES class B/Intermediate), and for the Control classes, from -1 (Control class E/Advanced) to 14 (Control class A/Primary).

TABLE 33

Means and Standard Deviations for Pre-Test and Post-Test Mathematics Computations

Pair	Class	N	Pre-Test	Post-Test	Adjusted
Primary A	USMES	18	130.22 (7.24)[a]	130.39 (33.92)	131.30[b]
	Control	22[c]	120.59 (6.59)	134.86 (10.72)	134.00
Intermediate B	USMES	22[c]	144.68 (8.67)	162.59 (10.38)	163.00
	Control	21	146.14 (13.28)	149.19 (14.40)	148.80
C	USMES	16[c]	173.81 (14.14)	183.62 (15.97)	177.70
	Control	18	159.17 (14.92)	162.67 (15.47)	168.60
Advanced E	USMES	19[c]	187.05 (24.98)	195.84 (17.19)	192.20
	Control	33	173.09 (19.29)	172.21 (17.67)	175.90
F	USMES	22[c]	196.36 (10.35)	202.73 (11.68)	202.70
	Control	24[c]	194.92 (12.55)	199.67 (12.12)	199.70

a. Figures in parentheses are the standard deviation
b. Represents post-test mean adjusted for pre-test differences
c. Statistically significant at or beyond the .05 level

TABLE 34

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Mathematics Computation for Pair A

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	39	11680.00	299.487		
Treatment (T)	1	131.00	131.000	0.431	.522
Subjects x T	38	11549.00	303.921		
Within Subjects	40	14472.00	361.800		
Assessment (A)	1	1255.00	1255.000	3.899	.053
T x A	1	986.00	986.000	3.063	.085
Subjects x P x T	38	12231.00	321.868		
Total	79	26152.00	331.038		

TABLE 35

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Mathematics Computation for Pair B

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	42	9092.000	216.476		
Treatment (T)	1	766.000	766.000	3.772	.056
Subjects x T	41	8326.000	203.073		
Within Subjects	43	6816.000	158.512		
Assessment (A)	1	2439.000	2439.000	31.339	.000
T x A	1	1186.000	1186.000	15.239	.000
Subjects x A x T	41	3191.000	77.829		
Total	85	15908.000	187.153		

TABLE 36

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Mathematics Computation for Pair C

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	33	18157.00	550.212		
Treatment (T)	1	5369.00	5369.000	13.435	.001
Subjects x T	32	12788.00	399.625		
Within Subjects	34	2770.00	81.471		
Assessment (A)	1	712.00	712.000	12.061	.002
T x A	1	169.00	169.000	2.863	.097
Subjects x A x T	32	1889.00	59.031		
Total	67	20927.00	312.343		

TABLE 37

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Mathematics Computation for Pair E

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	51	39903.00	782.411		
Treatment (T)	1	8519.00	8519.000	13.572	.001
Subjects x T	50	31384.00	627.680		
Within Subjects	52	7800.00	150.000		
Assessment (A)	1	183.00	183.000	1.297	.259
T x A	1	564.00	564.000	3.998	.048
Subjects x P x T	50	7053.00	141.000		
Total	103	47703.00	463.136		

TABLE 38

Repeated Measures Analysis of Variance Treatment (USMES, Control) by Assessment (Pre-Test, Post-Test) Mathematics Computation for Pair F.

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Between Subjects	45	9590.00	213.111		
Treatment (T)	1	118.00	118.000	0.548	.530
Subjects x T	44	9472.00	215.273		
Within Subjects	46	3361.00	73.065		
Assessment (A)	1	701.00	701.000	11.657	.002
T x A	1	14.00	14.000	0.233	.637
Subjects x P x T	44	2646.00	60.136		
Total	91	12951.00	142.319		

Tables 39 and 40 are summaries of the repeated measures analysis of variance for Mathematics Computation. Overall, both groups (USMES and Control) showed statistically significant growth over the pre-test/post-test period. The USMES sample gained 8.88 scaled score points and the Control Sample gained 5.85 points.

In summary, all the USMES classes gained in Mathematics Computation skills, over the pre-test/post-test assessment period.

b. Between group differences. As with the Reading Comprehension, the comparison of the USMES and Control classes was done with a two factor analysis of covariance.

The first factor in the analysis was (USMES vs. non-USMES) and the second factor was Grade Level (Primary, Intermediate, and Advanced). Table 41 contains the combined pre-test, post-test, and adjusted means for each factor, while Table 42 presents the summary of the analysis of covariance. After adjustment for pre-test differences, there was a significant difference between the USMES and Control classes in Mathematics Computation, a significant difference among the Grade levels, and also a significant interaction between Treatment and Grade level. An examination of Figure 6 shows that at the Primary level the Control group surpassed the USMES group by approximately 10.9 points, while at the Intermediate and Advanced levels the USMES group surpassed the Control group by 12.8 and 9.3 points, respectively.

Table 43 presents a summary of the analysis of covariance for each individual class. In pairs B and C (Intermediate) and 5 (Advanced) significant differences in favor of the USMES classes were found. In all other

TABLE 39

One-Way Repeated Measures Analysis of Variance
for Mathematics Computation-USMES

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Within Subjects	108	163972.00	1708.04		
Assessment (A)	1	3820.00	3820.06	21.583	.001
Error	108	16991.00	176.99		
Total	217	184783.00			

TABLE 40

One-Way Repeated Measures Analysis of Variance
for Mathematics Computation-Control

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Within Subjects	143	175038.00	1224.04		
Assessment (A)	1	2466.00	2466.00	22.697	.00005
Error	143	15537.00	108.65		
Total	287	193041.00			

TABLE 41

Combined Pre-Test, Post-Test and Adjusted Means for Treatment (USMES and Control) and Grade Level (Primary, Secondary, and Advanced) Mathematics Computation

Group	N	Pre-Test	Post-Test	Adjusted
USMES	97	166.8	175.7	164.4
Control	118	160.8	165.3	160.7
Primary	40	124.9	132.8	152.7
Intermediate	77	154.2	163.3	164.2
Advanced	98	186.4	190.4	170.8

TABLE 42

Two-factor Analysis of Covariance for Mathematics Computation Treatment (USMES vs. Control) by Grade Level (Primary, Intermediate, Advanced)

Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Treatment (T)	1	2136.348	2136.348	9.1950	.0028
Grade (G)	2	2953.344	1476.672	6.3550	.002
T x G	2	3937.800	1968.900	8.4740	.0003
Error	246	57157.608	232.348		
Total	251	66185.100	263.686		

TABLE 43

One-Way Analyses of Covariance by Class
for the Mathematics Computation Subtest

Pair	Sources of Variance	df	Sum of Squares	Mean Squares	F-Ratio	P
Primary Level	Treatment	1	46.88	46.88	0.079	.780
A	Error	37	21914.40	592.28		
	Total	38	21961.28	577.93		
Intermediate Level	Treatment	1	2137.61	2137.61	16.718	.0003
B	Error	40	5114.60	127.86		
	Total	41	7252.21	176.88		
	Treatment	1	563.07	563.07	4.972	.033
C	Error	31	3510.87	113.25		
	Total	32	4073.95	127.31		
Advanced Level	Treatment	1	2901.45	2901.45	15.980	.0003
E	Error	49	8896.83	181.57		
	Total	50	11798.28	235.97		
	Treatment	1		56.22	0.569	.455
F	Error	43		98.86		
	Total	44				

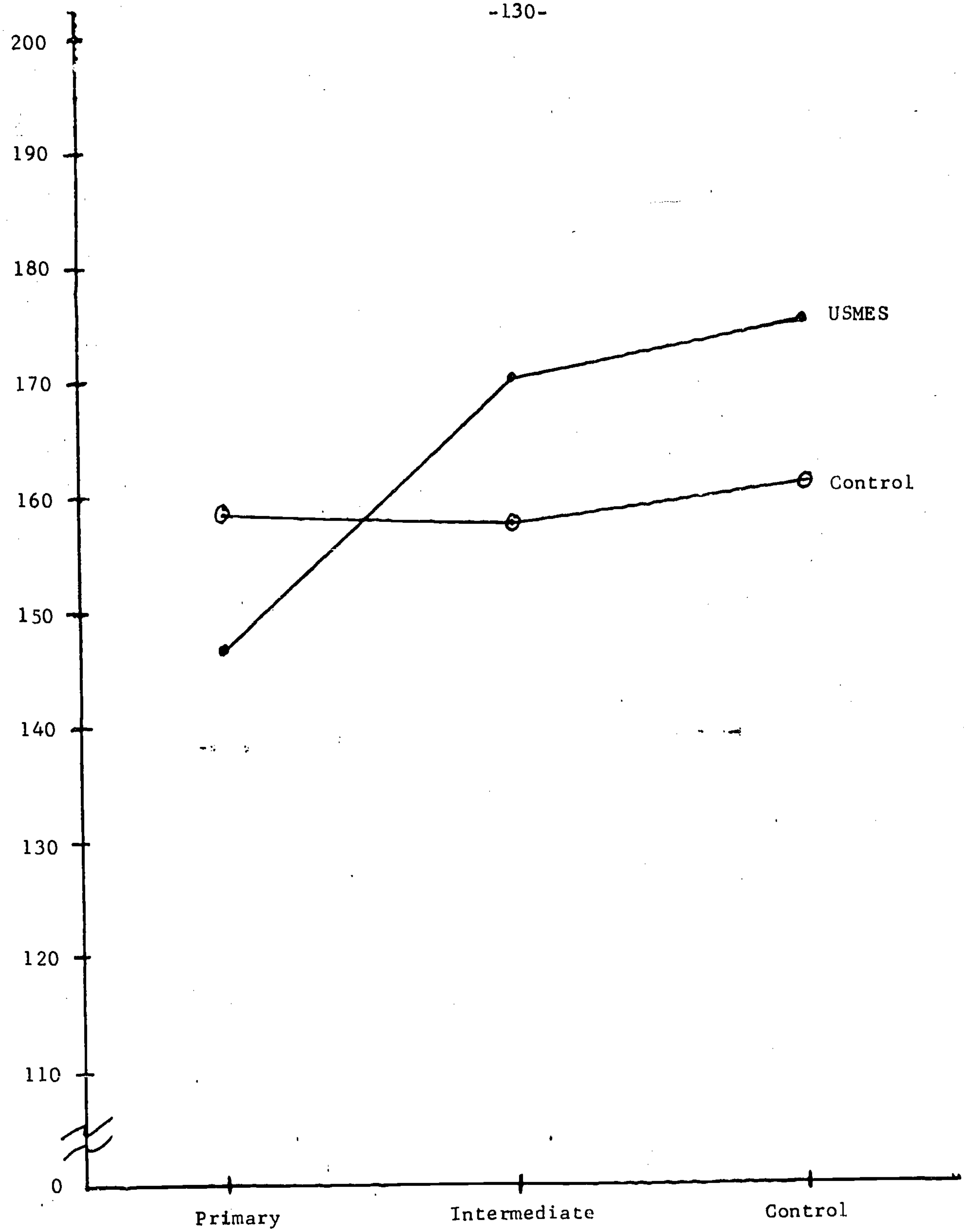

Figure 6.--Adjusted Cell Means by treatment and grade factors on the SAT Mathematics Computation subtest.

classes, there were no statistically significant differences. However, an examination of the adjusted means shown in Table 43 indicate that the Control classes of pair A perform better than their USMES counterparts in Mathematics Computation after adjustment for pre-test differences.

In Mathematics Computation, the USMES classes performed better than their Control counterparts at all grade levels, except Primary. As was the case with Reading, the exposure does not hinder, and in fact, beyond the Primary Grade level, may even enhance learning in the basic areas of Mathematics Computation.

Chapter Summary

In response to interview questions about the effects of USMES on student performance, teachers cited many favorable outcomes of USMES. They felt that as a result of using USMES, students had become more responsible for their own learning. The teachers also cited student growth in data collection abilities, graphing, hypothesis testing, decision making and verbal communication amongst peers as decided strengths of the program. Most felt that their students had become more inquisitive, more logical in their thinking, and more self-reliant.

Teachers also cited improvement in some of the basic skills areas, most notably, arithmetic applications, and language arts, but these replies were clearly dependent on the unit challenge which teachers used in their USMES classes. USMES teachers who were familiar with a variety of units stressed this qualification.

Primary grade teachers complained that their students encountered difficulty with some units (usually the Describing People challenge) when the children needed to organize data which they had collected. These younger children were frustrated in their progress on the unit because they had not acquired some of the basic arithmetic skills needed to assemble or make sense out of their data.

Teacher perceptions of their USMES students' development in problem solving were not supported by the analysis of the Playground Problem Test results. There are many possible explanations for this discrepancy. Some are more probably than others.

One might question the validity of the teachers' perceptions or the honesty of their responses during the on-site interviews. While such criticisms cannot be dismissed entirely, the very favorable teacher responses regarding the effects of USMES on their students' problem solving behaviors were consistent across interviewers, across geographical areas, across grade levels, across units, across school community socioeconomic levels. Furthermore, teachers were discriminating in their responses during the interviews as a whole. Many qualified their observations about student effects of USMES, as noted earlier in this report. Moreover, they offered very critical appraisals on other issues: teacher training, support networks, materials, and resources.

More likely areas for explanation of the discrepancy between teacher perceptions and student performance data for problem solving lie with the unsatisfactory testing procedures and with the instrument itself. The general problems with 1973-74 data collection cited earlier in this report applied to the collection of both basic skills data and problem solving data. However additional questions must be raised about the value of the Playground Problem data because, unlike the SAT, the Playground Problem requires special training for proper test administration. Without rigorous training, and in the absence of a precise written guide to test administration (the Manual in Appendix A was not prepared until after the 1973-74 data collection period), some observers invalidated the responses of some groups by using unacceptable testing procedures. (See Section V of the scoring protocol for a listing of these problems.)

Even those results which were not invalidated by unacceptable testing procedures are suspect. The reliability and validity of the test itself needed to be established. (The review of problem solving research and measurement and the development and refinement of new problem solving measures are a substantial protion of the work still underway on the 1974-75 USMES evaluation. Information on the reliability and validity of the Playground Problem, beyond the scorer reliability procedures and the content validation process already achieved, will be given in the 1974-75 report.)

Results of the analyses of basic skills data were favorable toward USMES. Overall, both USMES and Control classes showed a significant gain in SAT Paragraph Meaning scores from pre-test to post-test administration. Examination of gains by classes revealed that all USMES sample classes and five of the six Control classes realized significant increases.

Analysis of overall differences between USMES and Control groups in these Paragraph Meaning scores, after adjustments were made for pre-test differences revealed that USMES groups attained significantly higher scores than the Controls. Significant differences in adjusted post-test means were also observed among grade levels. As one would expect the advanced classes were superior to intermediate classes, which, in turn, were superior to Primary classes.

Analyses of the Mathematics Computation SAT subtest scores showed that as a whole, both USMES and control classes gained significantly from pre-test to post-test administration. After adjustments for pre-test differences in these scores were made, the analysis revealed that overall, the USMES groups were superior to Control groups in post-test performance in Mathematics Computation. However, this overall result must be qualified by grade level. Control groups were superior to USMES groups at the primary level. Comparisons at the intermediate and advanced grade levels of elementary school classes in the sample showed USMES groups superior to Control groups. This treatment by grade level interaction is corroborated by the report of teacher perceptions of their students' development in arithmetic computation skills.

Limitations to the student performance data necessarily restrict the confidence one can attach to these results. Larger, more representative samples, and careful data collection with valid instruments are goals for the 1974-75 evaluation. Teacher insights will continue to be used as an important source of information about USMES.

CHAPTER V

TEACHERS' APPRAISALS OF USMES MATERIALS

Teachers' appraisals of USMES materials were solicited through the following statement:

> Often times the success of a new program involves the development of useful, appropriate materials, tools, and references. We'd like to know which USMES materials are useful to you, which are not, and if there are any new materials which you think should be developed to assist students and/or teachers.

Interviewers were directed to give the respondents ample time to comment. Then they used the following probes as they seemed appropriate:

You didn't mention the:

(a) Design Lab

(b) Supplies for the Design Lab

(c) Teacher resource manual(s)

(d) Technical papers

(e) How-to-cards

(f) Audio versions of How-to-cards.

If necessary, the interviewers solicited additional comments with these further probes:

> Which ones (in each category) did you use?
> For what purposes?

The following evaluation of USMES materials is based on the responses given by the eighty USMES teachers to the interview described above. The order we have chosen in which to discuss these materials reflects our perception of the relative importance assigned to them by the teachers.

The Design Lab and Its Supplies

There can be no question that the Design Lab was seen by the teachers as a vital part of the USMES project. In fact, many teachers (and most of the principals whom we interviewed separately) stated that getting a Design Lab in their schools was a major motivating factor for undertaking the USMES program. It seemed paradoxical then, that the Design Lab also appeared to be one of the strongest sources of discontent with USMES. The discontent stemmed from various problems: space, staffing, and supplies.

A. Space for the Design Lab

In many schools, there was physically no room for a separate Design Lab, resulting in one of the following three situations:

(a) The Design Lab was located in one of the teacher's classrooms where it could be used easily by that teacher, but only with great difficulty by anyone else; or

(b) The Design Lab was put into another school in that district, and the children were bussed infrequently to use it; or

(c) There was no pretense of having a Design Lab.

It would be difficult to assess which of these situations irritated the teachers the most.

B. Staffing for the Design Lab

Where a Design Lab did exist as a facility separate from the classroom, its use was limited by lack of staffing. One constant theme echoed by virtually all of the teachers whom we interviewed was the need to have the Design Lab staffed on a regular basis so that it would be available for the children's use when the need arose.

"Assigning a class to the lab on Friday from 1:15 to 1:45 defeats its purpose."

"Trying to work with 30 children in the Lab is equally unsatisfactory."

The teachers noted that both of these typical restrictions were necessary if the only people available to staff the Design Lab were the classroom teachers themselves. The only appreciable variability among teachers on the issue of staffing the Design Lab arose in their suggestions as to <u>who</u> should staff the lab: student-teacher, parent, para-professional, teacher aide, release-time teacher, mature high school students, retired skilled tradesman. In those few schools where the Design Labs were staffed on a regular basis (in one case, very successfully by a retired Army Sargeant), the success of the Lab was highly evident, and the teachers were clearly enthusiastic about the merits of the USMES program.

C. <u>Supplies for the Design Lab</u>

Complaints about the unavailability of supplies for the Design Lab were widespread among the teachers whom we interviewed. The reasons offered for this lack of materials were diverse:

(a) Some teachers reported that no money was available to purchase the supplies. Other teachers claimed that administrators were unwilling to spend money which had been appropriated for this purpose. Still others complained about lost requisitions or other undue delays in securring materials for the labs.

(b) A less common accounting for the unavailability of supplies for the Design Lab came from teachers in a handful of inner-city schools. Here the materials were purchased but were subsequently stolen. Very little remained of the original purchases in these schools. (In one of these schools, the principal resorted to locking the remaining tools and materials in his private lavatory to prevent further theft.

Needless to say, these materials were not readily available to students.)

(c) In some schools, the teachers reported that their USMES classes had to compete with those of non-USMES teachers for use of the Design Lab and its supplies. The prevailing viewpoint among principals and teachers in such schools, as reported by the USMES teacher interviewees, was that the program should not be sustained for just a few classes, but that the entire school should have access to the Design Lab. Consequently, the materials were consumed quickly.

These expressions of discontent with the arrangements for locating, staffing, and supplying the Design Lab, although widespread, varied considerably in intensity. Those teachers who were eager to continue using USMES expressed confidence in circumventing or dealing with the problems. For example, many teachers and their principals bypassed the problem of inadequate or unavailable supplies for the Design Lab by soliciting tools, wood, batteries, or other materials from parents and/or local businessmen. In some cases, parents volunteered materials. In still another school, the USMES classes conducted bake sales to raise money for the Design Lab materials.

Many of the teachers in new USMES schools were advised, or decided themselves, to wait until the Design Lab was available and equipped before undertaking an USMES unit. These teachers and their principals alike cited the unavailability of the Design Lab as the reason they did not use the program sooner after their training. In some cases, the rationale seemed sincere; in many others it seemed like an excuse to delay getting involved in USMES.

Several teachers noted that the USMES program did not need to revolve around the Design Lab--in fact many units did not require its use at all. These individuals volunteered the opinion that many colleagues in their locales delayed implementing USMES unnecessarily because the developers oversold the Design Lab. Apparently, the Design Lab did sell the program but teachers blamed the developers for emphasizing the Design Lab's uses at the expense of the program's philosophy and its possible applications without Design Lab facilities.

Clearly these Design Lab problems exist in varying degrees in the vast majority of the sites where the USMES program is being implemented. However, these problems are administrative, not conceptual; it would be grossly unfair to overlook the favorable aspects of the Design Lab. From the teachers' viewpoint, the motivating influence of the Design Lab on children was enormous. Teachers reported that the students fortunate enough to have access to a Design Lab loved using it. Those in the program looked forward to going to the lab; those not in the program constantly inquired about it.

The seeming paradox--that one of the most desirable features of the USMES program, the Design Lab, was also one of the greatest sources of discontent about the program--is not so paradoxical in light of the foregoing discussion. Teachers felt that the Design Lab could be a very powerfull learning opportunity. They were vocal about their frustrations in not being able to use the Design Lab at all, or in not being able to use it to its best advantage.

We will preface the discussion of the rest of the USMES materials with a description which typified the response we received about the materials in the USMES program. Teachers talked readily and at length about the Design Lab. When we began to probe for responses about other materials, it was not unusual to get a blank look. After we specifically asked the teachers to comment on the Resource Manuals, or How-to-cards, or technical papers, we found it necessary to describe these materials at length in order to help the teachers recall the item we were talking about. We can think of no other description which describes more aptly and succinctly the teachers' feelings about the degree of usage and utility of these materials.

Teacher Resource Manuals

In order of importance to teachers, the Resource Manuals follow the Design Lab, but at a considerable distance. When we asked teachers to comment frankly on how helpful the Resource Manuals were to them for the units they were using, the vast majority of the teachers said that the Manuals were of very limited value, if in fact they had used them at all.

Teachers' complaints about the Resource Manuals encompassed a number of different kinds of criticisms, and they revealed a diversity of expectations for the Manuals and a diversity of viewpoints on the USMES program.

One kind of criticism came from teachers who said they never referred to the Manuals because they were too directive for the intended philosophy of the USMES program. Such teachers contended that a challenge should not be contrived, that it must flow from the students, and that those problems which arose naturally in class were not likely to appear in a Resource Manual for a given unit. Therefore, in the viewpoint of these teachers, the Manuals and indeed the units were useless. These teachers seemed to be rejecting the Manuals, even in concept.

Another large group of teachers concurred that the Manuals were not useful to them, but for a somewhat different reason. These teachers noted that unless one had gone through a unit in a workshop or with another teacher, the

Manuals were of little help. Furthermore, these teachers explained, if one had pursued the training, then one did not need the Manuals.

A third kind of opinion about the Manuals reflected criticism of the Manuals themselves, but not the concept of the Manuals. These several teachers pointed out that one could not use the USMES program simply by reading the Manuals but that the Manuals could be helpful to teachers after they had been through one unit at a workshop. These teachers criticized the Manuals for being "too wordy," "too padded with case studies," or "not concrete enough." The teachers wanted a short, concise, "one, two, three" approach to a unit, with a brief overview of what to expect, and specific suggestions on how they should present "the challenge."

We heard very few favorable comments on the Manuals. These came from teachers who said they appreciated the flowcharts or diagrams of possible directions the unit could take, and from teachers who said they were able to use a few ideas about activities that worked in other classes.

In summary, then, the Resource Manuals were not very helpful to USMES teachers. The teachers preferred to learn how to use a unit at a workshop or from other teachers. They constantly reminded us that they "just didn't have time to read all that." (Another pervasive comment from Development Teachers is relevant here. During earlier portions of our interviews, these teachers expressed great resentment at having to compile logs of their USMES developmental activities in their classrooms for the USMES Central Staff. It is these edited log materials which comprise the case studies in the Resource Manuals which other teachers objected to most strenuously.)

"How To" Cards (Audio and Written Versions)

It is easiest to appraise the degree of usage of the audio "How To" cards first, because very few teachers had heard of their existence and thus had nothing to say about them. Teachers from only two geographical areas had any comments about these aduio tapes. Those teachers whom we interviewed in one large, urban school district expressed resentment that their school administrators would not, or had not, provided funds to purchase the audio "How To" cards. These teachers felt that the audio tapes would be very helpful for those of their students who had difficulty reading. Yet, these teachers had never reviewed the audio tapes.

One teacher in a rural school had tried using the tapes with his seventh-grade class which he said was comprised "mostly of slow-learning boys." This teacher reported that his students felt the tapes were "condescending." He noted, however, that many of his students were older than the average seventh grader.

With these two exceptions, the teachers whom we interviewed were either unaware that audio "How To" cards existed, or they vaguely remembered that they had heard of them but expressed no interest in using them.

The written "How To" cards seemed to be available at all of the USMES schools which we visited. In many cases, they were in evidence in the Design Lab, posted on its walls, or on the carts which were designed to serve as movable Design Labs. Despite this advertising, however, the vast majority of teachers acknowledged that their students used them rarely, if at all. A particular complaint made by lower grade teachers was that the reading level was too difficult. As these teachers repeatedly pointed out, one set of cards could not possibly service all levels of children in grades one through eight. One primary grade teacher was attracted by the concept of the How-To cards, i.e., to encourage children to resolve their own difficulties, to answer their own questions, to get help on an individual basis when it was needed. This teacher had begun to develop her own "How-To" cards using a comic book frame approach incorporating limited verbal materials with pictorial representation.

Upper grade teachers as well stated that their students did not use these cards. Several teachers admitted to using the cards themselves as a resource for teachers. Most agreed that it was easier in any case to show or tell their students how to perform a certain task. Several teachers commented further that their students were not accustomed to learning by the "How To" card approach. When we asked some of the teachers if they had offered group instruction in the use of the cards, only one teacher reported that she had, and even then that her effort did not result in increased usage of the cards.

In summary, the How-To cards have not been successful, if the amount-of-usage and teacher enthusiasm are indicators of success. Lower grade teachers categorically rejected the utility of the cards because of their difficult reading level. Upper grade teachers were also negative about the utility of the cards, but the reasons for their negative appraisal were less clear. It may be that the cards were too difficult even for many upper grade students. Possibly the teachers preferred to be more directive with their students in the areas of instruction offered by the How-To cards. Many teachers seemed to be attracted to the concept of encouraging students to learn needed skills and acquire facts on their own, but in practice the teachers were not using the cards in this way.

Technical Papers

Least used of all the USMES materials and resources were the technical papers. The vast majority of the teachers admitted that the papers were too difficult for them to understand. The few who said the papers were not difficult explained that they had no time to read them. There was not one positive indication that the technical papers were a useful contribution to The USMES program.

Chapter Summary

Teachers' reports of the degree of usage of USMES materials and their appraisals of the effectiveness of these materials indicate that considerable attention should be devoted to revising and/or eliminating the Resource Manuals, the "How To" cards and the Technical Papers. Clarity, simplicity and conciseness would be attributes in these materials valued by the teachers. The sheer volume of the materials in their present form discouraged many teachers from using them.

Clearly, the Design Lab is by far the most attractive tangible component of the USMES program for the teachers. Many difficulties have arisen with supplying, staffing, and making the Design Lab accessible to teachers and their students. Nevertheless, those teachers who are committed to the USMES program, and especially those who are not isolated in schools without other USMES teachers, have been resourceful in sustaining and improving the Lab's uses. Future USMES workshops at the national level and at the local level should include presentations from experienced USMES teachers on suggestions for coping with the problems of scheduling, staffing, and supplying the Design Lab for effective student use.

CHAPTER VI

THE EFFECTIVENESS OF USMES TEACHER TRAINING

Background

The USMES approach to learning the process of real problem solving requires that the students themselves, not the teacher, discover and analyze a problem meaningful to them, choose the variables that should be investigated, collect and analyze the pertinent data, judge the correctness of their hypotheses and form appropriate conclusions and recommendations. The teachers' role in this process is that of a coordinator or a collaborator rather than the more conventional role of a director or an information-giver. The inexperience and unfamiliarity of many teachers with this USMES-styled role compounds the importance of effective teacher preparation in the USMES project.

Various teacher training models have been used by the USMES project. For several years, National Summer Workshops have been held to train teachers, who were new to USMES, in the implementation of first trial units, and to afford experienced USMES teachers the opportunity to discuss plans for the development of new USMES units. Participants at these National Workshops represented an extensive range of geographic areas.

The USMES project also implemented two models of district-wide teacher training programs which were more intensive by geography. The Lansing District Implementation Experiment involved University-district collaboration in a medium-sized community. The Chicago District Implementation Experiment involved only the district resources found in a very large city.

These inservice training efforts have been complemented by pre-service training components for students in schools of education.

All of the above models have relied on the more immediate impact of an experienced USMES training staff for preparation of teachers to utilize USMES in their classrooms. The basic strategy was limited in that it produced only "first generation" USMES users; none of these models were based on pyramidal structures.

Realizing that widespread implementation of the USMES program could not be achieved efficiently with training models limited to first generation effects, the USMES Central Staff adopted a training strategy with built-in multiplication factors for its limited experienced staff and limited financial resources. This strategy, patterned after the generally successful technique used by many NSF projects, involves training district resource teams who, in turn, train and support district teachers.

The USMES Central Staff invited each of approximately 25 districts to plan, with project staff assistance, a method of implementation that suited the districts needs and resources. "The size and composition of the team and the design of the school-year implementation program were negotiated separately with each interested district to optimize the rate and quality of implementation." Only districts committed to plans that had the possibility of a large number of classroom implementations were invited to be part of the Resource Personnel Workshop in the summer of 1973.

The following 17 resource teams attended this two-week RPW training session in Lansing, Michigan:

(a) From California--

Bakersfield City School District Team

Bakersfield Greenfield School District Team

Bakersfield Standard School District Team

Carmel Team

Fullerton Team

Los Angeles Del Amo Group

Los Angeles 95th Street School Group

Los Angeles Valley Group

Monterey Team

(b) From Georgia--

Atlanta Team

La Grange Team

(c) From Illinois--

Chicago Team

(d) From Massachusetts--

Arlington Team

(e) Representing centers for the Elementary Interm Program affiliated with Michigan State University--

Detroit Area Team

Flint Area Team

Lansing Area Team

At the Michigan workshops, the project staff trained over 90 RPW participants in the philosophy and content of USMES units and in teacher training strategies. Documentation of the workshop format and activities as well as an account of participants' immediate evaluation of the RPW and their initial plans for local training are contained in the "Report of the Resources Personnel Workshop, Lansing, Michigan, June 24-July 5, 1973," prepared by the USMES Central Staff at EDC.

Purpose

The purpose of this chapter is to provide formative feedback on the effectiveness of USMES teacher training to the National Science Foundation, to the USMES Central Staff and their consultant/specialists for training, and to existing and prospective USMES District Resource Teams. Special attention is devoted to the effectiveness of the 1973-74 Resource Personnel Workshop efforts, but more generally, pervasive issues about USMES teacher training are also addressed. Recommendations from the USMES Evaluation Staff for future applications of various USMES training models are presented.

Most of these results have already been presented to the USMES Central Staff and discussed with them as soon as substantial trends could be noted and patterns established. (The sources of information, especially of negative criticisms were not identified to the developers, however.) The Central Staff incorporated some of our recommendations in subsequent training efforts. Given the especially formative nature of this part of the total 1973-74 USMES Evaluation Project, noteworthy reactions of the Central Staff to the feedback on USMES teacher training are included along with the results themselves.

This assessment of USMES teacher training is based upon interview data from the following respondents:

(a) 26 development teachers

(b) 16 implementation teachers

(c) 16 "second generation," locally-trained RPW teachers

(d) 20 Chicago Workshop trained teachers

(e) 2 pre-service trained teachers

(f) 13 RPW team leaders

(g) 17 elementary school principals

(h) 3 district level curriculum supervisors

(i) 5 district superintnedents or associate superintendents.

The respondents and the interview method were described in Chapter II. Interview guides for the largest respondent groups--USMES teachers, principals, and team leaders, are shown in Appendices A, B, and C, respectively.

Results

Naturally, teachers, team leaders, and administrators emphasized different kinds of issues about USMES teacher training because their perspectives and role responsibilities were different. The interview responses below, therefore, are organized and discussed first by respondent-roles, and then by a synthesis of responses across groups. A summary of our observations follow.

A. Teachers' Viewpoints on USMES Teacher Training

Our teacher respondents were about evenly split between those who had attended national workshops (26 development teachers and 16 implementation teachers), and those whose training had taken place in their local school districts (20 Chicago workshop trained teachers; 16 "second-generation," RPW-trained teachers; and 2 pre-service trained teachers).

Actually, the location of the training did seem to influence the degree of involvement of teachers in the USMES program. The chance to travel to a National Workshop was viewed by many teachers as an attractive incentive for undergoing USMES training. Conversely, having to pursue training at the local level was viewed by many teachers as a penalty, especially after some of their colleagues had talked about the extra curricular advantages of the National workshops, particularly those in Boston.

Financial incentives also attracted teachers to the Program. The money paid to both development and implementation teachers to attend national workshops during Summer, 1973 and the money paid to development teachers to prepare logs of their new unit development efforts were seen as important reasons to initiate or continue USMES involvement. In California, where teachers must accumulate salary credits to achieve a higher pay scale level, local USMES training workshops were given for credit and were therefore taken.

We point out these teacher reactions because teachers, preferring to see themselves as altruistic, seemed embarrased to admit that money or travel played any part in their decision to use USMES. While many teachers mentioned money and/or travel, most of those who did tried to "laugh it off" and to say they were not speaking in a serious vein. Only two of the teachers, one who was no longer using USMES and the other who was soon to discontinue its use (he wouldn't get paid to do logs so it didn't seem worth his while), admitted that mo · was the greatest incentive, to them, and, in their judgement, to other teachers as well.

Aside from the initial appeal of travel or financial incentives, most of the teachers volunteered for USMES training. The reasons they gave for getting involved in the program were variations on either of two themes: (a) "I was bored with what I was doing and wanted to try something new; USMES sounded like an exciting way to teach," or (b) "I always taught the USMES way but it seems more acceptable to other people if it's part of a program." The first kind of comment was offered the more frequently as the reason for getting involved in USMES. In many cases, it seemed to be a very sincere reason.

None of the teachers said that he/she was required to use USMES. In fact, all respondents of whatever position or role were unanimous in stating that involvement with USMES must be on a volunteer basis. Yet, interestingly enough, one school required teachers to try at least one USMES-styled unit during the year, and the program seemed to be going exceptionally well there. There, the teachers were enthusiastic about the program, and interes n USMES was on the increase. This extraordinary result, though was probably due to an extraordinary principal.

Teachers' answers to the question of whether or not the training met their expectations reflected at once the fact that they arrived at the workshops with varying levels of information, misinformation, and preparation for training. For teachers with no knowledge about USMES workshops tended to be confusing. For those with some knowledge of USMES, and especially for those with a bent for math or science, the same workshops tended to be judged as time-wasting and boring. As one teacher put it: "One local workshop combined the interested, ignorant, friendly and hostile without planning." This kind of mixed assessment pertained to national workshops just as frequently as to local training efforts. Consistent with this result was the finding that about half of the teachers who attended USMES workshops did not feel sufficiently prepared to use USMES in the classroom, while the other half thought their training was beneficial to the point of enabling them to proceed to classroom application.

While teachers' expectations and appraisals of workshops were diverse, the suggestions they offered for improving the training recurred with much regularity and consistency across sites and across interviewers. These suggestions are discussed below, but no priority should be attached to the order of presentation.

(a) The person who directs the training session was a key factor in each teacher's evaluation of the workshop he/she attended. We observed widespread resentment among teachers toward the attitudes of the "college people," whom the teachers felt were ill-prepared, uninterested, and therefore condescending in their treatment of the teacher-participants. A few of the college prefessors who served as instructors/consultants/specialists at the national workshops received repeated praise, but we heard the same few names over and over again. The teachers cited their qualities of being knowledgable, supportive, enthusiastic, dynamic, and familiar with teachers' problems as the reasons these few individuals were so effective as trainers for USMES.

Regardless of their training site, teachers commented that they would like to see the training sessions incorporate more informal discussion with experienced, believable USMES teachers. They seemed to feel that they profited much more from sharing experiences about teaching USMES among themselves than from listening to professors or other consultants whose experiences in elementary school classrooms were remote or nil. The teachers perceived the opportunity to interact with their colleagues about USMES as important reason for conducting a workshop, especially a national workshop.

(b) Many teachers offered the comment that the use of children in workshops was one of the worst aspects of the training. The teachers felt that the situations were contrived and bore no resemblance to those found in a real classroom. However, most of these teachers commented further that the basic training technique of showing children using the materials or working on a unit challenge was a good one. For national workshops conducted during the summer months, they suggested using video tapes or films of the program in use in a classroom. An additional suggestion for local training was that some of the sessions be conducted during the school day when released time teachers, undergoing USMES training, could witness children using USMES "for real" in actual classes or in the design lab.

(c) The teachers repeatedly asked for suggestions as to how one teacher could manage several small groups in a class of 30 to 35 children who are engaging in physically active and diverse kinds of efforts. Furthermore, the Design Lab was seen as an exceedingly difficult responsibility for the teachers when they were working with that many children. Many teachers expressed concern for the children's safety when such large numbers were using the equipment. (At this point, teachers again cited the need for staffing the design lab so that they could send small groups of children to a supervised design lab to work on a particular task.)

(d) In regard to teacher training in the use of Design Labs, many teachers who had attended the Lansing or Boston workshops during the summer of 1973 advised us that the concept of the Design Lab was oversold at these workshops. These teachers noted that they themselves had assumed that an USMES unit could not be done with out a Design Lab in the school. They noted that many of their USMES teacher colleagues with lesser experience still held this misconception about the role of the Design Lab in USMES.

(e) Several teachers whom we interviewed suggested that national level and local level USMES training sessions should separate upper and lower grade teachers because they face different kinds of problems in using the USMES approach with their children. A few further commented that lower grade teachers would better focus on a more limited number of USMES units which seem to work best with the younger children.

(f) When discussing their use of time at the national workshops, a majority of the teachers thought that intensive training on a single unit was a mistake, They felt incapable of using the other units without some introduction to each one. Further, USMES units are to begin with a problem which arises naturally in the classrooms. But with so limited a repertoire, the teachers were seldom able to discover a suitable problem arising naturally and therefore resorted to contriving a problem which related to the only unit they could deal with comfortably. The teachers seemed to be asking for two- or three-day sessions on each of three or four units at a two-week national workshop.

(g) In general, the teachers called for less talking and more active involvement at the workshops. (Descriptors such as "boring," "time-wasting," "Mickey-Mouse," and "like summer camp reunions" were used frequently by teachers to characterize workshops, more so at the national than at the local level.) Despite the fact that the USMES program is more a philosophy than a set of materials, the teachers were not interested in listening to philosophy. They seemed to want a very systematic, "how-to-do-it" approach so that when they went back to their schools, they would know exactly what to do. Most of the teachers would like to go through several units in exactly the way the children would be expected to go through them. Possibly the underlying philosophy could be discussed after the units have been experienced.

A small minority of the teachers noted that discussions of the USMES philosophy were certainly in order and were entirely consistent with the whole intent of the program. One teacher who seemed to reflect this viewpoint commented: "I expected lesson plans and just got ideas. I expected a rigid schedule and got freedom. The workshops should be conducted exactly like the philosophy."

(h) Only a small number of teachers directly requested more time for skills sessions during the workshops. However, we observed that much of the uneasiness which teachers expressed about proceeding with their units seemed to be attributable to teachers' uncertainty about the competencies they thought would be required of them.

B. <u>RPW Team Leaders' Viewpoints on USMES Teacher Training</u>

It was noted earlier in this report that the Resource Personnel Workshop model for USMES teacher training involved training district resource teams who, in turn, were expected to train and support additional teachers in their own districts. Each team was comprised of a leader and two to five members.

If the number of "second-generation," locally-trained teachers pursuing USMES units in their classrooms were to be used as a criterion for evaluating the success of the 1973-74 RPW training efforts, then the RPW approach for USMES could only be judged a failure. Local applications of the RPW model following the Lansing workshop in July, 1973 through the completion of interviewing in May, 1974 produced far fewer "second-generation" teachers than the Lansing workshop. At the time of the interviews, some of the teams had done nothing beyond the initial planning stages for local training. Others had just completed informational sessions for prospective USMES users but had not yet begun training. Only about half the teams had proceeded with training.

These observations do not deny the potential for a greater yield of locally-trained USMES teachers at some later date. It did appear to the evaluators that most administrators at both the building and district levels wanted to see USMES "pilot-tested" or "modeled" by first-generation teachers in their schools before they would encourage or allow training for large-scale USMES use.

The comments below are based primarily on our discussions (two by telephone) with 15 of the 17 team leaders who had attended the Lansing, Michigan Resource Personnel Workshop for district resource teams. The viewpoints of six RPW team members who went to the Lansing workshop, whom we interviewed as first trial implementation teachers, are also considered in this section. Again, one should not attach an order of importance to the order of presentation of the following points:

(a) All of the team leaders agreed that local USMES training should not be compulsory. Those leaders who could comment from experience noted that a variety of advertising techniques could be used to attract teachers to local USMES workshops: posters, news-letters, announcements at faculty meetings, and especially, by example of successful USMES teachers. Notices that USMES workshop attendance could be used for credit toward salary increments in California were acknowledged as helpful in that state. One team leader recommended using a low-keyed information session at the teachers' minimum day meeting to recruit. He advised: "Make it the order of business. Don't tack it onto a long meeting filled with other agenda items."

(b) Support, permission, and/or encouragement from key administrative people seemed to be important for getting local training started. In a school with considerable autonomy and sufficient resources, the key administrator was the building principal. In other districts, one or more central level administrators were reported to control when

USMES training could take place and/or how much support it would get. Noting a relationship between widespread dissemination of the program and political consciousness, one team leader lamented that "you must invite the right administrative people to the workshop (in Lansing); don't slight or offend these people."

(c) In those districts where no local training had taken place prior to the date of interview, the main reason given for the delay was the lack of a Design Lab. Most leaders would not give a workshop until the lab had been set up. A few leaders alluded to clearing up other school business or referred to "working around school vacations" as other reasons for a delay in training.

(d) Local workshops which had been given used a variety of time frames: one half-day a week for several weeks on the teachers' minimum days (the days on which students were dismissed early and teachers remained for planning, conferences, or other work); two full-days on a weekend; one or two hours a week after regular school days for several weeks; portions of faculty meetings. Only the first of these applied options was considered reasonably satisfactory, and then it was used in California where the teachers also received salary credit for workshop attendance. It was generally agreed that after school was the worst possible time to give a workshop, and weekend timeslots were resented by many teachers.

Our request for suggestions as to what times would be best for USMES workshop sessions produced a firm consensus that the workshops should be intensive. Most of the team leaders whom we interviewed felt that they would or did loose teachers' interest if the workshops were spread out over weeks or even months. Some specific suggestions on when to conduct workshops follow:

(i) an intensive workshop in August, just prior to the opening of school, with briefer sessions as needed throughout the year to provide continuing assistance to teachers;

(ii) a summer session with each day divided into two parts--working alone with teachers and then trying things out on a group of children;

(iii) a three-day intensive session, after the Design Lab is set up, ideally with released-time teachers at the beginning of the school year, followed by occasional minimum day sessions for continued assistance;

(iv) half-day sessions on the teachers' minimum days, once a week over six weeks.

While there was no uniform preference on when to train, there were general points of agreement in all of the suggestions we heard from team leaders. They would like to proceed with intensive training after some "first-generation" USMES teachers could demonstrate by example that the USMES approach works in their classrooms.

(e) Almost all of the team leaders who had conducted an initial information session or who had proceeded to actual training thought that their efforts to date were successful. Most based their judgements on subjective criteria such as expressions or perceptions of teacher interest and enthusiasm. Only a few team leaders were able to cite the more objective measure of success--the number of locally trained teachers who were using USMES units in their classes.

(f) Team leaders echoed the USMES teachers' comments on the issue of who should conduct the training. (Some of the team leaders themselves conducted portions of local training sessions, while other leaders delegated this responsibility.) The team leaders noted that successful workshops are led by dynamic, knowledgable people. The first day must be stimulating, and therefore motivating, and the workshop should be intensive so that the momentum is not allowed to die. On the qualities of the trainers, one team leader commented: "The presenters should not operate outside their area of competence, and their personalities should be dynamic. They must convey interest and involvement." Another active leader offered this suggestion: "Get teachers who are involved to go over the teaching of their units and give a synopsis of what happened, what one can expect."

(g) The content of the local workshops did not seem to be an area of disagreement among team leaders. They all felt that the approach of having teachers go through a unit themselves, which was used at the national workshops conducted by the USMES Central Staff, was the best approach for local training too. While most of the team leaders emphasized that their teachers must get "hands-on experience," a few cautioned that activity-oriented sessions on methodology must be interspersed with discussions of the USMES philosophy, to insure that teachers don't perceive USMES as a set of materials or a Design Lab. What constitutes an appropriate balance between time spent on "how-to-do-it" sessions, and time spent on discussion of the USMES philosophy, may be a point of disagreement between the teachers and team leaders whom we interviewed. Or, it may be that some team leaders were trying to bridge a gap,)between expressed philosophy and demonstrated application), which was perceived by several teachers who attended the national Resource Personnel Workshop in Lansing, Michigan.

One RPW team leader offered an additional suggestion on what content to include in local workshops. We think his suggestion merits special note because it would seem to serve a need expressed by many USMES teachers. He reccommended that a couple of sessions in a workshop be devoted to specific content, skills, and technical background which teachers would need to use the "more difficult," science-content-laden units. Using the Burglar Alarm unit to illustrate his point, he noted that teachers need some instruction in the basics of electricity before they can deal effectively with this unit in their classes. It is his opinion that without sufficient background, the teachers would use the unit manual to acquire a finite amount of material which they feel they needed to get across to the children. Lacking any real understanding of the content themselves, the teachers would disseminate measured amounts of information to their students and defeat the purpose of the USMES program. He rejected the value of optional skills sessions because he felt that most elementary school teachers would not know what scientific information or skills they lacked. He dismissed the utility of the technical papers for this purpose because he was convinced that none ot the teachers would read them or was capable of reading them.

(h) Those RPW team leaders who had completed teacher training workshops noted the importance of providing continuing support to teachers. They felt that it was the team leader's responsibility to identify resource people who could help the teachers, and to keep Design Lab materials in adequate supply for the teachers. When teachers encountered problems with scheduling Design Lab use, with ordering and/or acquiring Design Lab tools and materials, or with technical aspects of a unit, they needed immediate assistance. Waiting days or even weeks to resolve the difficulties was deemed unacceptable because the teachers and their students would loose interest, which, once lost, is virtually impossible to recapture.

C. Principals' Viewpoints on USMES Teacher Training

It would appear that a knowledgable (about USMES), supportive principal is a necessary but insufficient condition for success with the USMES program in a school. In no school did we find an active, committed cadre of USMES teachers on the faculty if the principal knew little and cared less about the USMES program. And almost without exception, those principals who could discuss the program knowledgably and who would provide logistical support and encouragement to USMES teachers were principals who had attended USMES workshops at the national or local level.

Having its principal attend a workshop did not insure that a school would be the site of much USMES usage, however. Some principals, despite their USMES knowledge, commitment and good intentions, were apparently unable to provide needed assistance to teachers without support from higher administrative levels. A few principals had other motives for attending USMES workshops: travel; the chance to meet other principals; curisoity. Two principlas attended a national workshop with the primary intention of procuring National Science Foundation funds for their schools. The nature of the USMES program was of little concern to them; the perceived prospect of outside funding was of great interest.

A total of 21 principals, 4 of whom also served as team leaders, were interviewed about the effects which USMES usage has had on their schools, about the administrative problems they encountered in the adoption of this new curriculum, about the support for USMES they were receiving from higher level administrators or others, and the support they were dispersing to USMES teachers. Though we did not interview the principals about teacher training directly, several comments emerged from principals on the issue of teacher training. In general, these responses came from the more knowledgable principals. The points are summarized below in no particular order:

(a) Teachers need to be receptive to the USMES philosophy in order to be successful with the program. Echoing the point made by team leaders, the principals agreed that teachers should not be compelled to use the program.

(b) USMES teachers cannot be isolated from one another; they need continuing peer support as much as they need assistance from administrators. Enthusiasm and commitment for the program are nurtured when teachers can consult with one another about ideas for using USMES. Training one or two teachers from an area isolated from other USMES activity is a waste of time.

(c) The principal and appropriate higher level administrators need to be warned clearly and directly as to what financial and space commitments a school must make in order to use the USMES program. This comment was applied most frequently to the Design Lab problems--finding space for it; supplying it, staffing it.

(d) Those principals who were knowledgable about the program commented that it would be very difficult for a teacher to use USMES without his/her principal's moral and logistical support. In the same vein they emphasized that USMES teacher training sessions should address the issue of what content and basic skills would be developed by each USMES unit and/or by the program overall. This information would be helpful to principals and teachers alike especially in those districts where prospective users have difficulty seeing how a diffuse, integrated program like USMES could meet specific curriculum requirements of the district.

(e) The principals shared the same views held by USMES teachers and team leaders on who should conduct training sessions, i.e., dynamic knowledgable people who are familiar with the problems of elementary school teachers.

(f) One principal, whose school was the site of much USMES activity, offered the following suggestions for USMES teacher training:

"Look at the teacher as a learner; see where she is and set expectations from there. Do not expect a perfect unit the first time: let each teacher experiment by setting one more goal for each unit she tries. Don't bog a teacher down with an 'official' USMES unit; rather encourage a teacher to solve with the USMES philosophy any problem which arises with a group. Identify those most likely to succeed and let them start. Be very supportive to people trying USMES-styled units; reinforce heavily. Tell teachers to stay away from USMES materials (the Design Lab) until the USMES method has been tried and the teacher feels comfortable with it; then try another unit with materials."

(g) Another principal, whose school is the site of sustained, intensive USMES usage by a limited number of teachers offered a different perspective on USMES teacher training:

"Those involved (those who go to national workshops) carry the h... ...ogram doesn't spread without teacher ... ...nal workshops and getting involved. School inservice is not enough. Local training is too diluted." This opinion is shared by a substantial number of principals and teachers.

Additional Observations by the Evaluation .

The findings reported in this section have been culled from our interviews with several respondent groups. Unstructured observations by the evaluation team during the February-May, 1974 site visitations and informal discussions with several key respondents have also been considered here.

Insufficient, inaccurate, or misdirected communication between the USMES developers and the workshop participants accounted for many of the problems and much of the dissatisfaction with USMES Training which we observed during our site visits. In the view of many administrators, team leaders, and teachers whom we interviewed, the USMES Central Staff failed to clarify the financial, space and time commitments which an individual, school, or school district must make to USMES usage and especially to USMES training.

The first major misconception held by a large number of interview respondents was in regard to the role of the Design Labs in USMES units. Frequently, it was assumed that a unit couldn't be done unless there was a Design Lab in the school. Some of our respondents who observed this problem attributed it to the USMES developers' oversell of the Design Lab and its uses as the most attractive features of the USMES program. They felt the developers should have emphasized the philosophy, the interdisciplinary nature, and the real life problem solving aspects of the program. As a result, prospective USMES teachers and principals were preoccupied with the problems of finding space for the Design Labs in overcrowded buildings, and of supplying and staffing the labs with already strained financial resources.

The USMES Central Staff conceded the problem and noted that misconceptions about the role of the Design Lab probably had their roots in the 1971 summer workshop when the staff was encouraged to make sure participants got to use the lab, even if a need was not identified within the course of the unit work. There appeared to be some carry over of this policy to later workshops through 1973. However, the USMES developers have since made a concerted effort to correct the misconception by clarifying the role of the Design Lab in their newer written materials and through staff members' explanations at workshops.

The responsibilities of participants at the Lansing Resource Personnel Workshop for conducting local training constituted a second major area of misunderstanding. A significant number of these Lansing RPW participants did not realize that they were expected to train other teachers in their home districts. They expected only to use USMES in their own classrooms, just as First Trial Implementation teachers had done when they returned from national USMES workshops.

Apprised of the confusion over responsibilities for local training, the USMES developers explained that they had negotiated with district level administrators about inviting teams to Lansing to prepare for local training efforts. However, in many cases, these communications were not relayed downward to the principals and teachers who actually participated at Lansing. To remedy this problem, the USMES Central Staff has been communicating about local training in [illegible]ections: first, toward the appropriate level in a school district's [illegible]ration; and second, downward to the actual participants. The Central Staff now demands written commitments to pursue local USMES training from the proper district official before it will invite a team and pay its expenses to a Resource Team Workshop. Furthermore, the USMES developers now insist upon receiving team rosters so that they can issue information about the workshop to the participants directly. The policy of direct contact with local USMES trainers appears to have disadvantages as well, however. (The evaluation project director and associate director noted continued, even increased, dependence on USMES Central Staff resources by local teams during our 1975 site visits.) The dilemma faced by the USMES developers is how to clarify and be appropriately supportive without nurturing dependence on its limited resources.

A third major problem with USMES teacher training during 1973-74 involved setting unrealistic expectations for local training efforts, or even applying the RPW teacher training model prematurely. For several teams at the Lansing workshop, it was their first exposure to USMES. The designated trainers felt inadequate to train others, because they were newly trained themselves. At Lansing, they had received intensive training in one USMES unit, but they could not talk about other units. When these inexperienced Lansing workshop participants returned to their home districts, they were encouraged by their administrators to delay local workshops until they felt comfortable teaching the program, until Design Labs were set up, and until they could demonstrate for their local colleagues that the program was workable in their districts. Only in districts where these conditions were already met, could one find any locally-trained, "second-generation" USMES [illegible] re actually using USMES in their classrooms. These districts also tended to have supportive administrators, and more importantly, a cadre of experienced, enthusiastic USMES teachers who could assist their newly trained colleagues.

Chapter Summary

A few major themes can be synthesized from the foregoing discussion of USMES teacher training and implementation, especially of the RPW model. These points will be listed below along with our recommendations for improving future training efforts. The USMES developers need to be clear and direct about the personnel, financial, space and time commitments which USMES schools and individual USMES teachers should expect to make to USMES. A sizable number of 1973 Summer workshop participants claimed that the Design Lab, "hands-on," and interdisciplinary aspects of USMES were used as "bait" to attract educators to the program, but the demands of local implementation were not addressed carefully. Schools and individual teachers who were uncertain about the nature of the program, who had misguided notions about the support they would receive, or who did not understand what was expected of them, soon became disinterested or even disgruntled. The USMES developers have responded to this suggestion by addressing the issues about commitments in their newer written materials, in their application procedures for workshop participants, and in other written and verbal media.

Who teaches the USMES workshop sessions on at any level, was an issue of prime concern to all of the groups of respondents whom we interviewed, regardless of their position. Teachers, team leaders and administrators alike urged that workshops be taught by very dynamic persons, who are knowledgable about the USMES approach and the content and skills of various units. They should also be able to communicate this knowledge effectively and understand the problems faced by elementary school teachers. Not surprisingly then, the USMES developers must deal with the perenially difficult problem of identifying and using outstanding instructors who fit a variety of demanding specifications.

Teachers also asked for more opportunities at workshops to discuss problems about classroom application of USMES with experienced USMES teachers. Working on USMES with 30 or more children, especially in the Design Lab, was an issue which concerned teachers greatly, and they found informal discussion with peers who have had to deal with such problems very helpful. Our recommendation to the USMES Central Staff was that they modify their policy of channelling all their most experienced, committed and competent USMES teachers into future unit development work. We urged instead that they use some or most of these teachers as members of district resource teams. Given the relatively advanced stage of development work, we pointed out that widespread implementation and maintenance had become more pressing issues. Our general suggestion brought interested, studied and somewhat receptive responses from certain members of the Central Staff. Those who were primarily responsible for directing unit developing work clearly were not favorable to the suggestion.

Organization of the USMES workshops rather than the content per se seemed to concern many participants. Most teachers agreed that experiencing USMES units the same way their children would was the best way to learn about the program. However, they would like to use several units in lesser detail rather than to use one unit so intensively. They felt that this distribution of time over a greater number of units would make them more knowledgable about the program and more comfortable with its use. The method didn't transfer to other units with experience on only one unit. Acknowledging this issue, the USMES Central Staff has been experimenting with a variety of organizational schemes for their national workshops subsequent to these held during Summer, 1973.

The USMES Evaluation Team is hopeful that these findings, commentary and recommendations on USMES teacher training will be helpful for improving future training efforts at the national and local levels.

CHAPTER VII

INDIRECT EFFECTS OF USMES IMPLEMENTATION

This chapter reviews the observed effects of the USMES implementation, both positive and negative, on personnel other than the subjects of the program. The primary outcomes--the effects of USMES on students [illegible] been considered in Chapter IV. In addition, the viewpoints of teachers and administrators have been presented as indicators of program utility and program effectiveness. However, what we are reporting here is the effects of the program usage on these same teachers and administrators. These observations were made during site visits or were collected via interviews.

Effects on USMES Teachers

Teachers using USMES seemed able to stand back, observe, and review their own role as teachers. Many found they had grown dissatisfied with the traditional role of teacher as the authoritarian person from whom all order and orders emanate. Yet they frankly realized that if an alternative role had not been presented to them, they would never have made this discovery. They found that they had grown far more respectful of children and children's opinions, more sensitive to the way children learn, more aware of how little attention they had paid to these factors previously. This discovery has been made, not only in their own classrooms, but in the opportunity afforded by USMES to interact with other teachers at workshops. Another large segment of the teachers--at least one third--were aware of these alternative teacher characteristics in themselves, but explained that this was not a result of USMES....they had always behaved in this manner.

A few USMES teachers, especially those located in urban areas and faced with heavy pressures for standardized test score increases, were caught in the midst of conflicting commitments. On one hand, they had to answer to the demands of parents and school administrators, and on the other, they were urged by USMES developers to honor their training commitment and to implement the program in their classrooms. The priority of commitments was not clear to them and they resented being caught in this double bind.

USMES development teachers must write logs of the unit development activities which they create, nurture and oversee in their classrooms. Most enjoyed the responsibility of classroom unit development but abhored having to write the logs, even though they were being paid for their efforts. They were particularly discouraged when, after sending their logs to the USMES Central Staff, they did not receive any comments or constructive criticisms on their efforts. The development teachers ask for continual feedback on their logged efforts. This was a near unanimous and totally unsolicited comment from the development teachers.

Effects on Non-USMES Teachers and Their Students

In an earlier chapter, we commented on the problem which resulted from the location of control classes in the same schools as the experimental classes. The "contamination" of these non-USMES classes by the USMES program was a phenomenon which members of the evaluation team observed during their site visitations.

However, from another perspective, this stands as a positive factor: the philosophy and operation of USMES is inviting and infectious to non-

USMES teachers and students. One non-USMES teacher borrowed ideas and materials from an USMES colleague and pursued a challenge in her own class. Another read some USMES resource unit books. Several subscribed to a philosophy which could be paraphrased as the USMES philosophy. Students who had been trained in USMES in previous years persuaded their non-USMES teachers to allow them to use the Design Lab.

These are but a few examples of the "spill-over" of USMES into non-USMES classes, students and teacher. They were gleaned from our site visits and are only partially indicative of the full extent of the USMES influence on the larger environment. Nevertheless, they do report a positive influence of USMES beyond those directly trained and engaged in its program.

Effects on Principals

Principals who administrate schools in which USMES classrooms were located, looked favorably on the program but realized decided responsibilities. Some even expressed a need to have the extend of staffing, space and administrative responsibilities more clearly specified at the beginning of their commitment to USMES. Non-USMES teachers requested that the use of the USMES Design Lab be shared with their classes. USMES teachers complained that the lab was not sufficiently available for their classes--that the lab should be staffed by personnel in addition to the USMES teacher, and that it be made available for longer hours during the day. Other teachers pressed for a location for the lab which would make it accessible to all rather than to the USMES class alone. In general, the principal was the officer who was required to deal with these frustrations of the USMES and non-USMES teachers alike which arose from the presence of the USMES program.

Effects on Parents

Teachers and principals reported hearing little or no response from parents about the USMES program. We heard reports that some parents were willing to supply materials for the Design Labs when called upon, and that they were aware of and pleased with the level of interests and involvement of their children engaged in the USMES program. However, the evaluators had no instrument or intent to engage parents directly; these two comments are only second hand and without estimate of their representation or comprehensiveness.

Effects on School or Community

Again, no deliberate effort was made to measure the effect of USMES on the school or community spheres. Obvious to the evaluators was the impact of a few USMES unit challenges whose solution extended beyond the classroom to the rest of the school, or even into the durrounding community: changes in the school procedures for lunch, and recreation; changes in local traffic patterns due to a new stop sign. Such challenges, by their design, brought about interaction between USMES students and the school/community and affected the school/community with their unit activities.

CHAPTER VIII

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

"Proof of Concept"

The proof of concept," was to have been the primary focus of this evaluation project, i.e., the examination of the student's problem solving ability and basic skills as they developed under the influence of the USMES program. However, late funding prevented as intensive a focus upon this issue as we had originally planned. Two modifications in the original intent were made: (1) we salvaged as much as possible of the originally planned student performance test data, but we also turned to and relied upon the perceptions of the teachers trained and actually involved in the USMES project; (2) the issues for investigation were broadened and, despite the funder's concern for proof of concept, the project took on the shape of a formative evaluation for the continuing development of the USMES program, more than the shape of a summative evaluation on the USMES students' demeanor.

USMES in Theory and Practice

USMES has been described as primarily a philosophy of education and secondarily a set of activities and materials. The USMES philosophy calls for real and practical problem solving, problems discovered by the students themselves in their immediate school or community environment, problems which are relevant to their own concerns and interests. These students are supposed to conduct the necessary observations, collection of data, representation and analysis of data, formulation and trial of successive hypotheses, and decision on the final action to be taken. The teacher is to act as a collaborator, not as the director and students are to work in groups, mutually supportive and not primarily as autonomous individuals. While the "disciplinary" nature of the USMES units (or "challenges") is the skill and concept of problem solving, they describe themselves as interdisciplinary in that they draw upon and employ the various basic skills of the traditional curriculum.

This is USMES in theory. Our evaluation attempted to examine, by comparison, USMES in practice. Examining applications of USMES units, we found that in the beginning of the USMES unit activity much class time was spent in constructing, testing and experimenting, and other "hands-on" activities--almost half of the classroom time was spent in these data collection processes--but that as the year went on, the USMES classes reverted toward the more traditional pattern of activities: writing, reading, taking part in class discussions or presentations, looking and listening to other students, but especially to the teacher. Nevertheless, USMES student behavior remained distinctive from that of the control students.

Students in USMES groups spent considerably more time in the processes of working and constructing in small groups and proportionately less time listening and looking at the teacher. Almost no time was spent in pre-structured writing or working in workbooks or worksheets. The results suggest that USMES teachers did in fact adopt less directive, less dominating roles, especially at the beginning of their USMES units, and therefore students assumed more responsibility.

Effects of the USMES Program on Student Performance

Our study of the effects of the USMES program on student performance was drawn from teacher interviews and from test data. Teachers cited especailly a growth in affective skills: students were more cooperative, self-directed, inquisitive, more logical in their thinking, and more self-reliant. Further, they liked doing USMES.

Some teachers also noted improvement in some of the basic skills areas such as arithmetic applications and language arts. Such improvements were clearly dependent on the particular units which the individual teacher used.

Results of the analyses of basic skills data were favorable toward USMES; all USMES classes and five of the control classes realized significant increases, although USMES classes attained significantly higher scores than did the controls. Again, larger, more representative samples and more careful data collection with valid instruments are goals for the 1974-75 evaluation. Limitations noted in the students performance data collection necessarily restrict one's confidence in these 1973-74 evaluation year results.

Materials

A. Design Laboratory

From the teachers' viewpoint, the motivating influence of the Design Lab was enormous, a factor which offset various complaints and "growing-pains" in its usage this 1973-74 year. Initially, it appeared to have been over identified as the heart of the USMES program, to the extent that many teachers and administrators delayed using the USMES units until a lab had been acquired. Only later in the year did teachers begin to see that the lab was not essential and that some units did not require its use at all. Other problems centered around the staffing and availability or supplies for the labs, but these problems remained administrative, not intrinsic to the concept of the lab or its value to learning in the USMES program.

Teachers reported that students fortunate enough to have access to a Design Lab loved using it--an appeal which in turn strongly motivated the teachers. Those in the program looked forward to going; those not in the program constantly inquired about it.

B. Other Materials

There are few teachers who are satisfied with the materials. In fact, they are one of the weakest aspects of the USMES program. The technical papers are beyond the grasp of many of the teachers; the "How-To" cards are used by virtually none of the children. The manuals are subjected to a variety of complaints: they're poorly orgainzed, too wordy, contain unnecessary information. Many teachers feel they haven't the time to read them.

Another aspect of this non-use of the manuals should be noted. We were frequently asked by the teachers why, if one understands and accepts the USMES philosophy, one would make use of a manual? These teachers deemed the Manuals too pre-structured and directive. Once a challenge is proposed, the teacher follows and supports the interests of the children as they solve it. Further, there is the danger that USMES teachers will use these manuals as they do all teacher manuals, and thereby ignore the unique philosophy of the program.

This leads us to believe that:

(a) If the workshops are effective in articulating the philosophy of the program, the manuals could be very short, giving suggestions of challenges and possible activities.

(b) a few well developed challenges would probably suffice as examples of good units.

(c) No matter how well written, the manual will probably not be sufficient to direct some people to use the program in the way intended.

Several teachers and administrators suggested that the program needs good pre-service and in-service education to develop the philosophy, not more materials.

Training Models

The USMES project has used a variety of training models to prepare teachers for the coordinator's or collaborator's role they must play with USMES units. Most of these models have relied on the more immediate impact of an experienced USMES training staff at National workshops for preparation of teachers to utilize USMES in their classrooms. Thus, part of our evaluation was based on the appraisals of national workshop participants. However, special attention was devoted to the effectiveness of the 1973-74 Resource Personnel Workshop efforts, because this training strategy was based on the more cost effective method of training district resource teams who, in turn, should train and support local USMES teachers.

The Central Staff needs to clarify the financial, space, and time commitments which an individual, school, or school district must make to USMES usage and especailly to USMES training. Realistically, they should expect payoffs from local training efforts in the person of second-generation USMES teachers using USMES only in districts with already experienced, supportive USMES teachers.

Most of the teacher comments about the training sessions themselves applied about equally to both national and local workshops. Below, we highlight some of the feelings expressed most often:

(a) Typically, teachers want to know: "How do you do it in the classroom?" There has been some complaint that national workshops in particular were more oriented to lecture and discussion on the program's philosophy than to hands-on experience.

(b) Teachers asked for more opportunities at workshops to discuss problems about classroom application of USMES with experienced USMES teachers. They valued this exchange more highly than "what the 'experts' gave them."

(c) Workshop trainers need to be screened carefully to make sure they fit a variety of demanding specifications. Trainers must be dynamic personalities who are knowledeable about the USMES approach and the content and skills of various units. They should be able to communicate this knowledge effectively. Above all they should be familiar with the problems faced by elementary school teachers.

Indirect Effects

A. Teacher Style

USMES teachers of our sample were able to objectivize and analyze their role as teachers. In their reflections, many felt that they had become less authoritarian and less direct as a result of their training and experience in USMES. The teachers further reported that they find themselves more respectful of children, their opinions, and the way they learn.

B. Non-USMES Teachers

Some non-USMES teachers became aware of the program through an introduction made at a faculty meeting, while others asked colleagues about it; their students had heard of the design lab from peers on the playground and pressured these non-USMES teachers to use the Lab. This indirect effect also resulted in a "contamination" of control groups who, for this 1973-74 evaluation, were selected in the same schools as the USMES experimental groups. In the future, control classes must be selected from different schools.

C. Administrators

Administrators, particularly principals, must deal with various pressures, including the location of space for, equipping, and staffing of the design lab. If the principal is not supportive of the USMES program when these pressures are applied, he will, in effect, discourage teachers from its continued use.

Some principals are resentful of the developers for not giving their teachers more support. On the other hand, the principals report that there are no staff competitions, tensions, or hard feelings among teachers as a result of the presence of the USMES program in their schools. Scheduling sometimes became a problem, especially in the upper grades and in schools where rigid, fixed minute periods are used. There was usually no similar problem in the lower grade levels.

D. Parents

Teachers and principals reported little or no response from parents in regard to the student engagement in the USMES program. When there was a reference to the parents, it was positive (e.g., the contribution of lab tools by some parents).

E. Non-USMES Students

Non-USMES students, that is, peers of students engaged in the program, would learn about and be positively impressed by the program, either from previous USMES classes or from friends presently in the USMES program. Particular effects of this extended influence evidenced themselves in requests for use of the Design Lab by many non-USMES students of the same school.

F. Schools - Communities

Some schools and a few communities became conscious of the USMES program and experienced the effects of the students' problem solving activities. Those that did were impacted by the effects of USMES unit solutions on the existent community and school patterns: lunch periods, recreation, traffic patterns.

Other Observations by the Evaluation Staff

A. Characteristics of Successful USMES Schools

Probably the single most important condition necessary for the success of USMES in the schools is the presence of a very enthusiastic, supportive person on the staff. This could be the principal or other administrator. These key administrative people are important in getting local training started, making resources available and implementing the program.

Beyond this, there should be a supporting teacher or other member of the school staff whose strength of personality and enthusiasm will interest faculty enough to attend a workshop or attempt a unit. However, this single, supportive person will not guarantee successful use of the probram beyond a limited period of time. USMES teachers need the support of each other for an exchange of ideas and experiences, especially when the program is not going well. [illegible] teachers should not be isolated from each other.

Secondarily, it is quite important to have the space, and money to locate, equip and staff the USMES design lab.

B. Problem Situations

Although theoretically, the USMES program should be adaptable to all children, in actuality, it appeared to be more successful in middle class schools. This seemed to be more a problem of application than a problem intrinsic to the program itself, but the problem existed nonetheless. Schools located in lower class and ghetto neighborhoods reported the most difficulty with the program. Teachers in these settings judged their students not responsible or sufficiently independent to deal with the program. We suggest that workshops be directed toward using the program with students of this socioeconomic level so that teachers may have first hand experience with USMES in this situation, develop more relevant approaches and more appropriate expectations.

Another difficulty was the continual, excessive demands made on teachers in some districts to raise scores on basic skill tests (accountability), or to try new programs specifically designed to teach more content. Teachers in these districts felt (and probably rightly so) that their time should be spent teaching the content specified by the district. USMES was initially promoted as a math/science program. Intentionally or not, the developers convinced some people that it would teach math and science in an integrated fashion. Since it did not do this to teachers' satisfaction, math, and to a lesser extent science, were taught in their traditional position and, if no time remained, USMES was left out.

Some administrators and faculty frankly admit they don't know what the program is supposed to do. They find the developers vague and evasive when pressed to respond to that question. Under this condition, the limitations on time or finances will result in the dropping of the USMES program.

We suggest that the developers attempt to define the program more clearly than they have so the schools can in turn decide whether or not they want to spend the time of this activity. Content oriented schools may wish not to, but that decision can be made before a heavy investment of time and money is made in workshops and design labs.

The developers also need to be more clear and direct about the commitment school administrations are expected to make to USMES. Teachers and principals want to know what they're getting into. Developers and especially district people need to say who is going to help, how much, in what ways, and what responsibilities must teachers and principals perform in their respective roles.

APPENDIX A

SCHOOL INFORMATION FORM

1973-1974

SCHOOL INFORMATION FORM 1973-1974

Instructions: Please fill out one form for each school in the evaluation sample.

1. Name of School: ______________________

2. Address of School: ______________________
no. street
____
city/ state

3. Setting (Rural, Suburban, City): ______________________

4. Approximate Socioeconomic Level (High, Medium, Low). [This information may be available from the principal]. ______________________

5. How many years has USMES been taught in this school? ______________________

6. Design Lab.

A. Does the school have a Design Lab? If yes, please answer 6 B, C and D.

B. If the Design Lab has a manager, please list his/her name, position, (i.e. teacher, teacher aid, volunteer, etc.), and the number of hours he/she is in the Lab. ______________________

____

C. What tools and materials is the Design Lab lacking?

D. Describe in general the Design Lab facilities in the building (including whether there is a separate Design Lab room, in-class Design Lab arrangement, portable Design Lab cart, etc.).

APPENDIX B

CLASS INFORMATION FORM - USMES EVALUATION

1973-1974

CLASS INFORMATION FORM - USMES EVALUATION 1973-1974

Instructions: Please fill out one form for each class in the evaluation sample, USMES and control

City, State ____________

School ____________

Teacher ____________

Grade(s) ____________

Observer ____________

USMES - Control? ____________

No. of Children ____________

Unit (USMES) ____________

Subject (control) ____________

USMES Classes Only

1. How many years has the teacher been using USMES? ____________
2. What units, other than the present one, has the teacher used? ____________
3. Have any of the children had former exposure to USMES? ____________
   A. If yes, approximately how many of the children? ____________
   B. If yes, what units were they exposed to? ____________
4. A. Approximately how many hours/week were scheduled for USMES, including the Design Lab work? ____________
   B. Approximately how many weeks, excluding vacations, were spent on USMES this year? ____________
5. If more than one USMES unit was worked on this year, list the unit titles and the approximate dates for the units. ____________
6. Does this teacher express an interest in using USMES next year? ____________

USMES and Control Classes

1. List the names of the non-USMES science, social studies, math, and language arts programs and texts used by this class. ______________________________
____
____
____

2. List the approximate number of hours spent per week, on the following subjects and activities.

a. ________	a. Math	a. ________
b. ________	b. Science	b. ________
c. ________	c. Social Studies	c. ________
d. ________	d. Language Arts	d. ________
e. ________	e. Music	e. ________
f. ________	f. Art	f. ________
g. ________	g. Physical Education	g. ________
h. ________	h. Special Projects	h. ________
i. ________	i. Other (specify:_____)	i. ________

3. How many years has this teacher been teaching? ______________________

4. List any special training that this teacher has had in math and/or science.
____
____

Control Classes Only

1. Has the control teacher used any of the USMES materials this year? Unit Resource Books, How-to-cards, Technical Papers, Design Lab? ______________

____

2. Have the control children used any of the USMES materials or been exposed to USMES activities? ____

____

If yes, please explain. ____

____

____

3. Does the control teacher use the USMES philosophy in her class? __________

____

____

APPENDIX C

PROGRAM MONITORING FORM

USMES EVALUATION 1973-1974

USMES EVALUATION 1973-1974

Program Monitoring Form

Teacher ____________________ Grade ____________________

Present USMES Unit ____________

Other Units done this year and approximate dates ____________________

____

School ____________________

Address ____

____

1. How was the unit you are presently working on introduced to the students?

2. What were some of the typical student reactions to the unit?

3. What were your goals for this unit?

How did the students define the challenge for their situation?

4. Did the children lose sight of the goals during the unit?

If yes, then why in your opinion did this occur?

5. How often and in what situations was refocusing required during the unit?

6. Were there fluctuations in student interest during the work on the unit?

If yes, please explain at what points these occurred.

7. If the children hit any impasses during the unit, at what points did this occur and how was the impasse overcome?

8. Please explain the nature and extent of any student comments or criticisms on your present USMES unit and/or the USMES approach in general.

APPENDIX D

CLASSROOM ACTIVITY ANALYSIS

CLASSROOM ACTIVITY ANALYSIS

Teacher_______________ Date_________ Observer_______________

School_______________ # Students_______ USMES/Control__________ Unit/Subject______

		1	2	3	4	5	6	7
Measures								
Counts								
Constructs								
Assembles								
Tests/Experiments								
Calculates								
Records data								
Writes composition/illustrates								
Writes (pre-structured)								
Reads How-to Cards; Plays Tapes								
Reads - task								
Free reading, writing, drawing								
Messes around with materials								
CHILDREN	Talks to another - task							
	Talks to another - social							
	Takes part in small group discussion - task							
	Takes part in small group discussion - social							
TEACHER	Gives pre-structured info to teacher							
	Gives original info to teachers - task							
	Seeks information from teacher							
	Talks to teacher - social							
	Takes part in class discussion or presentation							
Listen/look at child								
Listen/look at small groups								
Listen/look at class								
Listen/look at teacher/lecture/film								
Collecting materials/maintenance								
Resting/waiting/fooling around								

Description of Categories -
Classroom Activity Analysis/USMES

ACTIVITIES

MEASURES: An instrument is used to measure distance, weight, volume or time. A measurement is read from a continuous scale.

Examples:
Timing with a stopwatch.
Measuring a board with a yard stick.
Measuring the length of a sidewalk with string.
Weighing a person on a scale.
Measuring ounces of a soft drink in a measuring cup.
Measuring amounts with measuring spoons.
Measuring length with a trundle wheel.
Using a tape measure to measure a person's height.
Using a classroom clock for timing.
Using an eggtimer.
Measruing weather conditions with a barometer, thermometer or rain gauge.

COUNTS: Quantities or frequencies are counted.

Examples:
Counting the number of pieces of metal which can be picked up by a magnet.
Counting the number of people going through the lunch line.
Counting the number of white Cuisenaire Rods which equal an orange rod.
Counting the number of cars driving through an intersection.
Counting the number of squares on a piece of graph paper.
Counting the number of times a pencil can be sharpened.
Counting the number of persons with a particular eye color.
Counting the number of children with freckles.
Counting the freckles!
Counting beans, scissors or books.
Counting 2's, 5's, or 10's.

CONSTRUCTS: Physical components are put together to create a whole. Something is built or made from scratch.

Examples:
A chair is built.
A soft drink is mixed.
A mustery box is made.
A mobile is made.
An irrigation system is made.
Ingredients are mixed.

CONSTRUCTS: (cont.)

Sandals are mixed.
Something is hammered together.
An apron is sewed together.
Life-size puppets are made.
Wood is cut.
Cement is mixed.

ASSEMBLES: Pre-cut or manufactured materials are assembled. A plan, set of instructions or recipe is followed.

Examples:
A plastic model airplane is assembled.
A geometric form is made from pre-cut paper shapes.
A light switch is made from electrical components.
A barometer is made from a science kit.
Stamps are glued into a stamp album.
A jigsaw puzzle is put together.
Bones are put together.
A circuit is assembled according to a plan.

TESTS/EXPERIMENTS: An experiment is performed and data is collected.

Examples:
Water is tested with litmus paper.
A soft drink is tested for taste appeal.
A circuit is tested to see if a light will turn on.
A chair is tested to see if it is the right size.
Paper towels are pulled to test strength.
A blindfold taste test is run.
Rocks are scratched to determine hardness.
A culture mold is grown on wet bread.
A bottle of pop is shaken to see if it fizzes.
Items are dropped in water to see if they float.

CALCULATES: Arithmetic is done (addition, subtraction, multiplication and division). Include math done in math workbooks.

Examples:
Sums are added.
Division is done on a Want calculator.
Frequencies are totaled.
Yards are converted to feet.
Multiplication problems are done.

RECORDS DATA: A record is made of raw data.

Examples:
The number of people crossing an intersection is recorded.
A tape recording is made of noise in a lunchroom.

RECORDS DATA: (cont.)

Pictures are taken of all the different animals for a report on the zoo.
A record is made of the number of times a die turns up three.
The height of a person is recorded.
A map is drawn of an intersection.
A record is kept of weather information.
Suggestions are written on the blackboard.
An inventory is made.
A description of an experiment is recorded.
Physical characteristics are tallied.

WRITES COMPOSITION/ILLUSTRATES: An original composition or illustration is created in connection with school work or a class assignment. (Includes graphing when the graph summarizes and illustrates findings.)

Examples:
A story is written.
A picture is painted.
A book report is written.
A graph is drawn.
A play is written.
Future field trips are mapped.
Self-portraits are drawn.
Letters are written in connection with the class project.
Social studies reports are written.
Advertisements are written.
Essay tests are taken.
Captain Cook's voyage is plotted on a map.
A histogram is drawn.

WRITES (PRE-STRUCTURED): Writting is done in workbooks or on worksheets. Pre-structured questions are answered in writing.

Examples:
Blanks in a reading workbook are filled.
A worksheet is completed.
A poem is copied.
Spelling words are written from dictation.
A questionnaire is filled out.
References are copied.
Word definitions are copied.
A true-false test is taken.
A map is traced.

READS HOW-TO CARDS AND PLAYS HOW-TO TAPES: USMES How-To cards and/or tapes are used.

READS - TASK: Reading is done in connection with school work or a class assignment.

Examples:

A reference book is consulted.
A text book is read.
A table of weights and measures is read.
A magazine is read.
Instructions are read.
A newspaper is read for weather forecast and "current events."

FREE READING, WRITING, DRAWING: Free time is used for reading, writing or drawing (NON-TASKS).

Examples:

A poem is written.
A letter is written.
A crossword puzzle is done.
A landscape is painted.
A novel is read.

MESSES AROUND WITH MATERIALS: Although the child manipulates USMES (or non-USMES) materials, the purpose of his behavior is not apparent.

Examples:

Blocks are piled.
Clay is pounded.
Buzzers are rung.
Etc.

INTERACTIONS

The child's predominant activity at the time of observation may be verbal interaction with another person or a group of people. The observer needs to discriminate between the following categories.

CHILD TO CHILDREN CATEGORIES:

TALK TO ANOTHER - TASK: The child talks with another child about the task.

TALK TO ANOTHER - SOCIAL: The child talks with another child socially.

TAKES PART IN SMALL GROUP DISCUSSION - TASK: The child talks in a group about the task.

TAKES PART IN SMALL GROUP DISCUSSION - SOCIAL: The child talks in a group about social, non-task topics.

CHILD TO TEACHER CATEGORIES:

GIVES PRE-STRUCTURED INFORMATION TO TEACHER: The child responds to the teacher according to a pre-structured format.

GIVES ORIGINAL INFORMATION TO TEACHER: The child talks with or to the teacher about the task.

SEEKS INFORMATION FROM TEACHER: The child seeks information from the teacher, questions the teacher.

TALKS TO TEACHER - SOCIAL: The child talks with the teacher socially.

TAKES PART IN CLASS DISCUSSION OR PRESENTATION: The child takes part in a class discussion or gives a presentation to the class.

LISTEN/LOOK:

LISTEN/LOOK - AT CHILD: The child attends to another child.

LISTEN/LOOK - AT SMALL GROUP: The child observes, looks on in a group setting.

LISTEN/LOOK - AT CLASS: The child observes, looks on during a total class activity.

LISTEN/LOOK - AT TEACHER/LECTURE/FILM: The child attends to a teacher, a lecture or a film.

OTHER:

COLLECTING MATERIALS/MAINTENANCE: Materials are collected or equipment is maintained.

Examples:
A pencil is sharpened.
Supplies for painting are gathered together.

RESTING/WAITING/FOOLING AROUND/ATTENDING TO SOMETHING OUTSIDE THE CLASS: The child is not actively involved in learning or free-time activities. The child is phased out or distracted.

APPENDIX E

ADMINISTRATOR'S MANUAL

for

THE PLAYGROUND PROBLEM

A Measure of Problem Solving Ability for

Use in the Evaluation of USMES

Prepared by

The USMES Evaluation Staff
Boston University

Mary H. Shann, Ph.D.

USMES Evaluation Project Director

TO THE OBSERVER:

This Manual and the accompanying materials consist of the following:

1. Instructions to guide you in the administration of the Playground Problem
2. A catalog of playground equipment
3. A form on which to record your observations of the children's behaviors
4. A cassette tape for recording various segments of the sessions.

GENERAL INSTRUCTIONS

The problem solving behaviors of elementary school children constitute one of the most important areas for evaluation of the USMES program. The Playground Problem is to be used as one means of assessing the success of the USMES program in reaching its goals. This test is designed to enable the observer to collect data on both verbal and non-verbal behaviors involved in problem solving.

The Playground Problem should be administered to designated USMES classes and control classes. Five children are to be selected randomly from each USMES class and similarly from each control class in the evaluation sample. The test is to be given to each group of five children rather than to individuals.

Each group of children should be taken to an open area near the school and asked to plan a playground. The materials the children are to use in solving the problem, the instructions you are to give them, and the role you are to play as an observer will be explained in detail shortly.

We are interested in assessing the degree of cooperation and self- or group-motivated interest the children demonstrate during the entire problem solving period and the follow-up question period. We are equally interested in the degree to which the children employ practical considerations in solving the problem.

Our analysis of the Playground Problem test results will be based on three kinds or records: (a) a tape recording of the children's verbal presentation during the follow-up question period; (b) your observations of the children's behaviors as recorded on the observation form accompanying this Manual; and (c) a layout of the proposed playground which the children will be asked to draw on a large sheet of paper.

In general, your role as an observer will be to organize the test session, to instruct the children on what to do, and to observe and record their behavior. Specific instructions for administration of the Playground Problem are given in the following sections of this Manual.

ORGANIZATION

1. Selection of Children

A random sample of five children should be picked from each control class and each USMES class in your school. In the past, children have not always been picked randomly, and this is not acceptable. When children are picked on the basis of good academic performance on the one hand, or on the basis of "getting rid of the troublemaker" on the other, the entire session will have to be disregarded.

It would be best for you to pick the children yourself, but the teacher can also make the selections if correct procedures are used. The easiest appropriate method is to write the names of each child on a piece of paper, throw each piece in a hat, and then select five.

2. When to Administer the Playground Problem Test

This can be a critical factor. Oftentimes, children are more restless and less attentive at certain times of the day, and especially at certain times of the year--for example, the day before Christman Vacation.

Try to run your test sessions at approximately the same time of day--that includes the control classes as well as the USMES classes. The recommended time of day is as close to the beginning of the day as possible. Avoid extremely cold or rainy days, since the Playground Problem is to be administered outside.

Second, do not run your test sessions on the day before or after vacation periods, or on the days when special school events are to take place. In the past, some sessions have had to be discounted because of confounding factors of this nature.

In all of these considerations, use your own good judgement. A test administered under somewhat less than ideal conditions is probably better than no test returns at all for a class.

3. Where to Administer the Playground Problem Test

In preparation for the test, you should locate a suitable open area near the school. An empty lot would be ideal. However, if one is not available, a playing field or clear black topped area would be appropriate. This area should be the same for all groups of children in the same schools on your sample list, both USMES groups and control groups.

4. Materials to Accompany Test Administration

Prior to the testing session, you will need to gather together the following items:

Observation Equipment

Observation form

Tape recorder and blank cassette

Watch

Tools (in a cardboard box)

50 foot tape measure
Yard stick
Ball of string
Large piece of paper
Tri-wall (to use as hard surface for drawing plan)
Felt tip pens
Pencils
12" rulers
Catalog of playground equipment
Scrap paper
Scissors

INSTRUCTIONS TO THE CHILDREN

Soon after arriving at the open area, you should give the children the following instructions and you should record them on tape:

"Let's suppose this area was going to be made into a new playground for the children in your school." (Indicate clearly the limits of the area). "How would you plan this playground?"

"Here is a catalog of playground equipment which could be bought. If you had $2,000 to spend, which equipment would you choose?"

"Please work together to decide which equipment should be bought. Draw a plan of the playground on this piece of paper showing where the equipment would be placed."

"You have forty minutes to work together to make your plan. Here are some things you may use if you want to." (Hand one child the box containing the tape measure, pencils, etc.) "Remember, you can spend up to $2,000 on equipment."

DO NOT GIVE THE CHILDREN ANY SUGGESTIONS AS TO WHAT OTHER CONSIDERATIONS THEY SHOULD KEEP IN MIND. In the past, some test results have had to be invalidated because of suggestions and clues which observers had given to the children in the instructions. The instructions should be as similar as possible for the USMES groups and for the control groups. Any evidence of intentional or unintentional bias unfortunately results in invalidation of the test session.

Let the children know that they will have forty minutes to figure out their plan and draw it on paper. Tell them that at the end of this period, you will ask them questions about their plan, and that their answers will be recorded on tape (more about taping later).

OBSERVATIONS

During the forty minute problem solving period, stay in the area in view of the children. You can repeat the instructions, if necessary. However, you should not participate in the problem solution by answering other questions or suggesting possible strategies. It is up to the children to decide whether or not to use the measuring equipment. Do not demand that any particular child help out in planning the playground if he or she does not want to.

After thirty minutes of the problem solving period have expired, tell the children that they have ten minutes to complete drawing their plan if they have not already done so.

During the forty minute problem solving period, the observer should make notes on the observation form describing the children's activities. Please write clearly. Each activity should be noted under the appropriate category heading. These notes should be specific and numbered sequentially. For example, under the heading "Measuring" the observer might note:

"5. Two kids measured the width of the lot with the 50' tape." The number "5" indicates that this is the fifth note the observer has made on the observation form. The next note might be:

"6. One child recorded the width of the lot as 45 feet." This observation would be placed under the heading "Recording Data."

You will have received intensive training in the use of this observation form at the Observers' Training Workshop.

PREPARATION FOR TAPING

After the forty minute problem solving period is completed, you should call the children together to prepare for tape recording the ten minute question period.

Children are often shy or giggly when they first speak into a microphone. Inaudiable responses make our work of analysis very difficult. To get around this problem, please ask each child to recite a sentence into the microphone, such as: "This is our plan," or "My name is ..." Tell the children that they must speak one at a time, and ask them to speak slowly and clearly.

Play the tape back to the children. This will give them some chance to get used to recording their voices, and it will give you a chance to see how well their voices are being picked up. (Note: this part of the recording is not important to us and can be erased).

When the entire session is over, we would ike to have the following recordings returned to us:

Part 1: the instructions as you gave them originally to the children

Part 2: the ten minute question period given after the thirty minute problem solving period and after the practice taping.

QUESTION PERIOD

This period during which the children explain their plan and outline their reasoning should be tape recorded in its entirety. The children's presentation may be up to ten minutes long. You should record the data and group at the beginning of each question period taping. If you wish, you may take the children back into the school to make the recording.

It is very important to remember that the questions you ask the children and the procedures you use in soliciting their answers MUST be as similar as possible for the USMES groups and for the control groups. Again, any evidence of bias may invalidate the results.

Although you may have to use your imagination and various strategies to encourage the children to respond or to explain what they mean in greater detail, use the following "script" a guide to the specific questions you should ask. It is very helpful, we are sure you know, if you show interest and enthusiasm in what the children have done. Remind the children to speak slowly and clearly so that other people can understand what they have said later. Do not rush the children but rather gently encourage them to say what they want.

FIRST QUESTION SERIES (Directed to the entire group*)

-- "How did you do?"

-- "Was it fun?"

SECOND QUESTION SERIES (Directed to the entire group*)

-- "Explain your playground plan."

-- "Why did you decide to but (4) pieces of equipment?"

-- "Do you know how much the equipment you have chosen will cost?"

-- "Why did you decide to put the swings over here? The slide over here?"

-- "What kinds of information did you need to help you make your decisions?"

THIRD QUESTION SERIES (Directed first to the entire group, and then to each child in turn who has not yet responded)

-- "Were there any other important factors you had to consider in making your decisions?"

-- "Is there anything anyone would like to say before we finish?"

While it may be necessary to structure the children's report by asking questions, you as the observer should not suggest rationale to the children by means of your questioning. For example, if there has been no mention of safety factors or indications that the issue of safety has been taken into consideration, the observer should not bring it up during the tape recording.

The playground problem does not have one solution. However, in the playground problem, a certain approach to problem solving is valued. An excellent response to the playground problem would include:

1. Measurement or calculation of available space.
2. Meaningful use of measuring equipment
3. Careful consideration of types of playground equipment chosen.
4. Comparisons between size of equipment as listed in catalog and space available on playground area.
5. Consideration of budget limitations.
6. Accuracy in drawing lay-out of proposed playground.
7. Consideration of human elements such as safety and aesthetic appeal.
8. Logical and clear presentation of rationale.

---

* When the question is directed to the entire group make sure that everyone talks who wants to, not only the "spokesman" for the group. Be sure they talk one at a time so that it is easy to understand what is being said.

However, particularly on the pre-test, the children may not respond in this manner. This in itself is interesting and important data and should not be interpreted as resulting from the format of the problem.

After the testing session is over, review the tape on your own. If you think any part of the conversation will be difficult for us to understand, please make a note of what was said and attach it to the observation form. Please be sure to return to us all tapings, observation sheets, scrap papers the students wrote on, and the playground layouts. The pre-test results should be sent to us soon after they have been completed. The Playground Manual and Catalog should be retained by you after administration of the pre-tests. They should be used again for administration of the posttests. Upon completion of the post-tests, please return to us the Manual and Catalog along with the testing results for the post-test.

Instructions for administration of this Playground Problem will have been reviewed in detail at your Observers' Training Workshop. However, if you have any further questions when you are ready to administer the test, please call the USMES Evaluation Team, collect, at (617) 353-3312.

Dr. Mary H. Shann

APPENDIX F

A MANUAL

of

CODING DIRECTIONS

and

DATA FORMAT

for

PROBLEM SOLVING INSTRUMENTS

(Playground Problem)

CODING DIRECTIONS AND FORMAT

Playground Problem

On the following pages you will find enlarged representations of the coding blocks pertaining to identification, behavioral, cognitive, product and validity criteria. The data is to be encoded in the proper column (box) in accordance with the instructions accompanying each criterion.

Section I.--IDENTIFICATION (Columns 1-11)

The objective of the ID code is to identify the teacher, the grade level, the school, the designation and the administration (pre-post) of the test.

Coding Directions

In columns 1 and 2 fill in the grade code of the teacher. The teachers are numbered from 01 to 99 and shall be obtained from the master list provided by the evaluation team office.

In columns 3, 4, and 5 enter the grade as follows:

	Column: 3 4 5
Grade 1	0 0 1
Grade 2	0 0 2
Grade 8	0 0 8
Grades 1 & 2	0 1 2
Grades 7 & 8	0 7 8
Grades 1, 2, & 3	1 2 3
Grades 6, 7, & 8	6 7 8

In columns 6 and 7 enter the school code. The schools will be numbered from 01 to 99 and shall be obtained from the master list provided by the evaluation team office.

In column 8 enter the treatment code as follows:

USMES	1
Control	2

In column 9 enter the administration code as follows:

Pretest	1
Posttest	2

In columns 10 and 11 enter the unit code as follows:

Consumer Research - Product testing	01
Describing People	02
Design for Human Proportion	03
Electro Magnetic Device Design	04
Playarea Design	05

Soft Drink Design	06
Traffic Flow	07
Weather Prediction	08
Burglar Alarm	09
Dice Design	10
Lunch Lines	11
Pedestrian Crossing	12
Advertising	51
Animal Behavior	52
Bicycle Behavior	53
Classroom Design	54
Communication	55
Community Services	56
Ecosystems	57
Learning Process	58
Manufacturing	59
Music Production	60
Nature Trails	61

All control classes should be designated 99 for the design block in columns 10 and 11.

Data entered in first 11 columns:

1	2	3	4	5	6	7	8	9	10	11

Section II.--BEHAVIORAL ASPECTS (Columns 12-15)

There are four factors which are considered in this segment. The scoring of this group shall proceed as follows:

Factor: 1

Motivation: to accept the problem and attempt to solve the problem.

Scoring:
- 0 No one accepts problem or trys to solve problem.
- 1 1 Student accepts/trys to solve problem.
- 2 2 Students accepts/trys to solve problem.
- 3 3 Students accepts/trys to solve problem.
- 4 4 Students accepts/trys to solve problem.
- 5 5 Students accepts/trys to solve problem.

Enter the proper score in column 12.

Factor: 2

Committment to task: the level of itensity of the group to continue working toward a solution.

Scoring:
- 0 No effort.
- 1 Disinterested, fooling around, little input.
- 2 Some positive input (one or two interested in problem and working with little progress).
- 3 Group is interested but efforts are not organized, some are working on the same item; some factors are not being analyzed and time is being wasted.
- 4 Group is positively interested and trying to solve problem but all actions not useful.
- 5 Group is interested, working and not wasting time or effort.

Enter proper score in column 13.

Factor: 3

Organization: allocation of responsibilities for efficiency of manpower.

Scoring:
- 0 No effort.
- 1 Unplanned, haphazard, or chaotic (students do their own thing-do not allocate item or all work on the same thing).
- 2 Not all students involved (either by choice or fiat). Some are working on problem some are not - may be arguing among each other.

3 Students have allocated some tasks - may have some working on same item; or possibly 1 may not be involved.

4 Tasks are allocated and students working efficiently-however students may have trouble with their item and seek help.

5 Tasks allocated and all are working productively.

Enter proper score in column 14.

Factor: 4

Structure: Group leadership

Scoring:

0 None

1 Autocratic--one person dominates who does not listen to other students' ideas.

2 Minority Leadership--one or two persons listen to others and then lead or direct.

3 Plurality--general agreement of several members leads to direction and leadership; most contributions are recognized and evaluated.

4 Democratic--all students contribute; no one's suggestions are ignored or ridiculed. One spokesman may arise but sources of ideas/efforts are recognized.

Enter proper score in column 15.

12	13	14	15

Section III.--COGNITIVE ASPECTS (Columns 16-55)

Data for this section can be derived primarily from the observer form and the tapes. It will be necessary to read the observer form and listen to the tapes to bridge any apparent gaps or vague statements found in either the form or the tape.

The cognitive aspects shall include variables considered in solving the problem and the level or method of measuring the variables. The implementation of the measurement in terms of calculation and the recording of the data will be collected and encoded.

A total of 10 variables can be accommodated by the scoring protocol. For each variable, its identification, measurement, calculation and recording will be scored.

IIIA. Factor: COST OF EQUIPMENT

Identification:

Scoring:	0	No
	1	Yes

Enter in column 16.

Measurement:

Scoring	0	No measurement done.
	1	Vague or very general estimates.
	2	Estimations by imprecise methods or by eyeballing. It does not provide enough information to arrive at a decision.
	3	Useful information which can be used to arrive at a decision but the data should be more accurate or precise.
	4	Precise measurement or clearly appropriate data that can lead to solution.

Enter in column 17.

Calculations:

Scoring:	0	No calculations.
	1	Vague or very general calculations that do little quantification.
	2	Calculations are imprecise or guesses are arrived at by trial and error and are not sufficient to provide necessary data to arrive at a solution.
	3	Useful calculations which can be used to arrive at a solution. It may not be accurate or have considered totals or balances. It should be more precise.
	4	Calculations are appropriate, precise and can lead to a solution.

Enter in column 18.

Recording:

Scoring	0	No records.
	1	Very general or imprecise records.
	2	Adequate records.

Enter in column 19.

16	17	18	19

IIIB. Factor: SIZE OF EQUIPMENT VS. SIZE OF CHILDREN (i.e., larger scale equipment for older children; smaller scale equipment for younger children)

Identification:

Scoring: 0 No

1 Yes

Enter in column 20.

Measurement:

Scoring: 0 No measurement.

1 Vague or general estimates, i.e., big equipment for big kids.

2 Express need to know proportion of big and small kids in their school.

Enter in column 21.

Calculations:

Scoring: 0 No calculations.

1 General or arbitrary assignment of equipment for size of children i.e., for example "lets get half big equipment; half small."

2 More careful estimates on how many big and small kids attend their school and selections of equipment reflects distribution of size of students.

Enter in column 22.

Recording:

Scoring: 0 No records.

1 Very general or imprecise records.

Enter in column 23.

20	21	22	23

IIIC. Factor: SIZE OF EQUIPMENT VS. AREA AVAILABLE (e.g., a swing will use 100 sq. feet and we have 1000 sq. feet all together to use.)

Identification:

Scoring: 0 No

1 Yes

Enter in column 24.

Measurement:

Scoring: 0 No measurement done.

1 Vague or very general estimates.

2 Estimations by imprecise methods or by eyeballing. It does does not provide enough information to arrive at a decision.

3 Useful information which can be used to arrive at a decision but the data should be more accurate or precise.

4 Precise measurement or clearly appropriate data that can lead to solution.

Enter in column 25.

Calculations:

Scoring: 0 No calculations.

1 Vague or very general calculations that do little quantification.

2 Calculations are imprecise or guesses are arrived at by trial and error and are not sufficient to provide necessary data to arrive at a solution.

3 Useful calculations which can be used to arrive at a solution. It may not be accurate or have considered totals or balances. It should be more precise.

4 Calculations are appropriate, precise and can lead to a solution.

Enter in column 26.

Recording:

Scoring: 0 No records.

1 Very general or imprecise records.

2 Adequate records.

Enter in column 27.

24	25	26	27

IIID. Factor: CAPACITY OF EQUIPMENT
(e.g., 4 kids can use a swing set with four seats; more kids can use a big jungle jim.)

Identification:

Scoring: 0 No

1 Yes

Enter in column 28.

Measurement:

Scoring: 0 No measurement.

1 Vague or general estimates; i.e., big stuff can be used by more kids.

2 Express need to know specific number of children who can use each piece of equipment at one time.

Enter in column 29.

Calculations:

Scoring: 0 No calculation.

1 General estimates of capacity (e.g., most of the kids in a class could use something at the same time).

2 Precise figures on capacity (e.g., altogether, the equipment we choose will handle 25 kids at one time).

Enter in column 30.

Recording:

Scoring: 0 No records.

1 Very general or imprecise records.

2 Adequate records.

Enter in column 31.

28	29	30	31

IIIE. Factor: DURABILITY OF EQUIPMENT (i.e., stronger, lasts longer)

<u>Identification</u>:

Scoring: 0 No
1 Yes

Enter in column 32.

<u>Measurement</u>:

Scoring: 0 No measurement.
1 Vague statements, i.e., its better.
2 General/precise, i.e., stronger, last longer.

Enter in column 33.

<u>Calculations</u>:

Scoring 0 No calculations.
1 Calculations in a general or vague sense.

Enter in column 34.

<u>Recording</u>:

Scoring: 0 No records.
1 Very general or imprecise records.

Enter in column 35.

32	33	34	35

IIIF. Factor: PLACEMENT OF EQUIPMENT FOR SAFETY CONSIDERATIONS

Identification:

Scoring: 0 No

1 Yes

Enter in column 36.

Measurement:

Scoring: 0 No measurement.

1 General or vague statements of more or less safety.

2 More precise measures of safety, i.e., more distance so kids do not run into the other stuff.

Enter in column 37.

Calculations:

Scoring: 0 No calculations.

1 Vague as to placement, i.e., that close enough.

2 Some concept of calculation, i.e., about 6 ft. or the like.

Enter in column 38.

Recording:

Scoring: 0 No records.

1 Very general or imprecise records.

2 Adequate records.

Enter in column 39.

IIIG. Factor: PLACEMENT OF EQUIPMENT FOR EFFICIENT UTILIZATION OF AREA

Identification:

Scoring: 0 No

1 Yes

Enter in column 40.

Measurement:

Scoring: 0 No measurement.

1 Vague or general statements, i.e., it fits.

2 More precise statements of placement based on size or shape of equipment or terrain.

Enter in column 41.

Calculations:

Scoring: 0 No calculations.

1 General or vague calculation based on placement and practical considerations, e.g., putting it there leaves us with more space for playing ball.

Enter in column 42.

Recording:

Scoring: 0 No records.

1 Very general or vague records.

Enter in column 43.

40	41	42	43

IIIH, I, J. Factors: OTHER CONSIDERATIONS (1), (2), (3)

Other considerations: provision has been made to identify 3 other considerations. They should be recorded in three separate blocks of 4 units.

FIRST extra (other consideration) should be coded as follows:

Identification	in column	44
Measurement	"	45
Calculation	"	46
Records	"	47

SECOND extra (other consideration) should be coded as follows:

Identification	in column	48
Measurement	"	49
Calculation	"	50
Records	"	51

THIRD extra (other consideration) should be coded as follows:

Identification	in column	52
Measurement	"	53
Calculation	"	54
Records	"	55

Score each extra consideration (there may be one, or up to three extras) according to the following codes for identification, measurement, calculation, and recording.

Identification: Was an additional variable or factor identified for consideration?

Scoring:
- 0 No
- 1 Yes

Measurement: Method used or selected to measure variable.

Scoring:
- 0 No measurement done.
- 1 Vague or very general estimates.
- 2 Estimations by imprecise methods or by eyeballing. It does not provide enough information to arrive at a decision.
- 3 Useful information which can be used to arrive at a decision but the data should be more accurate or precise.
- 4 Precise measurement or clearly appropriate data that can lead to a solution.

Calculations: Implementation of the method of measurement such as addition of costs or consideration of distance/area.

Scoring:
- 0 No calculations.
- 1 Vague or very general calculations that do little quantification.
- 2 Calculations are imprecise or guesses are arrived at by trial and error and are not sufficient to provide necessary data to arrive at a solution.
- 3 Useful calculations which can be used to arrive at a solution. It may not be accurate or have considered totals or balances. It should be more precise.
- 4 Calculations are appropriate, precise and can lead to a solution.

Recording: Data is listed and understandable.

Scoring:
- 0 No records.
- 1 Very general or imprecise records.
- 2 Adequate records.

Section IV.--PRODUCT ASPECTS (Columns 56-59)

Evaluation of four product aspects shall be based on the students' drawing of their playground design.

The Product - Plan

Scale:

Scoring: 0 No scale.

1 Approximate scale that indicated relative size of equipment; representations of distances are reasonable.

2 Scale is precise or is coded.

Enter in column 56.

Labels:

Scoring: 0 No labels.

1 Labels are present and appropriate to equipment.

Enter in column 57.

Landmarks:

Scoring: 0 No landmarks.

1 Landmarks are present.

2 Landmarks are present, appropriate and/or coded, i.e., enduring and relevant to playground area.

Enter in column 58.

Area:

Scoring: 0 No area limitations.

1 Area is defined.

Enter in column 59.

Section V.--RELIABILITY/VALIDITY PROBLEMS (Columns 60-66)

Based on your review of the audio tape and observer's notes, indicate whether you think any of the following factors may render this testing session invalid. Code your response 0 = No, 1 = Yes in the appropriate column.

Problem	Column
Biased selection of students	60
Prompting by observer	61
Prior student experience with this test	62
Inclement weather	63
Noisy testing environment	64
Outside interference/interruptions	65
Other	66

Section V.--RELIABILITY/VALIDITY PROBLEMS (Columns 60-66)

Based on your review of the audio tape and observer's notes, indicate whether you think any of the following factors may render this testing session invalid. Code your response 0 = No, 1 = Yes in the appropriate column.

Problem	Column
Biased selection of students	60
Prompting by observer	61
Prior student experience with this test	62
Inclement weather	63
Noisy testing environment	64
Outside interference/interruptions	65
Other	66

APPENDIX G

INTERVIEW FORM FOR USMES TEACHERS

USMES EVALUATION 1973-74

Interviewer: ______________________ Date: ____________

USMES 1973-74 EVALUATION

INTERVIEW FORM FOR USMES TEACHERS

1. Name: ______________________

2. Address: ______________________

____

3. Position (grade): ______________________

4. Number of years teaching experience: ______________________

5. Nature of training/experience in math, science, social science:

____

6. Is the interviewee: (check one)

_____a. an USMES development teacher

_____b. a local RPW trained, second-generation USMES teacher

7. Number of years experience with USMES: ______________________

8. A. USMES unit(s) which the teacher is currently using: ________

______________________ (or none?)

B. USMES unit(s) which the teacher has used in the past: ________

______________________ (or none?)

I. Place of USMES in the School's Curriculum

1. Would you consider USMES a replacement for or supplement to the subjects of math, science, and social science?

2. What essential skills does USMES
   a. foster?
   b. ignore?

3. Do you think USMES is really an integrated approach to teaching math, science, and social studies?

(For RPW trained, "second-generation" teachers")

4. Have you started an USMES unit in the classroom yet this year?
   a. If YES, continue on with Section II.
   b. If NO, go to Section III.

II. General Effects of USMES

A. On The Children:

5. Have you noted any changes (+ or -) in the childrens' attitudes toward math, science, or social studies, or any other aspect of school, which you think are the result of USMES?

6. Do the children seem any more responsible for their own learning and/or their own actions as a result of using USMES?

7. Does USMES seem to encourage a more cooperative or more competitive effort among the children as compared to other academic programs?

B. On USMES Teachers:

8. Has the use of USMES changed your teaching style in any way? (Does he/she see his/her role as a teacher any differently?)

9. Do you encounter the same kinds of discipline problems with USMES as with other programs?

   (Depending on the information gained from answers to question 6, you may see fit to eliminate this question.)

C. On Non-USMES Teachers:

10. Do non-USMES teachers in your school ask you about USMES?

11. Do they borrow USMES materials or express an interest in adopting your approaches?

III. USMES Teacher's Preparation and Training

12. Why did you get involved with USMES?
    a. volunteer?
    b. requirement?
    c. financial incentive?

13. Did your USMES training prepare you sufficiently to use USMES in the classroom?

14. What was the nature of your USMES training?
    a. national workshop?
    b. RPW workshop?
    c. other?

15. Did the training meet your expectations?

16. What suggestions would you offer for the improvement of the workshops?

17. Do you continue to get the kind of assistance you need?

IV. USMES Teacher's Reaction to the Observer in the Classroom

18. What has been the role of the USMES observer in your classroom?

19. Has the presence of the observer changed your classroom in any way?

V. <u>Use of Materials</u>

20. Oftentimes the success of a new program involves the development of useful, appropriate materials, tools, and references, We'd like to know which USMES materials are useful to you, which are not, and if there are any new materials which you think should be developed to assist students and/or teachers.

(Give respondent time to talk.)

You didn't mention:

a. Design Lab.
b. Supplies for Design Lab.
c. Teacher resource manual(s).
d. Technical papers.
e. How-to-cards.
f. Audio versions of How-to-cards.

21. Which ones (in each category) did you use? For what purposes?

a.
b.
c.
d.
e.
f.

22. In regard to the Design Lab, is its use granted as part of a reward structure?

23. Who initiates the students' use of the:

a. Design Lab?

b. How-to cards?

USMES Teachers

If time permits and if you are in the school building ask to see the Design Lab.

24. Note: a. size of room

b. location of room relative to classroom

c. condition of equipment

25. Ask the teacher if you could speak to two or three students (whom he/she will probably select) about the use of the How-to-cards.

Investigate:

a. Do the children know:

- where they are?

- how to use them?

b. Do the children feel free to use them at any time?

c. Do they use them only at the teacher's suggestion?

APPENDIX H

INTERVIEW FORM FOR USMES RESOURCE PERSONNEL

WORKSHOP TEAM LEADERS

Interviewer: ________________________ Date: ____________

USMES 1973-74 EVALUATION

INTERVIEW FORM FOR USMES RPW TEAM LEADERS

1. Name: ______________________________

2. Position: ______________________________

3. Address: ______________________________

____

4. Number and dates of local RPW Workshops conducted:

____

____

____

5. Number of years experience team leader has had with USMES: ______

6. Nature of USMES experience (former and current) - check as appropriate:

____a. USMES implementation teacher

____b. USMES development teacher

____c. USMES consultant

____d. Participant at National USMES Workshop

____e. Participant at Lansing RP Workshop

____f. Other (please specify): ______________________________

____

TEAM LEADERS

1. Have you conducted any workshops to train local teachers in use of USMES?

2. A. If YES - when did you conduct the workshops? Why was that time chosen?

   B. If NO - when will you conduct the workshops?

3. Was the workshop successful?

4. Did it meet your expectations? The teacher's expectations?

5. What would you do differently next time?

6. What factors are crucial in the success of the workshops?

If not yet answered:

1. How were teachers recruited for workshops? (Incentives? Compulsory?)

2. Did you get adequate support from appropriate persons? (EDC? Administrators? Others?)

APPENDIX I

INTERVIEW FORM FOR PRINCIPALS

USMES EVALUATION 1973-74

Interviewer: ______________________ Date: ______________

USMES 1973-74 EVALUATION

INTERVIEW FORM FOR PRINCIPALS

1. Name: ______________________

2. Address: ______________________

____

3. Per pupil expenditure: ______________________

4. Population of school district: ______________________

5. His/her school enrollment (number of children): ______________

6. Number of grades in his/her school: circle: K 1 2 3 4 5 6 7 8

ADMINISTRATORS

1. What reactions have you had about USMES from:

   a. parents

   b. teachers

2. What effect has USMES had on the school environment in general?

3. Any disruptive effects? (Scheduling? New supplies? Hard feelings among teachers?)

4. Have you had any problems with:

   a. scheduling?

   b. physical accomodations?

   c. policies regarding children working outside of classrooms (i.e., design lab, out of school) because of USMES?

ADMINISTRATORS

5. Nature and source of financial support for USMES:

   a. Does the school have a design lab?

   b. If so, who paid for it? NSF or the school district?

   c. What, if any, financial incentives are provided to teachers who participate in USMES?

      i. by the school district?

      ii. by NSF?

6. From whom do you receive USMES communications and support? (Attempt to elicit names of degree of contact?)

7. To whom do you disseminate USMES data and materials? (Attempt to elicit names of individuals and degree (frequency) of contacts.)

8. What suggestions, if any, would you offer to other principals who are considering adoption of USMES?

APPENDIX J

INTERVIEW FORM FOR CONTROL TEACHERS

USMES EVALUATION 1973-74

Interviewer: ______________________ Date: ____________

USMES 1973-74 EVALUATION

INTERVIEW FORM FOR CONTROL TEACHERS

(Or Non-USMES Math-Science Teachers in USMES School)

1. Name: ______________________

2. Address: ______________________

____

3. Position (grade): ______________________

4. Number of years teaching experience: ______________________

5. Nature of training/experience in math, science, social science:

____

6. Number of years USMES has been used in his/her school: __________

7. Number of USMES teachers (currently using USMES) in his/her school:

____

CONTROL TEACHERS

1. We are concerned with finding people who might be interested in using USMES next year or sometime in the future.

   a. Do you know what USMES is?

   b. If no, do you mean you've neve. ieard of the USMES project? (If no, interview ends.)

   c. If yes, what do you know about USMES?

      i. philosophy -

      ii. activities -

      iii. materials -

      iv. unit names -

2. What do you like about USMES? What don't you like about USMES?

3. Have you shared information with USMES teachers on the approaches used in the program?

   a. Have you tried any of them?

   b. Were they successful?

4. Elicit information on competitive feeling, if it seems appropriate.